JSDC
Journal of Studies in Dynamics and Change (JSDC);
Vol-12, Issue-3, ISSN: 2348-7038
International Peer Reviewed Quarterly Journal
www.jsdconline.com

Production Trends in Coastal Aquaculture: Assessing the Role of Area Expansion and Yield Improvement

Bhagabat Malik

ABSTRACT

This study examines the impact of area, yield, and their interactions on changes in shrimp production within India's coastal states' culture fisheries sector. Using secondary data from the Marine Products Export Development Authority (MPEDA), Government of India, spanning from 2011-12 to 2020-21, the analysis is segmented into two periods: period I (2011-12 to 2015-16) and period II (2015-16 to 2020-21). Employing a Decomposition Model, the study dissects the total change in fisheries production into three components: the Area effect, Yield effect, and Interaction effect. The findings underscore the significance of areas expansion in driving shrimp production, with the area effect dominating over yield and interaction effects in most coastal states. Notably, Karnataka and Goa exhibited unique dynamics, while Kerala and Goa showcased the highest area, yield and interaction effects, respectively. The study provides valuable insights for strategic decision-making in sustainable aquaculture growth and resource management.

Keywords: Coastal aquaculture, Shrimp production, Area and yield dynamics, Indian coastal states

JEL Classification Codes: Q1

Author Details:
Bhagabat Malik is a Research Scholar in the Department of A & A Economics, Utkal University, Bhubaneswar, Email: babul.bhagabat123@gmail.com

I. INTRODUCTION

The production of cultured fisheries, particularly shrimp, holds significant economic importance for coastal states in India. Understanding the dynamics of factors influencing production changes is crucial for sustainable growth and effective resource management. In this context, the study examines the effects of area, yield, and their interactions on changes in production in India's coastal states. Over the years, aquaculture has emerged as a vital sector in India, contributing substantially to the national economy and livelihoods of coastal communities. Shrimp farming, in particular, has experienced remarkable growth, driven by favourable environmental conditions, technological advancements, and increasing demand in domestic and international markets. However, this growth is not uniform across different states and is influenced by various factors such as

Suggested Citation:
Malik, B. (2025). Production Trends in Coastal Aquaculture: Assessing the Role of Area Expansion and Yield Improvement, *Journal of Studies in Dynamics and Change (JSDC), 12*(3), 1-7.
DOI: www. https://doi.org/10.5281/zenodo.18614531
Published on: 01 July 2025

cultivation area, yield per unit area, and their interactions. The relationship between area and production is fundamental, as the extent of cultivated area directly impacts overall output. Higher cultivation areas often lead to increased production, provided other factors such as water quality, stocking density, and disease management are adequately addressed. Additionally, the yield per unit area, influenced by factors like stocking density, feed quality, and farming practices, plays a crucial role in determining overall production levels. Understanding the interplay between area and yield is essential for optimizing production efficiency and ensuring sustainable resource utilization. Moreover, the interactions between area and yield can have significant implications for production changes. Synergistic effects may occur when optimal combinations of area and yield lead to enhanced production, while antagonistic interactions may arise when suboptimal conditions hinder production growth despite increased cultivation area or yield potential. Analysing these interactions provides valuable insights into the underlying mechanisms driving production dynamics in coastal aquaculture. This study aims to elucidate the relative contributions of area, yield, and their interactions to changes in production in India's coastal states. By examining data from different periods and regions, the study seeks to identify patterns, trends, and factors influencing production variability. Such insights are essential for policymakers, researchers, and industry stakeholders to formulate informed strategies for enhancing productivity, sustainability, and resilience in coastal aquaculture.

II. REVIEW OF LITERATURE

During the 1990s, coastal aquaculture emerged as a promising sector in India, recognized for its potential to boost exports and contribute to foreign exchange reserves (Krishnan & Birthal, 2002; Parthasarathy & Nirmala, 2000). In 1998, West Bengal, Gujarat, Kerala, and Andhra Pradesh exhibited comparatively greater profitability in various shrimp production systems compared to other states. (Swamidas & Satyanarayan, 2000). Fisheries investments in coastal areas returned twice as much as investments in livestock and agricultural firms, according to sectoral allocation of funds among these three industries. (Giri et al., 2022; Gowing et al., 2006; Krishnan & Birthal, 2002). Given the large export potential of fish and prawns, the Union Government and governments of coastal states in India have actively promoted brackish water fish and prawn farming since 1990s (Ayyappan & Krishnan, 2004). Assessment of fishery resources and their potential in terms of fish production, development of sustainable technologies for fin and shell fish culture, yield optimization, harvest and post-harvest operations and landing and berthing facilities for fishing vessels and augmenting export of marine products, (Debnath, 2021; Roy, 2013; Ayyappan & Krishnan, 2004 ; Parthasarathy & Nirmala, 2000).

Although there is no scarcity of studies on the trend of aquaculture production very little has been discussed on the factor-product relationship in fisheries sector. Moreover very few studies have focused on the area, yield and interaction which is an important aspect of production in economics.

III. OBJECTIVE

- To examine the effect of area, yield and their interaction on changes in production of culture fisheries

IV. METHODOLOGY

Data

The research utilized secondary data pertaining to area, yield, and production of cultured fisheries in India's coastal states over the past decade, spanning from 2011-12 to 2020-21. These data were gathered from the Marine Products Export Development Authority (MPEDA), an agency under the Government of India. The study period was divided into two distinct periods: period I, covering the years 2011-12 to 2015-16, and period II, encompassing the years 2015-16 to 2020-21.

Analytical Tools

To assess the impact of area, yield, and their interaction on the variations in total shrimp production in culture fisheries, we employ a Decomposition Model. This model allows us to analyse changes in production by decomposing them into three distinct components: the Area effect, the Yield effect, and the Interaction effect.

$$\mathbf{P} = \frac{\mathbf{A0}\ \Delta \mathbf{Y} * \mathbf{100}}{\Delta P} + \frac{\mathbf{Y0}\ \Delta \mathbf{A} * \mathbf{100}}{\Delta P} + \frac{\Delta \mathbf{Y}\ \Delta \mathbf{A} * \mathbf{100}}{\Delta P}$$

Production = Area Effect +Yield effect + Interaction effect

A_0 = Area in the base year
ΔA= Current area minus the base area
Y_0 = Yield in the base year
ΔY= Current yield minus the base yield
ΔP= Current Production minus base production

Where,
In the current period, Y, A, and P represent the yield, area, and production, respectively, within the culture fisheries sector. Similarly, A0, Y0, and P0 denote the area, yield, and production in the base period, respectively. Area is measured in hectares, yield in tonnes per hectare, and production in tonnes.

V. ANALYSIS

In the first phase (Table-1), in all coastal states of India except Karnataka and Goa, the impact of area expansion has been notably stronger and more beneficial than the combined impact of yield and interaction. This suggests that the rise in production in these states primarily resulted from an increase in cultivated area rather than from yield improvements. In West Bengal, the influence of area expansion outweighs the combined impact of yield and interaction, suggesting that the overall increase in shrimp production was predominantly driven by the expansion of cultivation area. In Karnataka, both the area effect and interaction effect are negative, while the yield effect is positive. Conversely, Goa has experienced a negative area effect despite positive yield and interaction effects,

indicating production increase primarily due to yield improvements. Initially, in all coastal states of India, the area effect predominated, followed by the yield and interaction effects. Kerala and Karnataka exhibited negative interaction effects, while the other states showed positive effects. Kerala boasted the highest area effect among all coastal states, while Goa had the highest yield and interaction effects. In the coastal states of India, the impact of area expansion on shrimp production has been significantly stronger and more beneficial than the combined influence of yield and interaction, except in Karnataka and Goa. This suggests that the overall increase in production in most states is primarily driven by the expansion of cultivated area rather than improvements in yield. Specifically, in West Bengal, the influence of area expansion surpasses the combined impact of yield and interaction, indicating that the growth in shrimp production is predominantly due to the expansion of cultivation area.

Table-1: Decomposition of Area, Yield and their Interaction Changes on Production in Period I (2011-12 to 2015-16)

Period I (2011-12 to 2015-16)			
Coastal States	Area Effect (%)	Yield Effect (%)	Interaction Effect (%)
West Bengal	54.40	34.70	10.90
Orissa	68.37	14.53	17.10
Andhra Pradesh	99.76	0.10	0.14
Tamil Nadu	54.88	21.22	23.89
Kerala	98.68	2.76	-1.44
Karnataka	-33.22	204.96	-71.74
Goa	-688.33	229.87	558.46
Maharashtra	80.21	7.48	12.31
Gujarat	33.95	24.94	41.11
Total	70.62	15.31	14.07

Source: Author's own calculation from MPEDA

However, in Karnataka, both the area effect and interaction effect are negative, indicating that despite positive yield effects, production is hindered by adverse conditions related to area and interaction factors. Conversely, Goa experiences a negative area effect despite positive yield and interaction effects, implying that production increase is primarily attributed to improvements in yield rather than expansion of cultivated area.

Initially, across all coastal states of India, the area effect predominates, followed by the yield and interaction effects. Kerala stands out with the highest area effect among all coastal states, suggesting significant production growth due to area expansion. Conversely, Goa boasts the highest yield and interaction effects, indicating substantial improvements in production efficiency and management practices.

Positive area effects may be attributed to factors such as favourable climatic conditions, availability of suitable land for aquaculture expansion, and government policies promoting aquaculture development. Positive yield effects could result from advancements in farming techniques, technology adoption, improved feed quality, and disease management practices. Positive interaction effects may stem from

synergies between various factors, such as improved water quality management, optimized stocking densities, and efficient farm management practices.
Overall, understanding the interplay between area, yield, and interaction effects is crucial for enhancing shrimp production in India's coastal states. Strategies focusing on optimizing all three factors while addressing regional challenges can contribute to sustainable growth and development in the aquaculture sector.

During the second phase (Table-2), Kerala, Karnataka, and Maharashtra witnessed a decline in the area effect. Tamil Nadu, Karnataka, and Goa were impacted by a negative interaction effect during this period. All coastal states in India experienced a positive yield effect. Andhra Pradesh stood out with the most substantial and significant positive area effect among all states, while Tamil Nadu exhibited the lowest. Maharashtra demonstrated high and positive yield and interaction effects, but changes in production were negatively influenced by the area effect. Throughout this period, the area effect was prominently positive in all coastal states of India, followed by yield and interaction effects. During the second phase of the study, several trends emerged in the coastal states of India regarding the area, yield, and interaction effects on shrimp production.

Table-2: Decomposition of Area, Yield and their Interaction Changes on Production in Period II (2015-16 to 2020-21)

Period II (2016-17 to 2020-21)			
Coastal States	Area effect (%)	Yield Effect (%)	Interaction Effect (%)
West Bengal	66.39	40.53	-6.92
Orissa	53.17	37.27	9.55
Andhra Pradesh	68.94	20.04	11.02
Tamil Nadu	21.67	79.88	-1.54
Kerala	-14.38	110.67	3.71
Karnataka	-86.10	334.67	-148.57
Goa	44.14	98.23	-42.37
Maharashtra	-815.11	220.90	694.21
Gujarat	25.11	71.62	3.27
Total	91.65	5.79	2.55

Source: Author's own calculation from MPEDA

Decline in Area Effect: Kerala, Karnataka, and Maharashtra experienced a decrease in the area effect, signalling a slowdown in shrimp production growth attributed to a reduction in cultivated area in these states. This decline may be due to various factors such as land constraints, regulatory challenges, or shifts in agricultural practices.

Negative Interaction Effect: Tamil Nadu, Karnataka, and Goa were affected by a negative interaction effect during this period. This suggests that production growth in these states was hindered by adverse interactions between different factors such as environmental conditions, farming practices, and management strategies. These negative interactions may have resulted in decreased productivity and efficiency within the aquaculture sector.

Positive Yield Effect: Despite the challenges faced by some states, all coastal states in India experienced a positive yield effect. This indicates improvements in

productivity and efficiency within the aquaculture sector, driven by advancements in farming techniques, technology adoption, and improved management practices. Positive yield effects contribute to overall production growth across the coastal states.

Significant Area Effect in Andhra Pradesh: Andhra Pradesh stood out with the most substantial and significant positive area effect among all states. This indicates robust growth driven by the expansion of cultivated area in the state. Factors such as government support, availability of suitable land, and favourable environmental conditions likely contributed to the positive area effect in Andhra Pradesh.

Maharashtra's Unique Scenario: Maharashtra demonstrated high and positive yield and interaction effects. However, changes in production were negatively influenced by the area effect. Despite favourable farming practices and management strategies, challenges related to area expansion may have limited production growth in Maharashtra during this period. Throughout this phase, the area effect remained prominently positive in all coastal states of India, indicating that the expansion of cultivated area continued to play a significant role in driving production growth. This expansion may be attributed to various factors such as government policies, land availability, and favourable environmental conditions conducive to aquaculture activities. In summary, while positive yield effects contribute to overall production growth, challenges related to area expansion and negative interaction effects can hinder production in certain states. Understanding these dynamics is essential for formulating effective strategies to sustain growth and development in the aquaculture sector across India's coastal states.

VI. FINDINGS AND CONCLUSION

The study reveals that during both periods I and II, the area effect exerted a greater influence on total shrimp production in India's coastal states compared to the yield effect, followed by the interaction effect. Period I exhibited a stronger area effect than period II across all coastal states. Additionally, period I displayed higher yield and interaction effects than period II in all states. States such as Karnataka and Goa experienced a negative area effect during period I, while Karnataka, Goa, and Maharashtra encountered it during period II. During period II, Maharashtra exhibited the highest negative area effect, alongside a notably high and positive interaction effect. The negative area effect in Maharashtra during period II, coupled with a significant positive yield effect, can be attributed to intensive farming practices such as the utilization of biofloc and recirculation systems in shrimp production. Overall, the study underscores the complex interplay of factors influencing shrimp production in India's coastal states, with the area effect being pivotal, especially in the context of evolving farming techniques and practices. Overall, the dominance of the area effect underscores the importance of land availability, regulatory support, and market dynamics in driving the expansion of shrimp production in coastal states.

VII. REFERENCES

Ayyappan, S., & Krishnan, M. (2004). Fisheris Sector in India: Dimensions of Devlopment. Indian Journal of Agricultural Economics, 59(3), 391-412.

Giri, S., Daw, T. M., Hazra, S., Troell, M., Samanta, S., Basu, O., . . . Chanda, A. (2022). Economic Incentives Drive the Conversion of Agriculture to Aquaculture in the Indian Sundarbans: Livelihood and Environmental Implications of Different Aquaculture Types. Ambio, 51, 1963-1973.

Gowing, J., Tuong, T. P., & Hoanh, C. T. (2006). Land and Water Management in Coastal Zones:Dealing with Agriculture-Aqquaculture-Fishery Conflicts. Environment and Livelihoods in Tropical Coastal Zones.

Kar, B., & Tripathy, S. (2020). Aquaculture Industry in Odisha: A Review. Space and Culture India, 8(2), 183-193.

Krishnan, M., & Birthal, P. S. (2002). Aquaculture Development in India: An Economic Overview with Special Reference to Coastal Aquaculture. Aquaculture Economics & Management, 6(2), 81-96.

Krishnan, M., Birthal, P. S., Ponnusamy, K., Kumaran, M., & Singh, H. (2000). Aquaculture in India: Retrospect and Prospects. In M. Krishnan, & P. Birthal, Aquaculture Devlopment in India: Problems and Prospects (pp. 10-31). New Delhi, India: National Centre for Agriculture Economics and Policy Research.

Naganathan, M., Sivagnanam, K. J., & Rejendran, C. (1995). Blue Revolution in a Green Belt. Economic and Political Weekly, 30(12), 607-608.

Parthasarathy, G., & Nirmala, K. A. (2000). Economic and Environment Issues of Brackishwater Aquaculture. In M. Krishnana, & P. S. Birthal, Aquaculture Devlopment in India: Problem and Prospects (pp. 52-58). New Delhi, India: National Centre For Agriculture Economics and Policy Research.

Roy, S. D. (2013). Impact of Fish Farming on Land Relations:Evidence from a Village Study in West Bengal. Indian Journal of Agriculture Economics, 68(2), 223-239.

Swamidas, C., & Satyanarayan, T. (2000). Economic of Productioin and Marketing of Brackishwater Shrimp. In M. Krishnan, & P. Birthal, Aquaculture Devlopment in India: Problems and Prospects (pp. 1-152). New Delhi, India: National Centere For Agriculture Economics and Policy Research.