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A Socio-economic Analysis on Shrimp Culture (*Litopenaeus vannamei*) in Godavari Districts of Andhra Pradesh, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Shrimp is a major exportable commodity, with high demand and prices on the international market. Andhra Pradesh is one of India's maritime states, with 974 kilometres of coastline. The state is the leading producer and exporter of farmed shrimp. Although shrimp farming has been practiced for many decades, a number of challenges that need to be addressed in order to improve the overall efficiency of the shrimp industry. In light of this, the present study was carried out to analyse the socio-economic status of shrimp farming in the East and West Godavari Districts of Andhra Pradesh. The data subjected to economic analysis revealed that the profitability of the venture in

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the study area. The estimates of Cobb-Douglas production function analysis showed that, stocking density, feed, probiotics and feed supplements, labour, and season dummy has significant influence on the shrimp yield. The estimates of resource use efficiency revealed the under-utilization of inputs, highlighting the need for optimising the use of resources to increase profitability. The returns to scale in shrimp culture of 1.04 indicates increasing returns to scale in production.

Keywords: Shrimp; production function; resource use efficiency; costs and returns.

1. INTRODUCTION

Aquaculture is the world's most rapidly expanding source of food production, with shrimp dominating in terms of economic value (Chittem and Kunda, 2018; Charishma *et al.,* 2022). In India, shrimp production has shown consistent growth and reached a new height of 8,15,745 tonnes during 2020-21 (MPEDA, 2021). Presently, an area of about 1,08,526.27 ha. is under *Litopenaeus vannamei* culture in eight coastal states with Andhra Pradesh dominating in total area under culture and production (6,34,672 tonnes), followed by Gujarat (50,410 tonnes) and Tamil Nadu-Pondicherry (44,735 tonnes) (MPEDA, 2021). In Andhra Pradesh, the shrimp industry faces certain challenges to its continued sustainability and growth, viz., the unavailability of high-quality seeds from Specific Pathogen Free (SPF) brood stock. Farmers struggle to differentiate between locally grown inbred seed and SPF bred seed due to lack of testing facilities. Another major concern in *L. vannamei* cultivation is disease outbreak, which poses more financial risk and slow industry expansion. Price volatility and lack of awareness of international prices and demand have resulted in financial losses for small-scale producers, even though a good market is available at the global level. Shrimp producers experience uncertainty over their profit margins due to the high price volatility. The global feed costs are progressively rising due to rising raw material and fishmeal prices, subsequently having a cascading impact on operational costs. The availability of adequate aquafeed ingredients is another major challenge that requires attention. Aquafeed demand has increased drastically during the last decade. Also, huge capital investment is required in brackish water shrimp farming during the initial years (Sadafule *et al.,* 2013). All of these concerns have an immediate impact on the economics and profitability of shrimp farming operations. In this standpoint, the present study has been undertaken with the following specific objectives.

1. To estimate the costs and returns of shrimp farms in the study area.
2. To analyse the resource use efficiency of shrimp production.
3. To enumerate the major production constraints faced by shrimp farmers.

2. MATERIALS AND METHODS

2.1 Sampling Procedure

A stratified random sampling technique was employed for identifying the sample respondents. The Godavari delta of Andhra Pradesh comprising two districts viz., East Godavari and West Godavari was considered as the universe of the study. As the first stage of sampling, two mandals from each district were selected as the sample mandals considering highest number of brackish water shrimp farms available in the mandals. The mandals *viz.,* U.Kothapalli, Tallarevu, Palakol and Narasapuram were taken as the sample mandals. As the second unit of sampling 30 farms from each of the four sample mandals were selected at random, with ultimate sample size of 120 farms.

2.2 Tools for Analyses

Percentage analysis: Percentage and averages were used to analyse the socio-economic characteristics (Tandel *et al.,* 2016; Lekshmi *et al.,* 2019; Ray *et al.,* 2020), costs and returns from shrimp farming (Reddy *et al.,* 2004; Sathiadhas *et al.,* 2009; Kumar *et al.,* 2016).

Production function analysis: Production function analysis was employed as a quantitative tool to determine the factors affecting shrimp production. Seasonal effect was also accounted using season dummies (Prabakar, 1995). In order to study the input-output relationship in shrimp production, the production scenario of the farmers is considered to be specified by Cobb-Douglas production function (Ara *et al.,* 2004; Devi and Prasad, 2004; Reddy *et al.,* 2008; Umamaheswari *et al.,* 2013; Thriveni *et al.,* 2022) which is presented as follows.

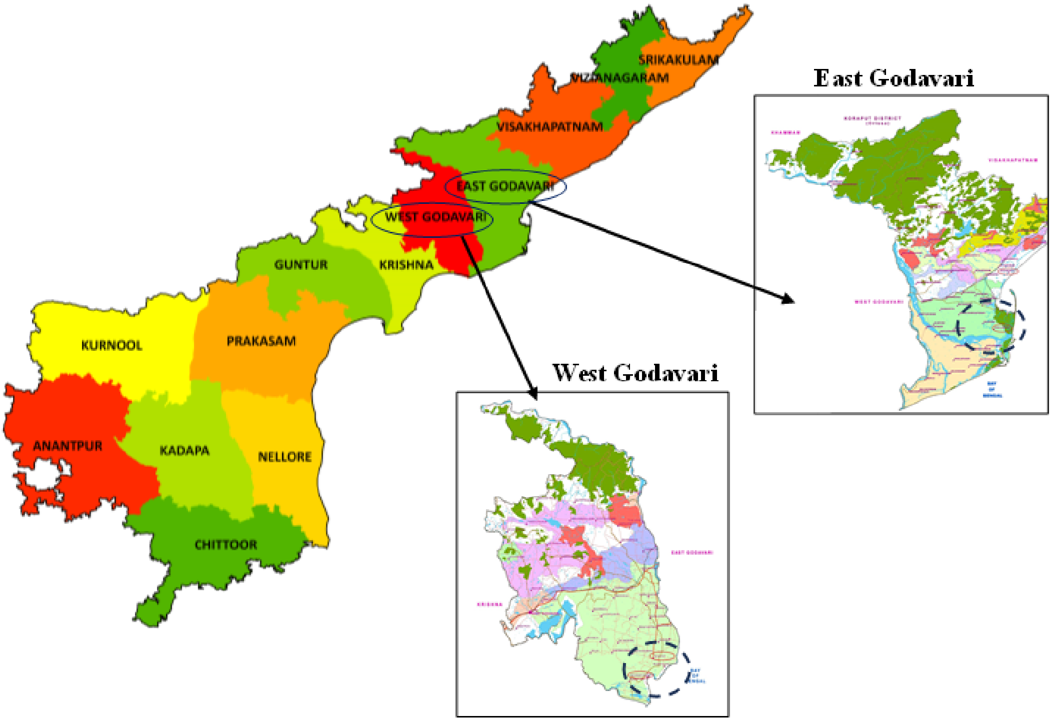

Fig. 1. Research locale

$$Y = \alpha\, X_1^{\beta_1}\, X_2^{\beta_2}\, X_3^{\beta_3}\, X_4^{\beta_4}\, D_1^{\beta_5}\, e^{u} \qquad (1)$$

Where, Y = Total shrimp production (in kg per acre), X_1 = Stocking density (in numbers per acre), X_2 = Quantity of feed used (in kg per acre), X_3 = Human labour (in man days per acre), X_4 = Probiotics and feed supplements cost (in Rs. per acre), D_1 = Dummy variable for season (if, Summer (March to July) =1, Winter (September to December) = 0), i = 1, 2, 3. ……., n farms, b_0 = Intercept, b_1, b_2, b_3, b_4, b_5 = Partial regression coefficients, μ_i= Random variable.

The linear additive form of the function is given by,

$$\ln Y = \ln \alpha + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 D_1 + u \quad \ldots \quad (2)$$

Resource use efficiency: The resource use efficiency was estimated using the Marginal Value Product (MVP) and Marginal Input Cost (MIC) efficiency ratio, which indicates that, the increase in gross returns by using an additional unit of a given input while keeping the level of other inputs at constant level (Gawa and Kumar, 2017). For this purpose, MVP was computed at their respective geometric mean levels, and MIC was taken as the factor's unit price. The MVP/MIC ratio of different inputs were estimated as:

$$MVP = \beta_i * \left(\frac{\overline{Y}}{\overline{X}_i}\right) * P_y$$

Where, $\overline{Y}$ = Average yield of shrimp in kg per acre at geometrical mean level of all inputs, $\overline{X}_i$= Geometric mean level of i^th^ resource, β_i = Elasticity of production of i^th^ input, P_y = Market price of the output in Rs. per kg, P_{x_i} = Market price of i^th^ input in Rs. per kg.

The resource use efficiency was computed by comparing each resource MVP with the corresponding unit price of the factor or MIC.

If MVP/MIC =1, the resource is optimally used,
If MVP/MIC <1, the resource is over utilised,
If MVP/MIC >1, the resource is under-utilised,
This resource ratio helps in decision-making regarding resource adjustments for increasing profits and minimizing losses for farms.

Garrett ranking technique: Garrett ranking technique (Garrett and Woodworth, 1969) was employed to identify the various production constraints, as perceived by the shrimp farmers and ranked as per the order of severity of problem. The order of merit assigned by the respondents were converted in to ranks using the formula,

$$\text{Percent position} = 100 \times \frac{R_{ij}-0.5}{N_j}$$

Where,
R_{ij} = Rank given for i^{th} reasons by the j^{th} individual, N_j = Number of reasons ranked by j^{th} individual.

By referring to Garrett's table, the percentage positions estimated were converted in to scores and then for each factor the scores of various respondents were added and mean value was arrived at. These means were arranged in descending order. The problem having the highest mean value was considered as the most important and was given the highest rank and vice versa.

3. RESULTS AND DISCUSSION

Socio-economic profile of shrimp farmers: A brief profile of shrimp farmers in the study area is presented in the Table 1 and 2. Data summarized below, showed that 43.33 per cent of shrimp farmers were in the middle age group, 40 per cent of farmers were found in the old age group, and 16.67 per cent of farmers were in the young age. It was observed that, 36.67 per cent of shrimp farmers were educated up to secondary level, followed by 30 per cent at graduation level, 26.67 per cent at higher secondary level, 3.33 per cent of farmers were educated up to primary level, and another 3.33 per cent were post-graduates. As far as their primary occupation is concerned, the majority of farmers occupation pattern was 'aquaculture and other business' (50 per cent), followed by 'aquaculture only' (33.33 per cent) and 'aquaculture with agriculture' (16.67 per cent).

It could be observed that all shrimp farmers were experienced, and around 43.33 per cent of farmers had experience between 5 to 10 years, followed by 40 per cent of farmers with experience between 10 to 20 years, and 16.67 per cent with farming experience of more than 20 years. The annual income of 51.67 per cent of shrimp farmers was between 11 to 20 lakhs, followed by 32.50 per cent of farmers between 5 to 10 lakhs, 12.5 per cent of farmers with more than 20 lakhs, and 3.33 per cent of farmers with less than 5 lakhs.

From Table 2, it could be observed that around 36.67 per cent of the shrimp farmers were having land between 2 to 5 hectares, followed by 26.67 per cent shrimp farmers with land between 5 to 10 hectares, and 26.66 per cent of shrimp farmers with land less than 2 hectares. Only 10 per cent of shrimp farmers were having a farm size of 10 hectares and above. About 40 per cent of the shrimp farmers operating their farms on lease basis. Whereas 36.67 per cent of farmers had their own farms, followed by 23.33 per cent of farmers operating their own farm and also leased in farms.

Table 1. Socio-economic profile of shrimp farmers

S.No	Particulars	Category	Frequency (n=120)
1.	Age wise distribution (in years)	Young age (up to 35)	20 (16.67)
		Middle age (between 35-50)	52 (43.33)
		Old age (above 50)	48 (40.00)
2.	Education	Primary	4 (3.33)
		Secondary	44 (36.67)
		Higher secondary	32 (26.67)
		Graduate	36 (30.00)
		Postgraduate	4 (3.33)
3.	Occupation	Aquaculture	40 (33.33)
		Aquaculture and Agriculture	20 (16.67)
		Aquaculture and other business	60 (50.00)
4.	Farming experience (in years)	5-10	52 (43.33)
		10- 20	48 (40.00)
		More than 20	20 (16.67)
5.	Annual income (in lakhs)	below 5	4 (3.33)
		Between 5-10	39 (32.50)
		Between 11-20	62 (51.67)
		above 20	15 (12.50)

(Figures in the parenthesis indicates percentage to total sample size)

Table 2. Details on shrimp farms

S.No	Particulars	Category	Frequency (n=120)
1.	Land holding (in ha.) (Water spread area)	Less than 2	32 (26.66)
		Between 2-5	44 (36.67)
		Between 5-10	32 (26.67)
		More than 10	12 (10.00)
2.	Ownership	Own	44 (36.67)
		Leased in	48 (40.00)
		Own and leased in	28 (23.33)
3.	Social participation	Input traders	88 (73.33)
		Input traders and Department of Fisheries (DoF)	24 (20.00)
		Input traders, DoF, and Marine Products Export Development Authority (MPEDA)	8 (6.67)
4.	Crops per year	Two	104 (86.67)
		Three	16 (13.33)
5.	Stocking density (nos. per m^2)	21-30	1 (0.83)
		31-40	29 (24.17)
		41-50	90 (75.00)

(*Figures in the parenthesis indicates percentage to total sample size)*

More than three-fourth of the farmers (73.33 per cent) were participating in meetings conducted by input traders. Barely 20 per cent of farmers were participating in trainings conducted by input traders and Department of Fisheries, and only around 6.67 per cent of farmers were participating in meetings conducted by input dealers, DoF, and MPEDA. The majority of the farmers (86.67 per cent) were taking up two crops per year. About 75 per cent of shrimp farmers maintained a stocking density between 41-50 nos. per m^2 i.e., intensive-type farming.

Costs and returns of shrimp farms: The details on total costs and returns of shrimp farms are presented in Table 3. The capital investment for intensive shrimp farms worked out to Rs. 5,11,840 per acre which includes pond construction, electricity installation, farm buildings construction, and farm equipment's viz., pump motors, aerators, check trays, feeding boats, and biosecurity set up. The total fixed costs worked out to Rs. 2,44,763 per acre. The share of rental value for owned or leased land was 43.49 per cent which accounted for a major share in total fixed costs, followed by salaries to permanent labour (30.23 per cent). The depreciation on various categories of equipment's by considering their respective life spans and interest on capital investment worked out to 13.73 per cent and 12.55 per cent respectively.

The total variable costs were estimated at Rs. 13,24,002 per annum which accommodates two crops. On an average, the cost of preparing pond before stocking accounts for 3.70 per cent of the total variable costs. *L. vannamei* seeds (PL'12) were purchased at an average rate of Rs. 0.40 per unit from the commercial hatcheries in the study area. The average cost of feed was Rs. 2,125 per 25 kg bag, which occupied the major share accounting for 68.82 per cent of the total variable costs followed by seed cost (10.88 per cent). The average cost incurred for probiotics, minerals and feed supplements accounts for 4.11 per cent of the total variable costs. Electricity and generator charges accounts for 4.62 per cent as mechanical aeration is a major component of energy use in the shrimp farming. The rest of the variable costs were water quality testing charges, labour charges, interest on working capital, urea, potash, formalin, and minerals which accounted for 0.41 per cent, 0.93 per cent, 4.94 per cent and 0.60 per cent respectively. The net returns for per acre of shrimp farm was Rs. 12,36,643 with Returns Per Rupee of Investment (RPOI) of 1.79, which reflected the profitability of the venture in the study area. In a similar study conducted by Kumar *et al.* (2020) found that *L. vannamei* was highly profitable business earned a net profit of Rs. 5,82,636 per acre.

Estimated shrimp production function: Production Function Analysis used in the study was log-linear or double log form, which showed that coefficient of multiple determination (R^2) is 0.85. It implied that 85 per cent of the variation in the yield of shrimp could be attributed by the

Table 3. Costs and returns of shrimp farms

S.No	Particulars	Amount (in Rs. per acre)
1.	**Capital Investment**	**5,11,840**
2.	**Annual Fixed Costs**	
i.	Rental value of own land	1,06,450 (43.49)
ii.	Depreciation on Pump motors, Aerators, and Buildings	33,603 (13.73)
iii.	Salaries to permanent labour	74,000 (30.23)
iv.	Interest on capital investment	30,710 (12.55)
	Total Fixed Costs (TFC)	**2,44,763 (100.00)**
3.	**Annual Variable Costs**	
i.	Pond preparation	48,970 (3.70)
ii.	Cost of seed	1,44,000 (10.88)
iii.	Feed cost	9,11,200 (68.82)
iv.	Electricity and Generator charges	61,150 (4.62)
v.	Urea, Potash, and Formalin	7,955 (0.60)
vi.	Probiotics, Minerals and Feed supplements	54,367 (4.11)
vii.	Water quality testing charges	5,450 (0.41)
viii.	Repairs and maintenance	13,200 (1.00)
ix.	Harvesting labour charges	12,313 (0.93)
x.	Interest on working capital	65,397 (4.94)
	Total Variable Costs (TVC)	**13,24,002 (100.00)**
Total costs		**15,68,765**
Yield of shrimp (in tonnes)		6.876
Average price of shrimp (per kg)		408
Production cost (per kg)		228
Gross Returns		28,05,408
Net Returns		12,36,643
Returns per rupee of investment		1.79

(Figures in the parenthesis indicates percentage to total)

Table 4. Estimated production function for shrimp farms

S.No	Variables	Coefficient	T ratio	p-value
1.	Yield	-	-	-
2.	Intercept	-7.520**	-2.208	0.029
3.	Stocking density	0.295 ***	7.679	0.000
4.	Feed	0.450***	8.269	0.000
5.	Labour	0.155*	1.736	0.085
6.	Probiotics and feed supplements	0.135**	3.045	0.003
7.	Seasonal variation	0.551***	5.395	0.000
	R^2= 0.85, Adj. R^2= 0.84, F = 131.48, Prob > F = 0.000			

, **, and * are 10%, 5% and 1% levels of significance*

explanatory variables included in the model. The overall regression result was significant at 1 per cent level with F value of 131.48, and hence the model is a good fit. The log-linear form estimates are presented in the Table 4, which shows that all inputs are positively related to the output of *L. vannamei* shrimp. The dummy variable introduced in analysis for representing seasonal variation had a positive and significant effect on yield. Furthermore, stocking density, feed, and seasonal dummy significantly affects the output of the shrimp at 1 per cent level, probiotics and feed supplements affects the output of the shrimp at 5 per cent level, while labour affects the output of the shrimp at 10 per cent level of significance.

The estimated coefficients of stocking density, feed, labour, probiotics and feed supplements and seasonal dummy are 0.295, 0.450, 0.155, 0.135 and 0.551 respectively. Therefore, it could be inferred that 1 per cent increase in the stocking (X_1) from its present average level will increase the output of shrimp by 0.29 per cent. Increasing 1 per cent in the feed (X_2) will increase the output of shrimp by 0.45 per cent. For labour (X_3), 1 per cent increase, the output

Table 5. Estimated resource use efficiency in shrimp farming

S.No	Inputs	MVP	MIC	MVP/MIC	Decision rule
1.	Stocking density	2.24	0.39	5.75	Under-utilized
2.	Feed	123.86	85.13	1.45	Under-utilized
3.	Labour	1800	295.66	6.09	Under-utilized
4.	Probiotics and feed supplements	42901.37	1094	39.21	Under-utilized

Table 6. Constraints faced by shrimp farms

S.No	Particulars	Garrett's Score	Rank
1.	Lack of availability of quality seed	63.43	I
2.	Outbreak of disease	54.87	II
3.	Exorbitant feed cost	47.27	III
4.	Lack of credit facilities	28.17	IV
5.	High electricity cost	18.97	V

will increase by 0.15 per cent. Moreover, increase by 1 per cent in the use of probiotics and feed supplements (X_4) will increase the output of shrimp by 0.13 per cent. In the estimated function, the sum of returns to scale was 1.04, exhibiting increasing returns to scale. Therefore, an increase in inputs by one per cent from the mean levels would result in a more than proportionate increase in yield.

Resource use efficiency: The allocative efficiency ratios of resources in the production of shrimp are presented in Table 5. The allocative efficiency for seed, feed, labour, probiotics, and feed supplements were 5.75, 1.45, 6.09, and 39.21 respectively. It could be inferred that, seed, feed, labour, probiotics and feed supplements were under-utilized with efficiency ratios more than one which implies that adding one unit of these respective input would improve the ratios and gross returns. Similarly, Gawa and Kumar (2017) found that feed was over-utilised while labour was under-utilised in rainbow trout farming in the Kashmir valley.

Constraint analysis: The major production constraints expressed by the shrimp farmers were ranked according to their mean score and presented in Table 6. The most important constraint encountered by the farmers was lack of availability of quality seed from hatcheries (63.43). The quality of the seed is mostly determined by the physiological state of the brood stock as well as the ambient circumstances in hatching tanks.

The second important constraint encountered by the farmers was disease outbreak in the production site (54.87). Poor handling of brood stock in hatcheries resulted in the emergence of several diseases in the farms. The third constraint was the exorbitant feed cost (47.27), which is increasing day by day due to raw material and fish meal price hikes. The fourth constraint was lack of credit facilities (28.17), owing to non-institutional credit with higher interest rates and insufficient credit from banks. High electricity cost (18.97) was ranked as fifth constraint. The regular use of aerators and pumping motors led to an increase in the electricity cost of farms, which is unavoidable. A study by Vasanthi *et al.* (2021) found that disease outbreak and high feed cost were the major constraints faced by the shrimp farmers in Nagapattinam district of Tamil Nadu.

4. CONCLUSION AND POLICY IMPLICATIONS

Based on the findings of the study, it can be concluded that shrimp farming is a profitable venture, and there lies scope for improving shrimp production in the East and West Godavari districts of Andhra Pradesh. A huge capital investment is required for pond construction, equipment, and electricity installation. Whereas feed was the major cost component and key factor in deciding the profitability of shrimp farming. The resource use efficiency estimate indicates that an increase in the use of seed, feed, labour, probiotics, and feed supplements to optimum levels will improve the profitability of shrimp production. The lack of availability of quality seed from hatcheries and disease outbreak were the major production constraints encountered by the shrimp farmers.

- Hence, provision of high-quality shrimp seeds, as well as certification by state fisheries department is suggested so that it could eliminate disease outbreaks and assure a high survival rate, resulting in increased productivity per acre.
- Since, feed plays a very important role in shrimp farming, the government may make efforts to provide supplementary feed at a subsidised rate to shrimp farmers.
- Governmental fisheries extension authorities may ensure farm level optimal usage of inputs viz., seed, feed, labour, probiotics and feed supplements vide periodical trainings so as to enhance the production efficiency of shrimp.
- To lessen financial losses and risks associated with shrimp farming, insurance is required, and the government may contribute a portion of the premium. Hence, the government and insurance companies may create conducive crop insurance policies for the shrimp culture on the similar lines existing in agriculture and allied sectors.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Ara, L. A., Alam, M. F., Rahman, M. M., & Jabbar, M. A. (2004). Yield gaps, production losses and technical efficiency of selected groups of fish farmers in Bangladesh. *Indian Journal of Agricultural Economics*, 59(4), 808-818.

Charishma, E., Sivakumar, S. D., Chadrakumar, M., & Selvi, R. G. (2022). An Analysis of Shrimp Culture Business in Nellore District, Andhra Pradesh, India. *Asian Journal of Agricultural Extension, Economics & Sociology*, *40*(10), 620-628.

Chittem, P. B., & Kunda, S. K. (2018). Socio-economic condition of the Litopenaeus vannamei farmers with implementation of better management practices BMP's in Andhra Pradesh, India. *International Journal of Fisheries Aquatic Studies,* 6(6), 325- 331.

Devi, K.U., and Prasad, Y.E., (2004). A study on technical efficiency of shrimp farms in coastal Andhra Pradesh, *Agric. Econ. Res. Rev*., 17(2): 175-186.

Garrett, H. E. and Woodworth, R. S. (1969). *Statistics in psychology and education*. Vakils, Feffer and Simons Private Ltd, Bombay.

Gawa, S., & Kumar, N. R. (2017). Economics and Factors Affecting Rainbow Trout (*Oncorhyncgus mykiss*) Production in Kashmir. *Indian Journal of Agricultural Economics,* 72(2), 166-176.

Kumar, B., Sharma, R., Lakra, W. S., Sharma, A., Prakesh, S., & Sharma, M. M. (2016). Economic Assessment of Shrimp Farming (*Litopenaeus vannamei*) in Gujarat-A Profitable Venture. *International Journal of Innovative Research in Science, Engineering and Technology,* 5(8), 15334-15342.

Kumar, S., Samsai, T., & Kandeeban, M. (2020). Production and marketing aspects of shrimp (Litopenaeus vannamei) in East and West Godavari Districts of Andhra Pradesh. *International Journal of Development Extension*, *9*(2).

Lekshmi, N. M., Praveen, K. V., Sreekanth, G. B., Singh, N. P., Vennila, A., Kumar, R. R., & Pandey, P. K. (2019). Economic Evaluation of Different Aquaculture Systems in Coastal waters of Goa, Southwest Coast of India. *Fishery Technology*, *56*, 231-241.

MPEDA (2021). Marine Products Export Development Authority, Kochi, India. retrived https://mpeda.gov.in/?page_id=651 (Accessed on October 2024).

Prabakar, C. (1995), An Economic Analysis of shrimp farming in Chidambarnar district of Tamil Nadu. M. Sc., Thesis (pub), submitted to Department of Agricultural (Ag.) Economics, Tamil Nadu Agricultural University).

Ray, S., Mondal, P., Paul, A. K., Iqbal, S., Atique, U., Islam, M. S., & Begum, S. (2021). Role of shrimp farming in socio-economic elevation and professional satisfaction in coastal communities. Aquaculture Reports, 20, 100-708.

Reddy, G. P., Reddy, M. N., Sontakki, B. S. and Bala Prakash, D. (2008). Measurement of efficiency of shrimp (Penaeus monodon) farmers in Andhra Pradesh, Indian J. Agric. Econ., 63(4): 653-657.

Reddy, S.S, Ram P. R., Sastry, T. V. N., and Devi, I. B. (2004), “Agricultural Economics”, (New Delhi: A Unit of CBS Publishers & Distributors Private Ltd.,), pp: 46,47.

Sadafule, N. A., Shyam, S. S., & Pandey, S. K. (2013). Economic analysis of shrimp farming in the coastal districts of Maharashtra. *Journal of Fisheries, Economics and Development*, *14*(1), 42-54.

Sathiadhas, R., Najmudeen, T. M., & Prathap, K. S. (2009). Break-even Analysis and Profitability of Aquaculture Practices in India. *Asian Fisheries Science*, *22*(2), 667-680.

Tandel, J. T., Tandel, K. V., Tandel, G. M., & Patel, M. R. (2016). A Socioeconomic survey of shrimp aquaculture practices in Valsad district, Gujarat, India. *International journal of research in applied, natural and social sciences*, *4*(9), 93-98.

Thriveni, K., Jayaraman, R., Senthikumar, V., Sujathkumar, N. V., Anand, C., & Ramana, T. V. (2022). Technical efficiency analysis of shrimp farms in Andhra Pradesh, India using stochastic frontier approach. *Indian J. Fish*, *69*(2), 119-127.

Umamaheswari, L., Chandrasekar, V., Swaminathan, N., & Poonguzhalan, R. (2013). Technical efficiency of freshwater aquaculture farms in the Union Territory of Puducherry: frontier production function approach. *Indian J. Fish*, *60*(2), 93-98.

Vasanthi, R., Rohini, A., Uma, K., & Narkis, C. (2021). An economic analysis of shrimp (Litopenaeus vannamei) in Nagapattinam district of Tamil Nadu. *Asian Journal of Agricultural Extension, Economics & Sociology*, *39*(10), 449-454.

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