



# An Insight into Challenges and Constraints of *Penaeus vannamei* (Boone, 1931) Farming Along the Coastal Districts of West Bengal, India

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

*Penaeus vannamei* farming emerged as one of the most lucrative cultured crustaceans farmed throughout the globe. It accounts for 94.5 % of the total shrimp aquaculture production in India. West Bengal with 6069 ha area under culture recorded 46021 MT *P. vannamei* production in 2022-23. Despite this surge, this sector is currently undergoing several hurdles in recent years. This study was initiated to identify those constraints, which can hinder the growth of this field. Study was conducted in three coastal districts of West Bengal i.e., Purba Medinipur, South 24 Parganas and North 24 Parganas. From each district three blocks were selected purposively. Ten farmers from each block were chosen using a simple random sampling method, resulting in a total sample size of 90 respondents. Personal interview schedule with well-structured and a pre-tested questionnaire was carried out to determine the constraints. Henry Garrett's ranking technique was employed to rank the identified constraints. Study revealed the survivability constraints as major obstacle, followed by marketing constraints, credit and financial constraints, seed constraints, feed constraints, management constraints and operational constraints. In addition, seven main constraints were subdivided into several segments to identify the root causes. Addressing these challenges in a comprehensive and coordinated way the productivity, profitability, and sustainability of *P. vannamei* farming in West Bengal can be effectively improved.

**Keywords:** *Penaeus vannamei* farming; constraints; challenges.

## 1. INTRODUCTION

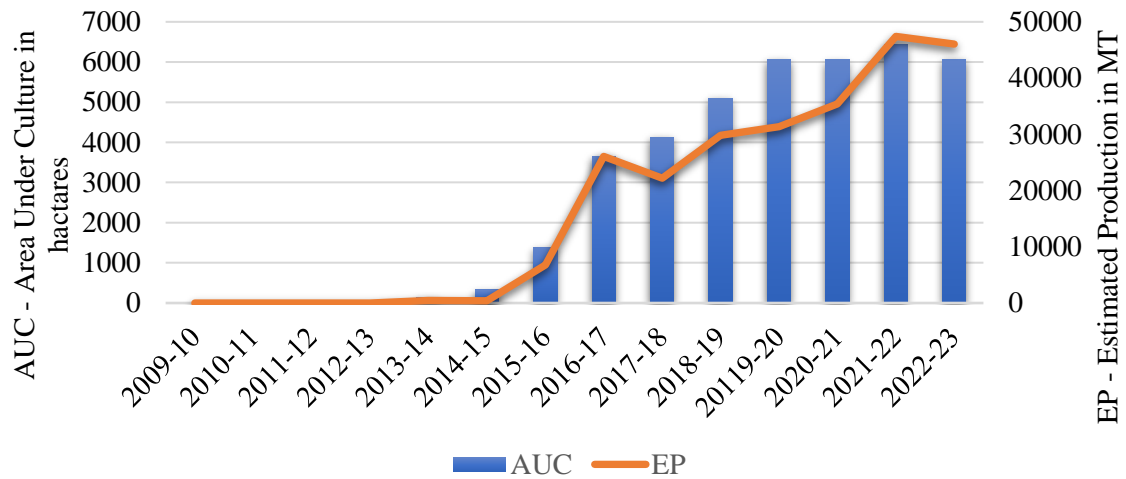
Shrimp is the remunerative crustacean farmed throughout the globe, has emerged as a significant commodity in world seafood trade. Pacific white shrimp (*Penaeus vannamei*) reigning as profitable venture among the top species cultivated globally, including in India [1]. India with 1.2 million ha potential brackish water area through out nine maritime states became one of the major shrimps producing countries. *Penaeus monodon* was the main candidate cultured shrimp species in India till 2009-10 after that *P. vannamei* culture gained momentum over other species because of availability of Specific Pathogen Free (SPF) seeds, manageable for high stocking densities, euryhaline nature (0 to 45 ppt), rapid weight gain (up to 20gm), less requirement of dietary protein (30–35%) and higher meat yield (65–70%) [1,2]. Another reason for the incorporation of *P. vannamei* was to revive the Indian shrimp farming sector, which was scuffling due to fatal white spot disease of *P. monodon* [1].

Starting in 2001 when *P. vannamei* was first introduced in India from Mainland China and Taiwan Province of China [3] now it reached 94.5 % of the total shrimp aquaculture production in the country [4]. West Bengal having a significant potential of the brackish water area of 200,000 ha, in which about 85,000 ha is spreading over three coastal districts, namely, Purba Medinipur, South 24 Parganas and North 24 Parganas [5]. After the introduction of *P. vannamei* in the state,

culture area has increased from 0 ha in 2009-10 to 6069 ha in 2022-23 (Fig. 1) and production also grown dramatically to 46021 MT in 2022-23 [4]. So, the introduction of *P. vannamei* as a substitute to *P. monodon* has helped to achieve the higher productivity and export earnings of the state and as well as the country [6,7]. In West Bengal intensive and semi-intensive culture of Pacific white shrimp is generally carried out in two crops, i.e. February to June and August to December. Though this industry is boosting the economy of the state and associate community, numerous challenges hinder the growth of this sector. Thus, the current study was initiated to identify those constraints, which can influence shrimp production with possible negative impact on economic growth.

## 2. MATERIALS AND METHODS

The study was conducted in three coastal districts of West Bengal i.e., Purba Medinipur, South 24 Parganas and North 24 Parganas. From each district three blocks were selected purposively. From Purba Medinipur district Nandakumar, Haldia and Bhagabanpur II blocks were chosen, whereas Mathurapur II, Kakdwip and Namkhana block were selected from South 24 Parganas district. Basirhat II, Minakhan and Hingalganj block were the study area for North 24 Parganas district. Ten farmers were selected from each block using a simple random sampling method, resulting in a total sample size of 90 respondents. Farmers were surveyed regarding their perceived constraints in *Penaeus vannamei*



**Fig. 1. AUC and production of *Penaeus vannamei* in West Bengal 2009 to 2023**  
(Data source: MPEDA, [4])

farming methods. Following discussions with Fishery Extension Officers, private marketing executives and non-sample farmers during a pilot study, several constraints were identified and categorized into seven broad groups. These constraints were then presented to the respondents, who were asked to rank them based on their perceived severity.

Henry Garrett's ranking technique [8] was employed to pinpoint the critical constraints encountered by the farmers. This method transforms rankings into numerical scores, making it possible to assess respondents' views on the significance of various reasons and factors. According to this method, farmers assigned ranks to all factors, and the results of these rankings were converted into score values using a formula.

$$\text{Percent Position} = 100 (R_{ij} - 0.5) / N_j$$

Where,

$R_{ij}$  = Rank given for  $i^{\text{th}}$  factor by  $j^{\text{th}}$  individual  
 $N_j$  = Number of factors ranked by  $j^{\text{th}}$  individual

Using Garrett's Table, the estimated percent positions were converted into scores, according to the table provided by Garrett and Woodworth. The scores for each factor were summed across all respondents and then divided by the total number of respondents. The factors having the highest mean value representing the most important constraint.

### 3. RESULTS AND DISCUSSION

Employing Henry Garrett's ranking technique, the present study pinpointed and rank the hurdles being faced by *P. vannamei* farmers along the coastal districts of West Bengal. Garrett's ranks and respective mean scores of 7 major categories were is presented in Table 1. All these domains were further affected by different sub components reflected from Table 2. to 8. Table 1, depicts the list of different factors, out of which survivability constraints were significantly graced the first position with Garrett's mean score 74.067, followed by marketing constraints (mean score 68.933), credit and financial constraints (mean score 58.300), seed constraints (mean score 48.211), feed constraints (mean score 43.456), management constraints (mean score 34.600), operational constraints (mean score 23.733). The results clearly indicate that, despite West Bengal's prominent position in *P. vannamei* production, farmers in the state face numerous challenges, including occurrence of diseases, operational issues, marketing difficulties, and management constraints. These challenges ultimately result in significant financial losses.

#### 3.1 Survivability Constraints Discerned by *P. vannamei* Farmers

Occurrence of disease outbreaks in *P. vannamei* culture is gaining serious concern in recent times which promote economic losses and operational challenges. Table 2. represents various

survivability constraints as reported by the farmers in the study area. White feces syndrome (WFS) with mean score of 71.278 perceived as the most serious concern deterring the productivity, followed by white spot disease (WSD) (mean score 61.111), black gill disease (mean score 50.611), fluctuation in water and soil physiochemical parameter (mean score 40.167) and running mortality syndrome (mean score 27). Study conducted by Tandel et al. [9] Chittam & Kunda [10] Maiti et al. (2019) also perceived disease as one of the major burning issues in shrimp industry. Early detection, proper diagnosis, and timely intervention are critical for minimizing the impact of disease outbreaks in *P. vannamei* culture which can be minimised through various strategies such as maintaining good water quality, implementing biosecurity measures, using specific pathogen-free shrimp stocks, and practicing proper farm management techniques.

### 3.2 Marketing Constraints Discerned by *P. vannamei* Farmers

Marketing constraints in vannamei farming can significantly impact its profitability and sustainability. Having a good demand in both domestic and international market, fluctuation in shrimp price was prevailed as the major marketing constraint (mean score 67.156) affecting farmers' revenues. Higher commission charge with Garrett's mean score 58.144

followed by lack of storage facility, lack of market information were the other factors as identified by the farmers is presented in Table 3. Addressing these marketing constraints requires a multi-faceted approach involving capacity building, adoption of best practices, and supportive policies from government and industry stakeholders. Collaboration among farmers, industry associations, and government agencies can also help in overcoming these challenges and improving market access and profitability.

### 3.3 Credit and Financial Constraints Discerned by *P. vannamei* Farmers

Credit and financial constraints are one of the significant challenges in vannamei farming, particularly for small and medium-scale farmers. Several things might restrict their ability to invest in essential resources, manage risks, and sustain operations. Present study revealed the influence of moneylender as the most crucial constraints, as farmers are bound to purchase the essentials from them due to lack of capital. Second constraint perceived by the farmers were lack of credit from financial institution with mean score 66.111 followed by high cost of electricity, subsidized insurance premiums, lack of government subsidy. Thus, limited access to formal credit due to high collateral requirements and perceived risks, high interest rates, inadequate financial support were the major identified setback.

**Table 1. Garret's ranks and respective mean scores of constraints discerned by *P. vannamei* farmers**

Factors	Mean score	Rank
Operational constraints	23.733	VII
Marketing constraints	68.933	II
Credit and financial constraints	58.300	III
Seed constraints	48.211	IV
Feed constraints	43.456	V
Management constraints	34.600	VI
Survivability constraints	74.067	I

**Table 2. Survivability constraints discerned by *P. vannamei* farmers**

Factors	Mean score	Rank
White feces syndrome (WFS)	71.278	I
Fluctuation in water and soil physiochemical parameter	40.167	IV
White spot disease (WSD)	61.111	II
Black gill disease	50.611	III
Running mortality syndrome	27.000	V

**Table 3. Marketing constraints discerned by *P. vannamei* farmers**

Factors	Mean score	Rank
Fluctuation in shrimp price	67.156	I
Lack of storage facility	41.856	III
Higher commission charge	58.144	II
Lack of market information	32.522	IV

**Table 4. Credit and financial constraints discerned by *P. vannamei* farmers**

Factors	Mean score	Rank
Lack of credit from financial institution	66.111	II
Lack of government subsidy	29.000	V
Subsidized insurance premiums	41.222	IV
Influence of moneylender	73.555	I
High cost of electricity	54.000	III

### 3.4 Seed Constraints Discerned by *P. vannamei* Farmers

Good seed is the key of any culture, and it influence the overall productivity and sustainability. Constraint analysis regarding seed of *P. vannamei* (Table 5.) showed, ‘involvement of long chain middleman for seed procurement’ as the most crucial. As maximum of vannamei seeds comes from Andhra Pradesh and Visakhapatnam, add a substantial share of middleman involve in the supply chain resulting into price hike. Maity et al. [5] also identified the same constraint as potential threat. Other constraints identified were price fluctuation of seed, unavailability of good seeds, low survival rate, and inadequate supply of seeds.

### 3.5 Feed Constraints Discerned by *P. vannamei* Farmers

In vannamei farming feed costs represent a significant portion of the overall production expenses. According to Hung and Quy [11] feed costs comprised 66 to 68 percent of total production costs. Farmers perceived high cost of feed as the most burning concern followed by high rate of supplementary medicine, lack of feed mills and lack of proper storage facility. Findings

emphasize the necessity of supplying low-priced, good-quality shrimp feed to enhance the productivity and profitability of the sector, which is also in concurrence with the observations of Chittem & Kunda [10].

### 3.6 Management Constraints Discerned by *P. vannamei* Farmers

High rate of daily workers with mean score 77.733 showed as most prevalent constraint. Whereas wages of skilled labour were found relatively high depending upon experience. Other factors identified were lack of quarantine standards followed by fluctuation of salinity, poaching, lack of convenient soil-water testing kit, postharvest loss, natural hazards like flood and cyclonic storm, and lastly lack of biosecurity in the farm [5].

### 3.7 Operational Constraints Discerned by *P. vannamei* Farmers

Results of operational constraints analysis (Table 8.) revealed that overdependence of contract farming was the primary barrier (mean score 70.611). This system involves an agreement between shrimp farmers and processing or marketing firms, where the farmers are supplied

**Table 5. Seed constraints discerned by *P. vannamei* farmers**

Factors	Mean score	Rank
Unavailability of good seeds	51.333	III
Inadequate supply of seeds	28.000	V
Involvement of long chain middleman for seed procurement	71.444	I
Price fluctuation	62.222	II
Low survivability	37.000	IV

**Table 6. Feed constraints discerned by *P. vannamei* farmers**

Factors	Mean score	Rank
High cost of feed	67.156	I
High rate of supplementary medicine	58.144	II
Lack of proper storage facility	32.522	IV
Lack of feed mills	41.856	III

**Table 7. Management constraints discerned by *P. vannamei* farmers**

Factors	Mean score	Rank
Postharvest loss	41.000	VI
Poaching	48.611	IV
High rate of daily workers	77.733	I
Lack of quarantine standards	68.432	II
Fluctuation of salinity	59.000	III
Lack of convenient soil-water testing kit	44.342	V
Natural hazards	38.128	VII
Lack of biosecurity	29.211	VIII

**Table 8. Operational constraints discerned by *P. vannamei* farmers**

Factors	Mean score	Rank
Lack of skilled labour	51.333	III
Lack of CAA certification	28.333	V
Overdependence of contract farming	70.611	I
Lack of information regarding export potential and standards	63.056	II
Disease prevention and control	36.667	IV

with required seed or feed or medicines in advance basis by the firms, while the farmers agree to sell their shrimp at predetermined prices to that firms. Lack of information regarding export potential and standards was the second most identified constraint with mean score of 63.056, followed by lack of skilled labour, disease prevention and control, lastly lack of CAA certification.

#### 4. CONCLUSION

In recent years, vannamei farmers of West Bengal achieved a significant increase in shrimp farm production. Throughout the last decade, most farms observed substantial improvements in both production efficiency and productivity. Despite these milestones this sector comes up with several hurdles in past few years. Addressing these challenges needs a comprehensive and coordinated approach involving government support, industry partnerships, and capacity-building initiatives. Better access to good-quality seed, affordable credit, technical training, promotion of sustainable practices, and market access will be key to overcoming these challenges. Addressing

these issues, the productivity, profitability, and sustainability of *P. vannamei* farming in West Bengal can be effectively improved, contributing to the economic development of its coastal communities.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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