

**Short Communication**

## Short Communication on an Economic Burden of Infectious Diseases to Indian Shrimp Farming

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**Abstract:** Infectious diseases especially, *Enterocytozoon Hepatopenaei* (EHP), White Spot Syndrome Virus (WSSV) infections and are the major constraints in the development of shrimp farming in India. A questionnaire-based survey covering an area of 7259 ha in 23 coastal districts based on multistage stratified sampling ( $n=909$ ) was conducted to estimate the Probability of Disease Occurrence (PDO) and the economic loss due to diseases was estimated. Loss of production ( $t \text{ ha}^{-1} \text{ crop}^{-1}$ ) due to WSSV and EHP was  $2.58 \pm 0.32$  and  $1.80 \pm 0.24$  respectively. Additionally, the total employment loss due to diseases was estimated at 1.65 M man-days worth US\$ 7.07 M. The results of the study revealed 49% as the overall probability of infectious disease occurrence in the country leading to an annual loss of 0.14 M ton of harvest worth US\$ 1.02 B. Prioritizing the research and implementation of specific policies would help in reducing the losses due to infectious diseases in Indian shrimp farming.

**Keywords:** Shrimp farming; Broodstock; Stocking

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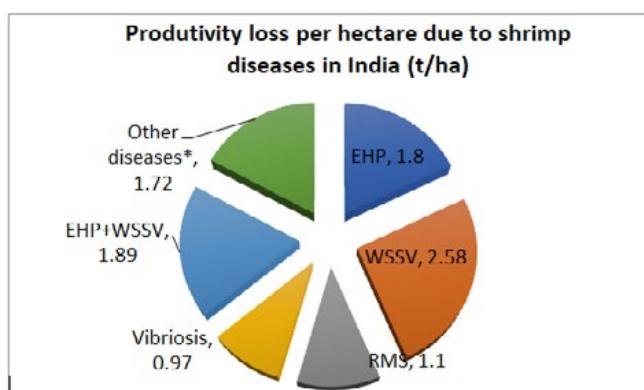
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## Description

Shrimp farming is an important economic activity earning a foreign exchange US\$ 4.89 B in 2019-20 and generates 14 million employment in India. A decade of *P. vannamei* farming in the country and the subsequent practice of screening broodstock at the national quarantine and post larvae before stocking for diseases have led to the substantial improvement in shrimp health and production. Further, scientific interventions through the development of molecular diagnostic tools, adoption of biosecurity measures, and better management practices helped in the sector's economic sustainability. However, these financial gains were short-lived due to mounting losses due to viral and bacterial diseases and stress due to deteriorating environmental conditions following farm intensification (**Figure 1**).

Microsporidian infection, *Enterocytozoon Hepatopenaei* (EHP) and viral infection due to White Spot Syndrome Virus (WSSV) in addition to White Faeces Syndrome (WFS), Running Mortality Syndrome (RMS), Black Gill Disease (BGD), Loose Shell Syndrome (LSS), White Muscle Disease (WMD) and Infectious Hypodermal and Hematopoietic Necrosis (IHHNV) continue to cause significant economic losses in shrimp farming worldwide including India.

Since its first report in 2009, microsporidian pathogen *Enterocytozoon Hepatopenaei* (EHP) has emerged as a significant threat in all the shrimp farming countries worldwide. Being an intracellular microsporidian parasite, EHP multiplies in the cytoplasm of hepatopancreas and midgut leading to size variation, growth retardation loss of production [1]. Similarly, the highly contagious virus, White Spot Syndrome Virus (WSSV) causes 100% mortality in 3-10 days. Since its first report from China and Taiwan during 1991-1992, the diseases continued to cause significant economic loss to the shrimp industry worldwide.



**Figure 1:** Productivity loss due to shrimp diseases in India.

Due to its environmental viability and availability of several carrier hosts, WSSV can cause acute mortalities leading to loss of crop [2].

To allocate the limited resources to control these infections, it is essential to understand the risk factors involved and the economic loss quantification. The national drop in shrimp production in Thailand (1996-97, 2013), China (1993) and in Brazil (2006) has been attributed to the widespread occurrence of infectious diseases [3]. Several studies have reported the economic loss worth billions of US dollars and employment losses due to WSSV and EHP in different countries at the other period.

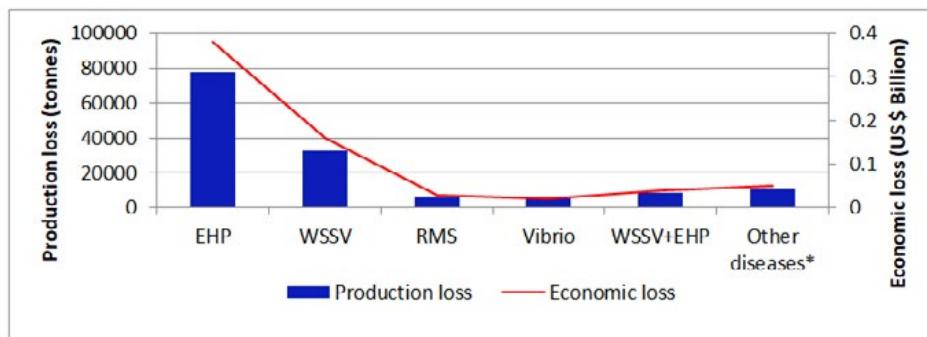
We have recently reported an economic loss due to infectious diseases in Indian shrimp farming [4]. Questioner based survey on the disease's occurrence and the associated loss in terms of mortality and employment was conducted. Economic loss to India's aquaculture sector due to infectious disease was estimated with particular reference to EHP and WSSV infections based on the difference between expected and actual production.

The study covered 8.63% of the country's total *P. vannamei* farming area in major shrimp producing states. Probability of Disease Occurrence (PDO) factor was calculated based on the percentage of reported disease incidence in farms from each region (**Figure 2**). The estimated PDO for Tamil Nadu, West Bengal, Gujarat, Andhra Pradesh and Maharashtra was 61%, 58%, 55%, 41% and 31% with the national average of 49%. The national estimated loss of production (t ha<sup>-1</sup> crop<sup>-1</sup>) due to EHP and WSSV was  $1.80 \pm 0.24$  and  $2.58 \pm 0.32$  t ha<sup>-1</sup> crop<sup>-1</sup>.

Correlation analysis revealed a positive influence of mortality and FCR on the economic loss while stocking density, culture period, average body weight and the survival rate were negatively influencing. This suggests that the increase in stocking density, culture period, average body weight, and survival rate lead to a sharp decline in economic loss. At the national level annual financial loss due to EHP and WSSV was US\$ 567.62 M and US\$ 238.33 M respectively.

The total production loss calculated per crop due to EHP was found to be 77,370 tons worth US\$ 380 M. In comparison, for WSSV it was 32,536 tons worth US\$ 160 M. The overall annual economic loss due to infectious diseases to Indian shrimp farming was estimated to be US\$ 1,028.55 M which includes US\$ 571.03 M due to EHP and US\$ 240.67 M due to WSSV.

The uniformity in the significance of production



**Figure 2:** Production and economic loss due to shrimp diseases in India.

variables selected in the study suggests that our analysis interpretations are equally applicable to all the shrimp production regions of the country despite variations in the farming systems. Effective implementation of Better Management Practices (BMP) could help reduce the impact of diseases as estimated economic loss comprised mainly the direct loss due to mortality and expenditures to control and manage EHP and WSSV.

## Discussion and Conclusion

The study of economic impact assessment of diseases helps decide the proportionate investment in national aquatic animal health management programs. The study revealed EHP and WSSV were the major threats for the Indian shrimp farming, leading to substantial economic losses, including the consequent loss of jobs. In addition to disease surveillance, implementing better management practices would reduce the loss and minimize financial losses. Further, the study revealed region-specific modifications in stocking density, culture period, and targeting size at harvest could mitigate the losses. Prioritizing the research areas, including

disease forecasting and policy interventions would help the sector's economic sustainability.

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