International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; SP-9(9): 422-425
www.biochemjournal.com
Received: 08-06-2025
Accepted: 12-07-2025

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Water quality assessment and management practices in whiteleg shrimp (*Litopenaeus vannamei*) aquaculture in Hisar district, India

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DOI: https://www.doi.org/10.33545/26174693.2025.v9.i9Sf.5529

Abstract
The rapid growth of aquaculture, driven by the stagnation of capture fisheries, has positioned whiteleg shrimp (*Litopenaeus vannamei*) as a critical species for global and Indian food security, contributing 6.1% to global aquaculture production and over 10% to trade value. This study evaluates water quality parameters in *L. vannamei* culture ponds across five locations (Mirka, Landhari, Bagla, Panihari, and Gandhinagar) in Hisar district, India, an emerging inland saline aquaculture hub. Physicochemical parameters, including pH (7.80-8.68), temperature (23.18-27.19 °C), salinity (12.34-18.63 ppt), turbidity (26.20-31.97 cm), total dissolved solids (7.61-16.79 ppt), alkalinity (170.83-329.11 mg/L), electrical conductivity (28.11-36.51 mS/cm), dissolved oxygen (7.15-8.80 mg/L), and biological oxygen demand (8.54-15.91 mg/L), were measured following standard protocols. Notable variations were observed, with Panihari recording the highest salinity, alkalinity, and TDS, and Mirka showing the highest pH, temperature, turbidity, and BOD. These parameters, often exceeding optimal ranges, highlight the need for enhanced water quality management to mitigate disease risks and ensure sustainable shrimp farming. The study emphasizes the adoption of better management practices to support the socioeconomic benefits of inland shrimp aquaculture in Hisar, contributing to India's fisheries export economy.

Keywords: Whiteleg shrimp, water quality, aquaculture, *Litopenaeus vannamei*, inland saline farming

Introduction
The global economic and political stability strongly depends on access to nutritious, affordable and safe food for the rapidly growing populations. Besides other food-producing sectors, capture and culture fisheries productions have played essential roles in global food and nutritional security. However, the onus has shifted on the aquaculture sector to meet the rapidly increasing food demands due to the almost stagnation of capture fisheries production in recent years. Consequently, due to horizontal and vertical expansion, global aquaculture production has increased by >500% between 1990 and 2018. At the current production value of 82.1 million tonnes, its current contribution to global fish production is ~46% (FAO, 2019) [4]. Among various aquaculture species, white leg shrimp *Litopenaeus vannamei*, hereafter referred to as 'Vannamei' shrimp, is essential. With a total production of 4.97 million tonnes, vannamei shrimp constitutes 6.1% and >10% of global aquaculture in quantity and trade value, respectively (FAO, 2019) [4].
In India, shrimp is also the primary aquaculture commodity. In the year 2019-20, frozen shrimp was the most significant contributor to India's total fisheries export earnings of Rs. 46,662.85 crore, both in terms of quantity (51%) and trade value (73%) (Handbook of Fisheries Statistics 2020). Due to high global demand, export potential and low salinity tolerance of vannamei shrimp, inland saline areas, previously considered wastelands, have emerged as attractive destinations for shrimp farming.
India is cashing on demand by increasing the area under shrimp aquaculture. During 2019-20, the total shrimp production in India was 6, 39,896 tons, and shrimps valued at Rs. 34152.03 crores were exported from India (Handbook of Fisheries Statistics, 2020). Shrimps are decapod crustaceans and organisms with approximately 233 families and 725 genera (De Grave *et al.*, 2009) [3].

It is one of the most popular types of seafood consumed worldwide (FAO, 2019) [4]. With the rising population, there is a massive demand for food products based on shrimp.

White-legged shrimp (*L. vannamei*) farming in India is primarily centered in coastal states ranging from Gujarat to West Bengal; however, the majority of critical inputs like feed, seed and other farm inputs are produced in Tamil Nadu and Andhra Pradesh (TNAU, 2014) from where they are transported to other shrimp farming states, including the recently emerging inland saline aquaculture areas in Haryana, Punjab and Rajasthan.

Despite the rapid growth, frequent outbreaks of devastating diseases often threaten the growth/sustainability of the aquaculture industry, and shrimp farming is no exception. Due to lacking an adaptive immune system, shrimp are prone to >20 viral, bacterial, fungal and parasitic diseases. Because of high input cost and disease risk, shrimp farming is considered a "risky business", in which the failure of 2 even one crop may lead to severe economic setbacks for the farmer (Joffre *et al*., 2018) [6].

Litopelaeus vannamei farming is critical to India's socioeconomic development. Technologies in aquaculture are constantly being improved to keep up with the changing environment. One such technology the organized farming community adopts is better management practices for a more sustainable environment and higher yields. Implementing better management practices has benefited farmers, society and the environment (Mohan *et al*., 2008; Naik *et al*., 2020) [9, 12].

Materials and Methods

Survey sites

A study of shrimp farming practices was carried out on selected shrimp farms in the Hisar district. Samples are taken from the following locations: Mirka, Landhari, Bagla, Panihari, and Gandhinagar.

Water quality parameter

The following physicochemical parameters of water collected from the culture ponds were examined during the study period: pH, temperature, salinity, turbidity, total dissolved solids (TDS), alkalinity, electrical conductivity (EC), and dissolved oxygen (DO) following the standard procedures specified by APHA (1998).

Water pH

A digital pH meter (AQUASOL™ DIGITAL pH meter) was used in the lab to determine the pH of a sample of pond water.

Temperature

The pond water's temperature was determined using a thermometer at the site.

Salinity

The Microprocessor COND-TDS-SAL meter (LT-51) was used to measure salinity.

Turbidity

The turbidity was measured with a turbidity meter. After adding unfiltered water to the turbidity vial, the cell was sealed. After shutting the cover, the sample vial was inserted into the instrument cell compartment. The meter displayed NTU once the range read button was clicked after setup.

Total Dissolved solids (TDS.)

A Microprocessor COND-TDS-SAL meter (LT-51) was used to measure TDS.

Alkalinity

In a flask, 50 ml of water sample was mixed with two drops of phenolphthalein indicator, and the mixture was titrated using 0.02N H_2SO_4. The sample turned pink, and the titration was continued until it disappeared; this was the end point, marked as A. Next, the same sample was mixed with 2-3 drops of methyl orange, and the mixture was titrated until the colour changed from yellow to orange. The amount of titrant used was marked as B.

Phenolphthalein alkalinity = ml of titrant A × 1000/ml of sample

Total alkalinity: = ml of titrant B × 1000/ml of sample

Electrical conductivity (EC.)

A Microprocessor COND-TDS-SAL meter (LT-51) was used to measure electrical conductivity. A sample of about 100 ml of water was collected and placed in a beaker. The sample reading in µ Siemens/cm was displayed on the meter. Distilled water was used for zero adjustment, and the following water sample was applied before recording electrical conductivity (EC).

Dissolved Oxygen (DO.)

A DO meter was used at the sampling site to measure the dissolved oxygen. The quantity of oxygen that permeates through a permeable or semi-permeable membrane and enters a probe (sensor) is measured by dissolved oxygen probes. A chemical reduction reaction occurs in the sensor once oxygen arrives, producing an electrical signal. The DO probe picks up this signal, which a meter displays.

Results

Water quality parameters of shrimp ponds

At the surveyed sites, notable variations in the parameters of water quality were observed (Table 8). The water quality in the several shrimp ponds in the Hisar areas differed. In surveying sites, salinity (18.6 ppt), alkalinity (329.11 mg/l) and TDS (16.79 ppt) was highest at Panihari and BOD (15.91 mg/l), Turbidity (31.97 cm), pH (8.68) and temperature (27.19 °C) was highest at Mirkan.

Water quality parameters of sampling sites

Site	Temp (°C)	pH	DO (mg/1)	Salinity (ppt)	Alkalinity (mg/1)	TDS (ppt)	EC (Ms/cm)	Turbidity (cm)	BOD (mg/l)
Mirkan Pond 1	27.19±0.053	8.68±0.047	7.99±0.049	16.28±0.032	226.15±0.000	8.25±0.029	34.33±0.032	31.97±0.042	15.91±0.034
Landhari Pond 2	26.15±0.034	7.84±0.046	7.33±0.032	14.21±0.032	292.51±0.038	9.2±0.040	31.21±0.040	29.17±0.035	12.21±0.035
Gandhinagar Pond 3	25.22±0.020	8.23±0.035	8.80±0.032	15.41±0.038	170.83±0.029	7.61±0.035	36.51±0.041	26.20±0.021	11.45±0.032
Panihari Pond 4	23.18±0.023	8.12±0.023	7.15±0.029	18.63±0.032	329.11±0.067	16.79±0.040	28.11±0.041	30.36±0.025	8.54±0.029
Bagla Pond 5	24.18±0.013	7.80±0.044	8.11±0.035	12.34±0.035	269.31±0.038	11.38±0.038	29.94±0.032	29.65±0.028	12.12±0.038
C.D.	0.102	0.127	0.115	0.107	0.109	0.117	0.119	0.098	0.108
SE(m)	0.032	0.040	0.036	0.034	0.034	0.037	0.037	0.031	0.034
SE(d)	0.045	0.056	0.051	0.048	0.048	0.052	0.053	0.044	0.048

In shrimp culture ponds, electrical conductivity ranged from 28.11 ms/cm to 34.33 ms/cm, total dissolved solids ranged from 7.61 ppt to 16.79 ppt, alkalinity ranged from 170.83 mg/l to 329.11 mg/l, and pH ranged from 7.80 to 8.68.

Discussion

Water quality parameters

Water quality is essential for maintaining the health of aquatic species and can act as a limiting factor (Kamrani *et al*., 2016; Sharifinia, 2015) [7, 14]. Water temperature generally depends on climate, sunlight, and the depth of water in the pond. The water temperature varied from 23.18 °C to 27.29 °C in shrimp farms in Hisar district. In some other studies, the water temperature of 28.59 °C was observed before stocking of *Litopenaeus vannamei* and at the end of the culture period, the water temperature of 28.14 °C was observed (Mustafa *et al*., 2022) [11]. Similar studies also showed the temperature varied from 24.2 °C to 30 °C in the brackish water shrimp farms (Bansode *et al*., 2020) [1].

The salinity in shrimp farms in Hisar was recorded from 12.34 ppt to 18.63 ppt during the study period. Similarly, Junda (2018) recorded a salinity range from 13-22 ppt. Kumar *et al*. (2023) [8] stated that the salinity range was 16.7-25.7 ppt.

Alkalinity in shrimp ponds is correlated with vital elements like growth, moulting, and the buffer effect on daily pH changes in the pond. Alkalinity concentrations should not be higher than 140 mg/l in order to promote healthy shrimp growth. The ideal salinity concentration range was found to be between 15 and 23 ppt in prior studies. Bansode *et al*., (2020) [1] recorded alkalinity range from 90 to 140 mg/l in their research. Shah *et al*., (2023) [23] noted the total alkalinity of village pond water as 266.00mg/L and was found to be appropriate for aquaculture. In the present study, the alkalinity range is recorded as 170.83 to 329.11 mg/L.

The pH values range from 7.80 to 8.68 at the study sites during the present investigation. The pH of pond water is influenced by many factors, including the pH of the source water, the acidity of the bottom soil, shrimp culture inputs, and biological activity. The ideal pH range for shrimp growth is between 6 and 9. Kumar *et al*., (2023) [8] reported the pH value in the shrimp pond was 7.8 to 8.6.

Dissolved oxygen concentration is the most critical water quality parameter because of its direct effect on the feed consumption and metabolism of shrimp and its indirect influence on the water quality. Dissolved oxygen was crucial for fish survival, growth, and other biochemical reactions (Boyd, 2020) [2]. The Dissolved oxygen (DO) of all the survey sites was in the range of 7.15 to 8.8 ppm and was maintained by aerators. Shah *et al*., (2023) [23] conducted a study on village pond water, and dissolved oxygen was reported at 10.37 mg/L, slightly above the optimum level.

TDS was observed in shrimp farms during the present investigation in the Hisar district from 7.61 to 16.79 ppm. Total dissolved solids cause toxicity through increased salinity, water ionic composition changes, and individual ions' toxicity. Mohankumar *et al*., (2024) reported similar values in the TDS in shrimp ponds 0.70 mg/L to 9.99 mg/L. Kumar *et al*., (2023) [8] similarly recorded the EC 8.99 to 9.87 mS/cm range. In another study, the range of EC was 2.08-14.35 mS/cm, as Poonkodi *et al*. (2017) suggested. The EC values range from 28.11 to 36.51 mS/cm in the present study, which is high from the optimum range.

The Biological Oxygen Demand (BOD) levels in the shrimp ponds studied during the period ranged from 12.80 to 28.42 mg/l. Similarly, Retno Susetyaningsih reported the range of the BOD in shrimp farms from 3.9 to 56.5 & mg/l.

The present study recorded turbidity from 26.20 to 31.97 cm, within the permissible limit required for shrimp culture. In another study, Mohanty *et al*., (2018) [10] recorded the turbidity range from 21.2 to 28.8 NTU.

Reference

1. Bansode VV, Sharangdhar MT, Mohite AS, Sawant SS, Mulye VB, Koli JM, Chibhade GB. Soil and water quality parameters of brackish water shrimp farms of Raigad District of Maharashtra. J Exp Zool India. 2020;23:941-946.
2. Boyd CE, Boyd CE. Microorganisms and water quality. In: Boyd CE, Boyd CE, editors. Water Quality, An Introduction. 2020. p. 233-267.
3. De Grave S, Pentcheff ND, Ahyong ST, Chan TY, Crandall KA, Dworschak PC, Wetzer R. A classification of living and fossil genera of decapod crustaceans. Raffles Bull Zool. 2009.
4. FAO. FAO yearbook. Fishery and Aquaculture Statistics 2017. 2019.
5. Handbook of Fisheries Statistics. Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India, New Delhi; 2020.
6. Joffre OM, Poortvliet PM, Klerkx L. An analysis of risk perception and risk management behaviors among shrimp farmers in the Mekong Delta. Aquaculture. 2018;495:528-537.
7. Kamrani S, Rezaei M, Amiri V, Saberinasr A. Investigating the efficiency of information entropy and fuzzy theories to classification of groundwater samples for drinking purposes, Lenjanat Plain, Central Iran. Environ Earth Sci. 2016;75:1-13.
8. Kumar U, Sharma SK, Sharma BK, Ojha ML, Matoria S. Water quality in culture ponds of pacific white shrimp, *Litopenaeus vannamei* (Boone, 1931) at

selected locations in Rajasthan and Punjab. The Pharma Innovation J. 2023;12(6):1068-1071.
9. Mohan CV, Phillips MJ, Bhat BV, Umesh NR, Padiyar PA. Farm-level plans and husbandry measures for aquatic animal disease emergencies. Rev Sci Tech. 2008;27(1):161-173.
10. Mohanty RK, Ambast SK, Panigrahi P, Mandal KG. Water quality suitability and water use indices, useful management tools in coastal aquaculture of *Litopenaeus vannamei*. Aquaculture. 2018;485:210-219.
11. Mustafa A, Paena M, Athirah A, Ratnawati E, Asaf R, Suwoyo HS. Temporal and spatial analysis of coastal water quality to support application of whiteleg shrimp *Litopenaeus vannamei* intensive pond technology. Sustainability. 2022;14(5):2659.
12. Naik BV, Patil SV, Shirdhankar MM, Yadav BM, Tibile RM, Chaudhari KJ, Wasave SM, Yewale VG. Socio-Economic Profile of Shrimp Farmers of South Konkan Region, Maharashtra, India. Int J Curr Microbiol Appl Sci. 2020;9(9):1371-1380.
13. Shah BA, Thakral N. Evaluation of surface water quality using hydro-chemical, bacteriological characters and water quality index: a case study on sacred ponds of Kurukshetra, Haryana, India. Sustain Water Resour Manag. 2023;9(5):159.
14. Sharifinia M. Macroinvertebrates of the Iranian running waters, a review. Acta Limnologica Brasiliensia. 2015;27(4):356-369.
15. TNAU. Agritech Portal. Accessed on 15.6.22.