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**Myla S Chakravarty**

Department of Marine Living  
Resources, Andhra University,  
Visakhapatnam - 530 003,  
Andhra Pradesh, India.

**P R C Ganesh**

Department of Marine Living  
Resources, Andhra University,  
Visakhapatnam - 530 003,  
Andhra Pradesh, India.

**D Amarnath**

Department of Marine Living  
Resources, Andhra University,  
Visakhapatnam - 530 003,  
Andhra Pradesh, India.

**B Shanthi Sudha**

Department of Marine Living  
Resources, Andhra University,  
Visakhapatnam - 530 003,  
Andhra Pradesh, India.

**T Srinu Babu**

Department of Marine Living  
Resources, Andhra University,  
Visakhapatnam - 530003,  
Andhra Pradesh, India.

**Correspondence**

**Myla S Chakravarty**

Department of Marine Living  
Resources, Andhra University,  
Visakhapatnam - 530 003,  
Andhra Pradesh, India.

## Spatial variation of water quality parameters of shrimp (*Litopenaeus vannamei*) culture ponds at Narasapurapupeta, Kajuluru and Kaikavolu villages of East Godavari district, Andhra Pradesh

**Myla S Chakravarty, PRC Ganesh, D Amarnath, B Shanthi Sudha and  
T Srinu Babu**

### Abstract

Water quality parameters viz., Temperature, pH, Salinity, Dissolved Oxygen, Alkalinity, Hardness, Nitrite- Nitrogen, Nitrate-Nitrogen and Ammonia were studied in 14 shrimp culture ponds (6 at Narasapurapupeta, 4 at Kajuluru and 4 at Kaikavolu villages) of East Godavari district, Andhra Pradesh. Temperature ranged from 26.5 °C to 28 °C in the ponds. pH varied from 6.95 to 8.38. Dissolved oxygen varied from 4.4 to 8.6 mg/l. Minimum values of dissolved oxygen were recorded at Kajuluru village pond and maximum in Narasapurapupeta ponds. Low salinity (2 ppt) was observed in Kajuluru ponds and high (10 ppt) in Kaikavolu ponds. The alkalinity was minimum (120 mg/l) in the ponds of Narasapurapupeta and maximum (500 mg/l) in Kajuluru ponds. The hardness ranged from 600 mg/l to 3440 mg/l. The values of ammonia were 0.02 - 1.07 mg/l. The nitrite-nitrogen was minimum (0.01) in Kajuluru ponds and maximum (0.80) in Narasapurapupeta ponds. The nitrate- nitrogen was minimum (3.36) in Kaikavolu ponds and maximum (6.40) in Kajuluru ponds. The cumulative effect of these water parameters will reflect on the shrimp production. The parameters observed were in the optimal range for shrimp culture except salinity in which case it was found that the shrimp was acclimatized to grow at low salinities.

**Keywords:** Water quality, shrimp ponds, East Godavari, Andhra Pradesh

### 1. Introduction

Shrimp culture has been a fast growing business industry with species diversification and crop rotation in view of the market demand both in internal and export market. The ambient water in which the shrimp lives has a cumulative effect with all its organic and inorganic loads on the survival, growth and performance of the shrimp with respect to production and hence an understanding of the water quality and its suitability is highly essential [1]. Thus the physico-chemical properties of a water body play a major role in its productivity and growth of aquatic organisms under culture [2]. Hence, the water analysis has been carried out to assess the optimum and harmful limits of various parameters for survival and growth of shrimps in shrimp ponds.

Many researchers have worked on the water quality parameters in shrimp culture [3-22]. The present study is aimed at assessing the existing water quality parameters such as Temperature, pH, Salinity, Alkalinity, Hardness, Ammonia-N, Nitrite-nitrogen, Nitrate-nitrogen and Dissolved Oxygen in fourteen shrimp culture ponds of Narasapurapupeta, Kajuluru and Kaikavolu villages of East Godavari district, which are distantly separated.

### 2 Materials and Methods

Water samples for the analysis were collected during 2015 from six different shrimp ponds at Narasapurapupeta village (Na1, Na2, Na3, Na4, Na5 & Na6; 16°62'19.79"N; 82°04'46.68"E), four ponds at Kajuluru village (Kaj1, Kaj2, Kaj3 & Kaj4; 16°46'62.85"N; 82°10'14.33"E) and four at Kaikavolu villages (Kai1, Kai2, Kai3 & Kai4; 16°66'05.61"N; 82°07'42.50"E) (Fig:1). Geographically these three villages were distantly separated Kajuluru and Kaikavolu villages are comparatively nearer to the brackish water source than the Narasapurapupeta. The distance between Kajuluru and Narasapurapupeta is 13 km, whereas the same from Kajuluru to

Narasapurupeta is 23.6 km. All the villages have fresh water source and hence the shrimps have been grown at very low salinities.

Surface water temperature of different shrimp ponds was recorded between mornings to mid noon with the help of thermometer. Samples were collected in separate reagent

bottles and analyzed at the laboratory for different parameters studied following the methods of APHA [23]. In case of dissolved oxygen, the collected water samples were fixed with Winkler's A and B separately and further were analyzed at the laboratory.

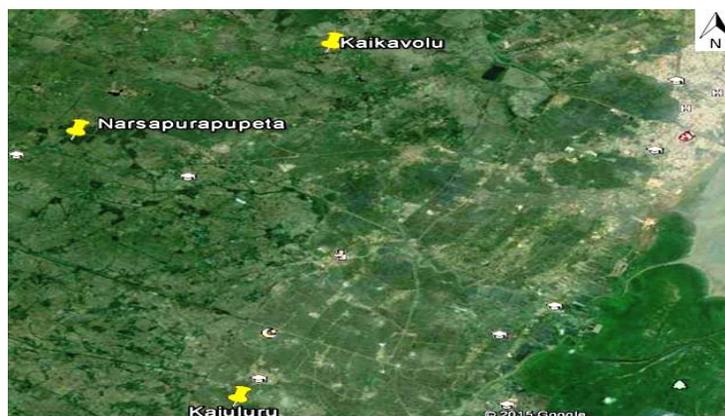


Fig 1: Study Area

**3 Results & Discussion**

**3.1 Temperature**

Temperature was low (26.5 °C) in pond 5 of Narasapurupeta and Pond 1& 3 of Kaikavolu villages. High (28 °C)

temperatures were recorded in ponds 1, 2 & 3 of Narasapurupeta village and at pond 2 of Kaikavolu village (Fig. 2).

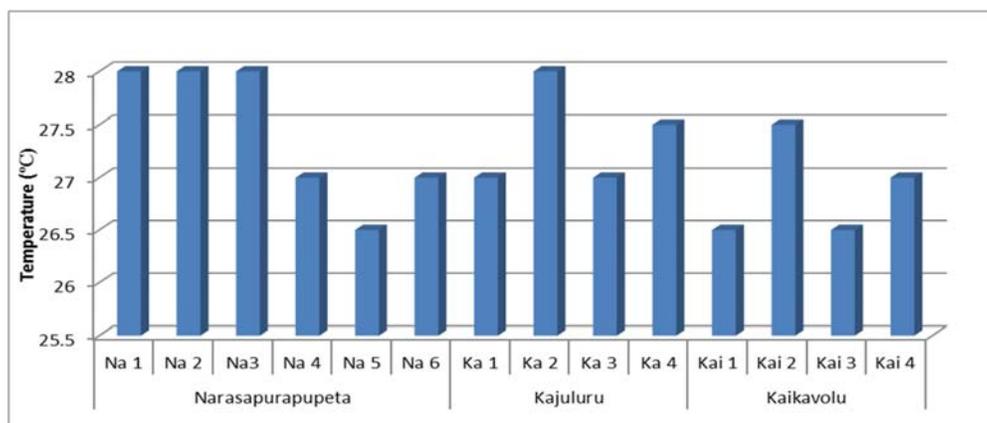


Fig 2: Temperature of pond waters at Narasapurupeta, Kajuluru and Kaikavolu Villages.

**3.2 pH**

pH ranged from 6.95 to 8.38 (Fig. 3).The average pH of water was 7.9. The low pH (6.95) was recorded at pond 1 of Kaikavolu village and high at pond 3 of Kaikavolu village.

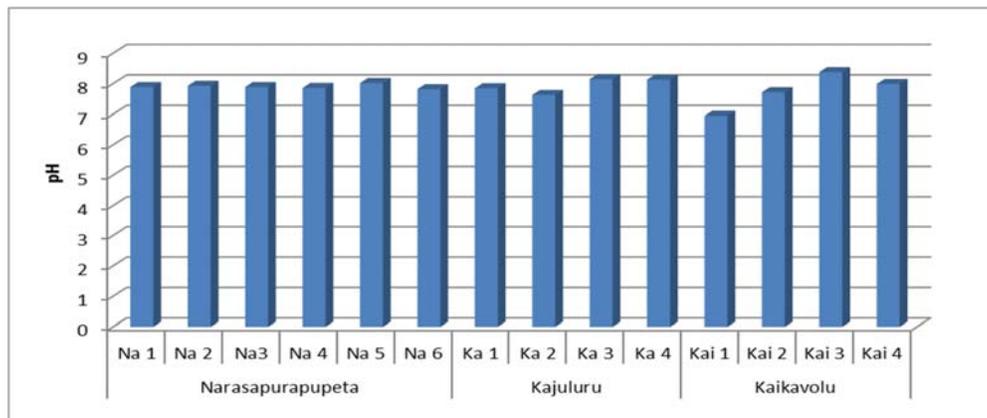


Fig 3: pH of pond waters at Narasapurupeta, Kajuluru and Kaikavolu Villages.

### 3.3 Salinity

It ranged from 2ppt (low) at pond 2 of Kajuluru and high (10 ppt) at pond 1 of Kaikavolu village (Fig. 4).

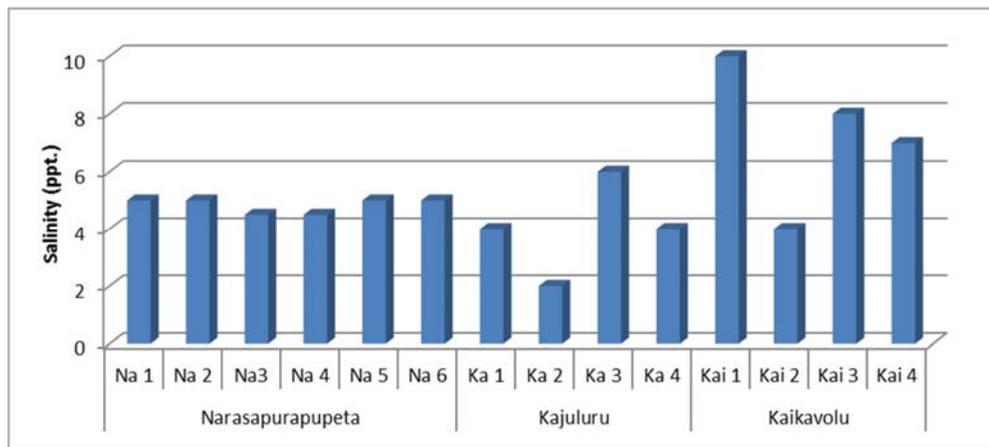


Fig 4: Salinity of pond waters at Narasapurapupeta, Kajuluru and Kaikavolu Villages.

### 3.4 Alkalinity

The alkalinity was minimum (120 mg/l) in ponds 1, 2 & 3 of Narasapurapupeta village and maximum (500 mg/l) in pond 3 of Kajuluru village (Fig. 5).

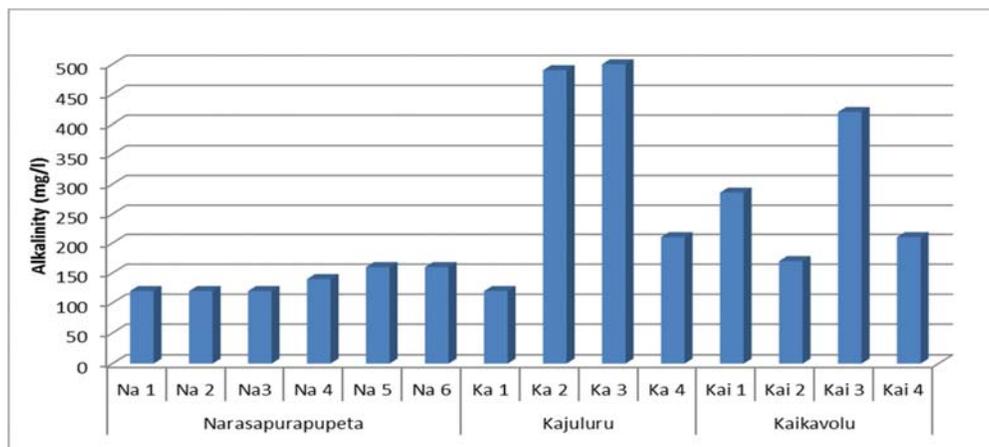


Fig 5: Alkalinity of pond waters at Narasapurapupeta, Kajuluru and Kaikavolu Villages.

### 3.5 Hardness

The hardness of shrimp ponds ranged from 1450 mg/l to 2300 mg/l. Minimum was recorded in pond 5 and maximum in pond 2 of Narasapurapupeta village. In Kajuluru village, minimum

hardness of 600mg/l was observed in pond 2 and maximum of 1640mg/l in pond 3. At Kaikavolu village, low hardness (1340mg/l) was observed at pond 3 and high (3440 mg/l) in pond 1 (Fig. 6).

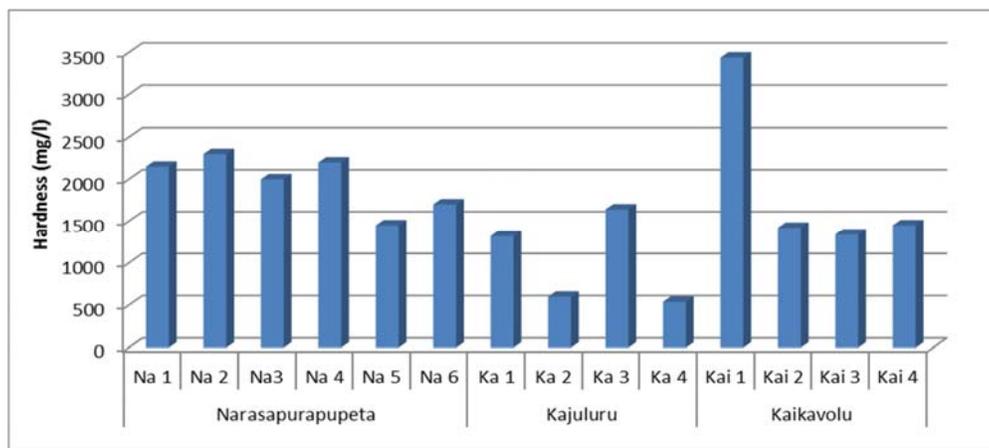
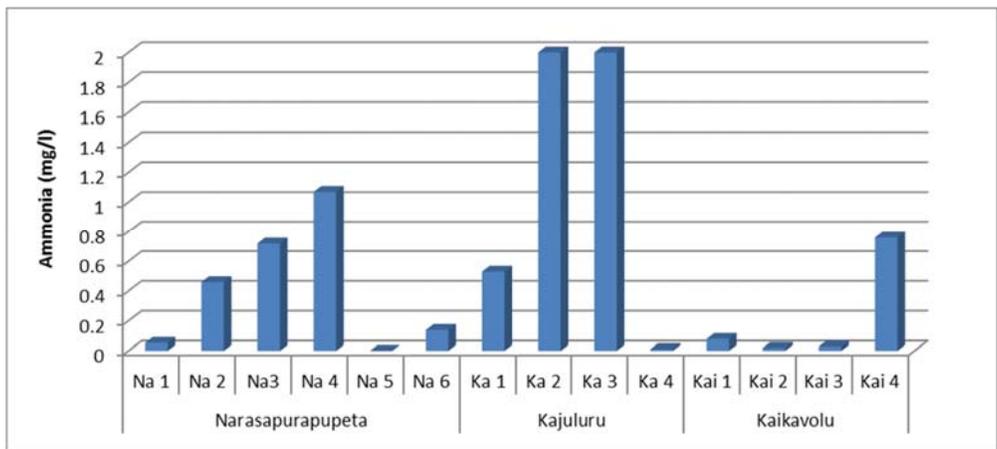


Fig 6: Hardness of pond waters at Narasapurapupeta, Kajuluru and Kaikavolu Villages.

**3.6 Ammonia**

The ammonia of shrimp ponds ranged from 0.46 mg/l to 1.07 mg/l with minimum recorded at pond 2 and maximum in pond 4 of Narasapurapupeta village and it was low (0.12) in pond 4

and high (2.0 mg/l) in ponds 2 and 3 of Kajuluru village. The minimum (0.02) was observed in pond 2 and maximum (0.76) in pond 4 at Kaikavolu village. The ammonia were absent in pond 5 of Narasapurapupeta village (Fig. 7).

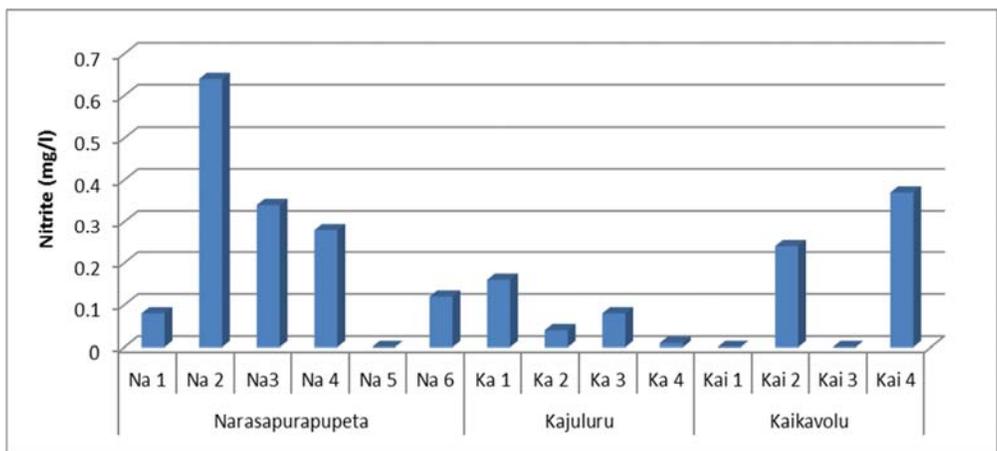


**Fig 7:** Ammonia of pond waters at Narasapurapupeta, Kajuluru and Kaikavolu Villages.

**3.7 Nitrite- Nitrogen**

The nitrite-nitrogen was minimum (0.01) recorded in pond 4 Kajuluru village and maximum (0.80) in pond 1 of

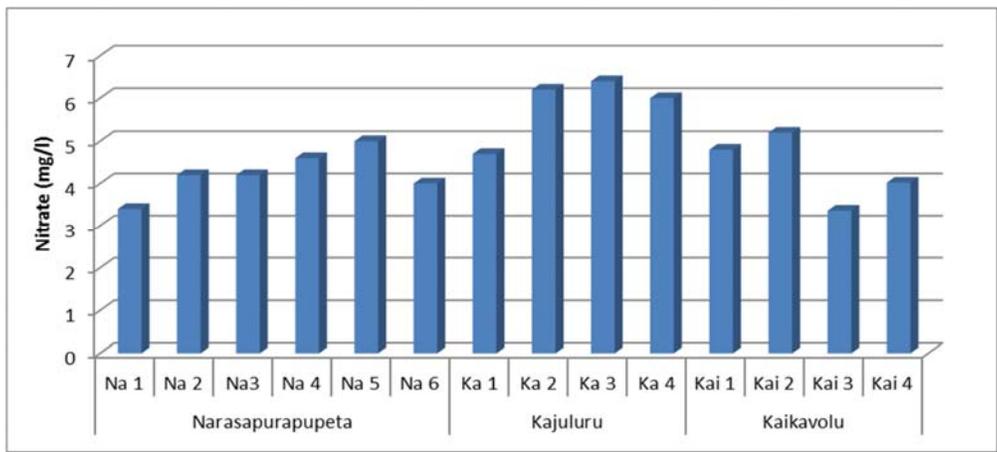
Narasapurapupeta village. The nitrates were absent in the shrimp ponds 5 of Narasapurapupeta village and ponds 1 & 3 of Kaikavolu village (Fig. 8).



**Fig 8:** Nitrite- Nitrogen of pond waters at Narasapurapupeta, Kajuluru and Kaikavolu Villages.

**3.8 Nitrate- nitrogen**

The nitrate-nitrogen was minimum (3.36) in pond 3 of Kaikavolu village and maximum (6.40) in pond 3 of Kajuluru village (Fig. 9).



**Fig 9:** Nitrate- Nitrogen of pond waters at Narasapurapupeta, Kajuluru and Kaikavolu Villages.

### 3.9 Dissolved oxygen

Dissolved oxygen varied from 4.4 to 8.6 mg/l (Fig. 10).

Minimum was recorded in the pond 4 of Kajuluru village and maximum in pond 1 of Narasapurapupeta village.

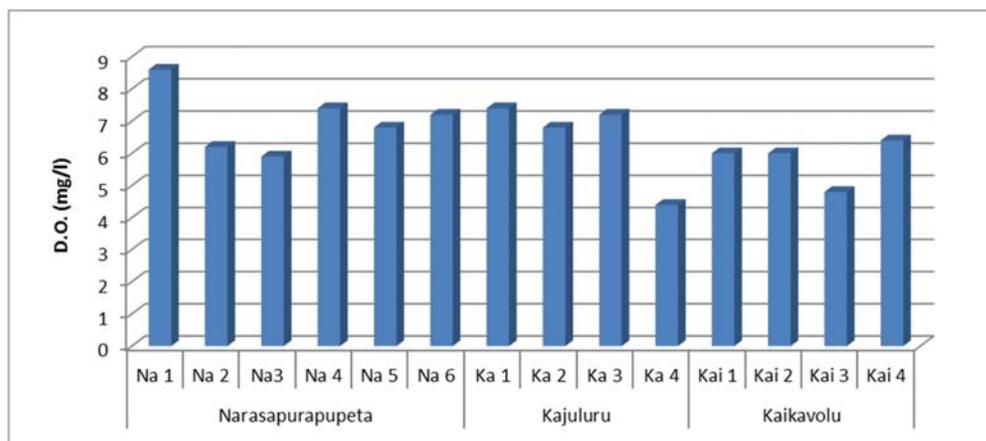


Fig 10: Dissolved oxygen of pond waters at Narasapurapupeta, Kajuluru and Kaikavolu Villages.

Management of water quality parameters in shrimp ponds has been important in view of their impact on the growth and viability of shrimp. Shrimp sustain normally in an optimal range of water quality parameters. Any increase or decrease beyond a particular range will definitely have its impact either negatively or positively on shrimp well-being. The sources of these changes are mostly exogenous leading to a change in the pond conditions. The exogenous changes mostly include the water intake system nutrients leads through feed, climatic changes etc. Variation in the water quality parameters is manifold and management to keep them in the optimal range is necessary for the success of shrimp culture.

Temperature is an indirect effect of light which influence the metabolic rate, physiological responses of culture organisms and decomposition of organic matter and subsequent biochemical reactions. It is also one of the most important factors controlling growth of the shrimp. In the present study, the temperature was recorded between 26.5 to 28.0 °C. Asha and Diwakar [24] also observed a similar temperature on inshore water of Tuticorin coast. The pH of the aquaculture pond water samples varied from 6.95 to 8.38. It has been found that the pH of aquaculture pond water showed permissible limit of pH that has been prescribed by MPEDA [25]. In the present investigation, range of salinity was 2-10 ppt. There was not much variation in the pond water salinity among the ponds. The normal range of salinity required for brackish water shrimp culture is 10-35 ppt. but acclimatizing and growing of shrimp at low saline conditions results in good growth of the shrimp, since it need not spend extra energy to expel out the salts in high saline conditions and the shrimp gains weight automatically. Subrahmanyam [26], Verghese *et al* [27] and Chakraborti *et al* [28] have observed a direct influence of salinity on the survival, growth and production of *P. monodon* in culture ponds. The total ammonia ranged between 0.02 to 2mg/l which is within the favourable limits of the water quality parameters [25]. The hardness of water in the present study showed a variation between 540 to 3440 which is out of the range of favourable limits.

Dissolved oxygen is one of the most important abiotic parameters influencing the life in the coastal environment. The dissolved oxygen content ranged from 4.4 to 8.6 ml/l. Increase in dissolved oxygen concentration may have resulted from the production of phytoplankton from strong and longer light period. In the present study the water pH of ponds lies between

6.95 to 8.38 which is within the desirable limit in most of the ponds. The alkalinity of the waters in the present study ranged from 120-500 mg/l which shows higher values than the normal ranges required for the waters suggested by MPEDA [25]. Varadaraju *et al* [8] have found that the water and soil properties of the ponds were within the permissible limits required for shrimp culture and the correlation between soil and water quality parameters with growth of shrimps revealed that water quality parameters namely pH, dissolved oxygen and temperature were found to be significantly affecting the shrimp production. The studies of Brahmabhatt *et al* [29] on physico-chemical characterization of shrimp ponds of Gujarat have confirmed the earlier observations.

Pankaj Kumar *et al* [10] have found a positive correlation between water temperature and salinity, salinity and primary productivity, primary productivity and dissolved oxygen, dissolved oxygen and nitrate, nitrate and total available phosphorous at all four stations of Patelwadi village, Diu (Union Territory) and also stated that the overall mean values of the nutrients in the water indicates the fertility of pond water leading to productive shrimp culture operations. Devi *et al* [15] have suggested necessity of controlling the ill effects caused by imbalance in the quality of water and soil of fish ponds for survival of aquatic animals. Chakravarty *et al* [19] while studying the culture of *Litopenaeus vannamei* in bore- and sea-water fed ponds at Ramathirtham Village, Nellore district, Andhra Pradesh have observed that the dissolved oxygen, hardness, nitrite-nitrogen, calcium and iron of sea- water fed ponds showed low values when compared to those of bore- water fed ponds. According to them temperature, pH, salinity, hardness, alkalinity, ammonia & magnesium of bore-water are lower than sea-water fed ponds. Hassan *et al* [21] have found that DO, salinity, NH<sub>4</sub>-N, NO<sub>2</sub>-N and PO<sub>4</sub>-P are significantly ( $p < 0.05$ ) higher in sampling stations inside culture ponds In Mafia Island, Tanzania. NO<sub>3</sub>-N is significantly ( $p < 0.05$ ) higher mean values at the stations along the effluent creek and no significant differences ( $p > 0.05$ ) have been recorded between the stations in terms of temperature.

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