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Suitability of Coastal Water for Brackishwater Shrimp Farming Along Dakshina Kannada District, Karnataka State

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Abstract

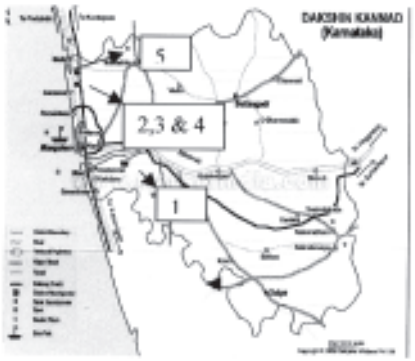
Selection of potential and suitable site is the first and foremost step for successful aquaculture. Adequate water supply and its characteristics, soil quality and topography are the most important parameters of a good site. Studies were conducted to determine the water properties along coastal line of Dakshina Kannada district of Karnataka state. Water samples were collected at different locations and rivers of Mangalore taluk and parameters viz., temperature, electrical conductivity, total dissolved solids, pH, salinity, turbidity, hardness and dissolved oxygen are studied. Properties of the source water are within the permissible limits required for shrimp culture. Hence the water of these sources is considered to be suitable for shrimp culture.

Key words : Suitability, Brackishwater, Shrimp culture.

Shrimp farming is a major aquaculture industry in tropical and sub-tropical regions around the world. The chief occupation of the people in coastal districts of Karnataka is agriculture and fishery. Shrimps are called the Pinkish Gold of the sea because of its universal appeal, unique taste, high unit value and increasing demand in the world market. Aquaculture, a system of cultivating the aquatic organisms under controlled environmental conditions, is more remunerative than agriculture and other live stock industry (Jayanthi et al. 2004). Presence of nutrients in adequate amounts in pond water is essential for successful aquaculture. The physico-chemical properties of pond water are more or less a reflection of the properties of pond bottom soil (Boyd and Munsiri 1996). Nutrient enrichment of pond waters is an essential management practice in aquaculture. To keep the aquatic habitat favorable for existence, physical and chemical factors like temperature, turbidity, color, odor, pH, dissolved gases like oxygen, carbon dioxide, hydrogen sulfide and methane will exercise their influence individually or synergetically. The water may be of poor quality viz., highly acidic, rich in nutrients and organic matter, high in suspended solids or polluted with industrial or agriculture chemicals. Shrimps are in equilibrium with potential disease organisms and their environment, changes in this equilibrium viz.,deterioration in water quality can result in fish becoming "stressed" and vulnerable to diseases. It is therefore important to know about water and soil quality parameters and their management which have influence on growth and survival of shrimps. The addition of feed and fertilizer to enhance shrimp growth also deteriorate water and its quality.A sufficient supply of good quality of water is a pre-requisite to shrimp culture this emphasizes the importance of water quality management in aquaculture. Water quality analysis is an important tool in aquaculture pond management. Once water quality inadequacies are recognized, treatments may be applied to mitigate them. The water and sediment quality problems are now common in shrimp ponds in many parts of the world. Considering the importance of the water in the selection of suitable site and in determining the productivity of brackishwater aquaculture system, it was considered worthwhile to determine some relevant properties of coastal water.

Methods

In Karnataka, three districts namely Dakshina Kannada, Udupi and Uttara Kannada have marine resources. Dakshina Kannada district covers $74^0 00'$ E to $75^0 30'$ E longitude and $12^0 30'$ N to $13^0 50'$ N lati-



1- Munnure 3- 4 Hoigegudda and Chitrapu
2- Kadike 5 Hejamadi

Figure 1. Site locations for the study, 1 Munnure, 2 Kadike, 3-4 Hoigegudda and Chitrapu, 5 Hejamadi.

tude (Fig. 1). The locations selected to check the suitability of water for brackishwater shrimp culture were Munnure, Kadike, Hoigegudda, Chitrapu and Hejamadi. The sources for these locations are Nethravathi and Shambhavi river. Samples were collected at a depth of 10–15 cm below the water surfaces of the source every fortnight during the period of study to check their suitability for shrimp culture. Water parameters viz., temperature (temperature) was measured in field with digital thermometer ; pH with pH meter (Eutech testr 30), electrical conductivity (EC) and total dissolved solids (TDS) with water quality analyzer (ELICO. PE. 136) and dissolved oxygen (DO) with DO meter (Lovi Bond, Oxi 200) were measured. Digital Nephelo-turbidity meter (Systronics-132) was used to measure turbidity, salinity with salinometer (Hach-sension 156) and hardness with EDTA titrimetric method were used.

Results and Discussion

Table 1 shows the properties of source water with minimum, maximum and average values (in parentheses) at respective sites. The yield of living resources from any water body is closely related to the primary productivity of the water, maintenance of a healthy aquatic environment thereby production of sufficient fish food organisms in ponds, are important for successful culture operations. Weak resistance to disease or direct mortality problems with water quality are often linked to culture intensity (Wamg and Fast 1992). The long retention time of water in shrimp ponds means that water quality is the net result of pond and external influences. Of the physical factors, heat and light are essential in all waters for photosynthetic activity, which in turn is basic to productivity. The dissolved oxygen concentration requirement of aquatic species is higher in warmer water than in cooler water.

Temperature is essential factor which influences the photosynthetic activity in the water body, the biochemical and physiological activity of the shrimps

Table 1. Properties of source water.

River	Nethravathi		Shambhavi		
Place	Munnure	Hejamadi	Hoigegudda	Kadike	Chitrapu
Temp (^{0}C)	28.70-32.00 (30.34)	26.6-30.7 (28.72)	28.00-32.50 (30.80)	26.9-30.70 (28.70)	28.0-32.40 (30.75)
pH	6.86-7.92 (7.27)	7.30-7.94 (7.70)	7.52-8.53 (7.86)	7.61-8.24 (7.92)	7.5-8.43 (7.85)
Salinity (ppt)	15.70-33.60 (25.13)	2.70-31.2 (12.87)	25.00-34.80 (30.75)	0.70-31.4 (12.88)	25.0-34.70 (30.74)
D.O. (mg/L)	5.94-7.18 (6.49)	3.95-7.66 (6.82)	5.30-7.59 (6.50)	5.4-8.21 (6.83)	5.40-7.60 (6.55)
E.C (mS/cm)	21.90-45.81 (31.66)	4.75-50.52 (19.28)	31.58-47.52 (44.41)	1.45-50.16 (19.19)	31.20-48.7 (43.76)
TDS (ppt)	11.86-22.91 (16.37)	2.52-21.06 (9.20)	17.16-20.75 (19.64)	1.08-21.06 (9.10)	15.50-24.1 (19.94)
Turbidity (NTU)	12.9-75.4 (39.56)	3.60-30.2 (14.04)	14.96-43.10 (28.16)	12.10-56.9 (32.94)	16.30-44.0 (30.24)
Hardness (mg/L)	5100	2450	3950	4400	4000

and the decomposition of organic matter at the pond bottom. It plays an important role in regulating the activities of cultured animals. The highest temperature of 32.5C and lowest of 26.6 C were recorded at Shambhavi river of Hoigegudda and Hejamadi locations respectively. The normal temperature required for brackishwater shrimp culture is 18 to 32 C, the optimum level required is 28 to 32 C. The temperature less than 14 c is critical for shrimp life (CIBA 2001). The temperature of source water was little more than desirable during April and May in Hoigegudda and Chitrapu locations. Variation in water temperature between the sources was not significant but remained within the acceptable ranges required for shrimp culture. There are many reports available which highlight the importance of temperature in shrimp farming. The growth and survival of *Penaeus monodon* are affected by the low temperature in laboratory (Subrahmanyam 1973). The rapid growth of *P. monodon* coinciding with increasing phase of temperature (Verghese et al. 1975).

The value of pH indicates acidic or basic nature of water. It is an index of the presence of metabolites, photosynthetic activity and fertility of the pond water. Low pH is reported to be harmful to crustaceans and higher pH can lead to alkaline death. Brackishwater contains a high concentration of nutrient salts and is perfectly buffered medium against abrupt changes in pH. The normal range of pH required for brackishwater shrimp culture is 6–9, the optimum level required is 7.5–8.5. Above or below this range, the water should be changed immediately (CIBA 2001). The highest values of pH 8.53 at Shambhavi river of Hoigegudda and the lowest of 6.86 at Nethravathi of Munnure stations were observed. No significant variations in pH among the sources were observed. The pH of the source water is well within the desirable range required for shrimp culture. The largest fish crops are usually produced in water which is just on the alkaline side of neutrality i.e., between pH 7.0 to 8.0 (Roule 1930). The shrimp culture can be controlled with wide ranges of pH from 4.8 to 10.8. The highest rate of growth is observed when pH value is between 6.5 to 7.5, moderate growth when the pH ranges from 7.5 to 8.5 (Ohle 1938).

Salinity is a single factor that plays an important role in shrimp farming as it influences many functions such as metabolism, growth, osmotic behavior and reproduction. Transformation of applied nutrient elements in brackishwater pond soil depends on the widely fluctuating water salinities (Chattopadhyay 1978). Rate of decomposition of organic manure is also affected under different water salinity levels Regular monitoring is required in coastal areas, where water salinity some times creates problems. The salinity ranged from 0.70 to 34.80 ppt at Shambhavi river of Kadike and Hoigegudda locations respectively. The normal range of salinity required for brackishwater shrimp culture is 10–35 ppt, the optimum level required is 15–25 ppt (CIBA 2001). If the salinity is allowed to go beyond the optimal limit, the shrimp refrains from taking normal food and hence emaciated and become susceptible to disease. The salinity of source water is little more than desirable during April and May. With the advent of monsoon in June-July, salinity slowly drops, reaching minimum in September. September onwards salinity of source water gradually increased till next monsoon. There is direct influence of salinity on the survival, growth and production of P. monodon in culture ponds (Subrahmanyam 1973, Verghese et al. 1975, chakraborti et al. 1985).

Dissolved oxygen concentration is the most important and critical water quality parameter because of its direct effect on the feed consumption and metabolism of shrimp, and indirect influence on the water quality. Prolonged exposure to low oxygen content causes low feed consumption which leads to slow growth and the culture organisms become inactive and they become susceptible to disease. Further, many or even all organisms may die from lack of oxygen. Photosynthesis and dissolution from atmosphere are the primary sources of dissolved oxygen concentration in brackishwaters. In tropical waters dissolved oxygen level is normally low because of higher temperature. Dissolved oxygen should be maintained in the range of 3–10 mg/liter, the optimum level required for shrimp culture is 4 to 7 mg/liter (CIBA 2001). The highest dissolved oxygen concentration of 8.21 mg/liter and lowest 3.95 mg/liter were observed in the Shambhavi river at Kadike and Hejamadi locations respectively. The dissolved oxygen concentration of source water was within the normal level required for shrimp culture.

Organic and inorganic, settleable, suspended and dissolved matter are termed as total solids. The highest total dissolved solids of 24.10 ppt and lowest of

1.08 ppt were observed at Shambhavi river of Chitrapu and Kadike location respectively. Total dissolved solids ranging from 15 to 25 ppt are considered as slight, 5 to 15 ppt as moderate and less than 5 ppt as severe (Hajek and Boyd 1994). TDS of all the sources water lies within the permissible limit. Turbidity can be caused either by planktonic organisms or by suspended soil particles. It interferes with the penetration of light and by absorbing nutrients present in the water and affects the growth of benthos. It can cause uneasiness and stress to the shrimp leading to disease. Suspended clay particles may damage the gills of prawns by clogging it. In certain cases, oxygen deficiency has also been reported as a result of sudden increase in turbidity. A highest turbidity of 75.40 NTU at Nethravathi river of Munnure site and minimum of 3.60 NTU at Shambhavi river of Hejamadi location were observed respectively. Turbidity ranging from 0 to 25 NTU is considered as slight, 25 to 100 NTU as moderate and more than 200 NTU as severe (Hajek and Boyd 1994). Turbidity of the source water is within the desirable level. Though turbidity caused by silt load normally influences the primary productivity of ponds (Chakraborti et al 1985), the effect of it was not observed on the survial or production of *P. monodon* in the culture ponds. The reasons for the higher production at lower transparency being higher survival rate caused by the availability of algae and particulate matter to the shrimp at the bottom, which graze on them (Hariati et al. 1996).

In brackishwater hardness and alkalinity are usually high so these variables are seldom important in management of shrimp ponds. The lower value of 2,450 mg/liter and higher value of hardness 5,100 mg/liter were observed at Shambhavi river of Hejamadi and Nethravathi river of Munnure location respectively. Electrical conductivity value indicates the total concentration of ionized constituents of a water sample. As the soluble salts content controls the osmotic pressure of soil solution, highly saline soils reduce the water availability due to high osmotic pressure and also reduce the availability of other nutrients. It is closely related to the amount of total dissolved solids and is also used as an index of salt content of water. The highest electrical conductivity of 50.52 mS/cm and lowest of 1.45 mS/cm were observed at Shambhavi river of Hejamadi and Kadike location respectively.

Conclusion

The salinity and temperature of water were little more than desirable during April and May in Hoigegudda and Chitrapu locations. In general the water parameters of the source water are within the permissible limits. Hence the water of these sources is considered to be suitable for shrimp culture.

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