Comparison of Source, Pond and Discharge Water during Shrimp Culture along Udupi and Dakshina Kannada Districts of Karnataka State

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ABSTRACT

Productivity of a fish pond depends largely on the abundance of fish food organisms and also on occurrence of congenial environmental conditions in the pond. Presence of nutrients in adequate amounts in pond water is essential for successful aquaculture. The stress induced by poor water quality may result in reduced growth rates. Studies are carried out to compare the properties of source, pond and discharge water during shrimp culture along Udupi and Dakshina Kannada districts of Karnataka state. Water samples were collected and various parameters were measured. The results of water analysis from the source, culture ponds and discharge channels during culture showed an increase in values of most of the water quality parameters in the ponds and discharge channel as compared to intake water. All the water quality parameters were within the permissible range.

INTRODUCTION

World aquaculture grew rapidly during the past 50 years and it is continuing to expand. This growth is possible because of an increasing demand for fisheries products and failure of capture fisheries to keep pace with demand. It is doubtful that aquacultural production can continue to increase fast enough to meet the rising demand for fisheries products (Boyd, 1999). Karnataka has a coastal line of 300 km which is distributed among three districts namely Dakshina Kannada, Udupi and Uttara Kannada. The yield of living resources from any water body is closely related to the primary productivity of the water and maintenance of a healthy aquatic environment there by production of sufficient fish food organisms in ponds. Nutrient enrichment of pond water is an essential management practice in aquaculture (Boyd, 1990). Water quality analysis is an important tool in aquaculture pond management, because results of analyses indicate if water quality is suitable for aquacultural production or if the concentrations of certain variables are suboptimal. Once water quality inadequacies are recognized, treatments may be applied to mitigate them. Considering the importance of the water in the shrimp culture, its influence in the productivity of the shrimp and also its effect on adjacent soil and water, the present study is under taken.

MATERIALS AND METHODS

Dakshina Kannada and Udupi districts cover 74° 00' E to 75° 30' E Longitude and 12° 30' N to 15° 00' N Latitude. The locations selected for the study are Hoigegudda, Chitrapu, Moodahodu, Aarate, Pangalagudda and Garadimane Figures 1-2. Water

Fig. 1 : India and Karnataka

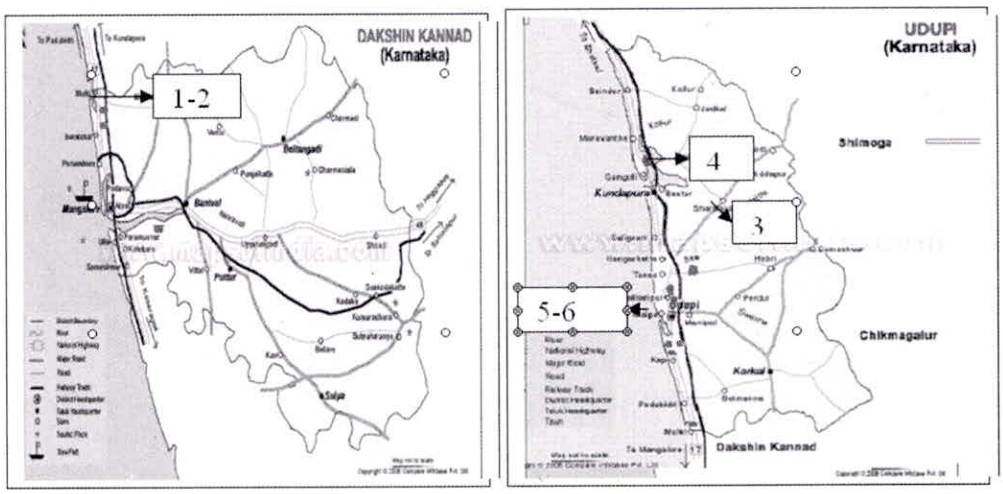

Fig. 2 : Dakshina Kannada and Udupi districts

(1-2 – Hoigegudda and Chitrapu location, 3- Moodahodu location 4- Aarate location, 5-6 Pangalagudda and Garadimane location)

samples are collected from the sources, ponds and outlet channels for the period from January to May 2007 every fortnight. The source of water for these ponds are Shambhavi river at Hoigegudda and Chitrapu locations, Seetha river at Moodahodu location, Kollure river at Aarate and Pavanje river at Pangalagudda and Garadimane locations. The discharge water samples are collected from the outlets after sixty days of commencement of the culture activity.

Water parameters *viz.,* temperature is measured in the field with digital thermometer, pH with pH meter (Eutech testr 30), electrical conductivity (E.C) and total dissolved solids (T.D.S) with water quality analyzer (ELICO PE-136) and dissolved oxygen with DO meter (Lovibond, Oxi 200). Digital Nephelo-turbidity meter (Systronics-132) is used to measure turbidity and salinity is measured with salinometer (Hach-sension 156).

RESULTS AND DISCUSSION

Comparison of Source and Pond Water

Water quality parameter of various sources and the ponds are shown in Figures 3-9. Water temperature plays a very important role in regulating the activities of cultured animals. It also helps in physiological properties like release of stimulii for breeding

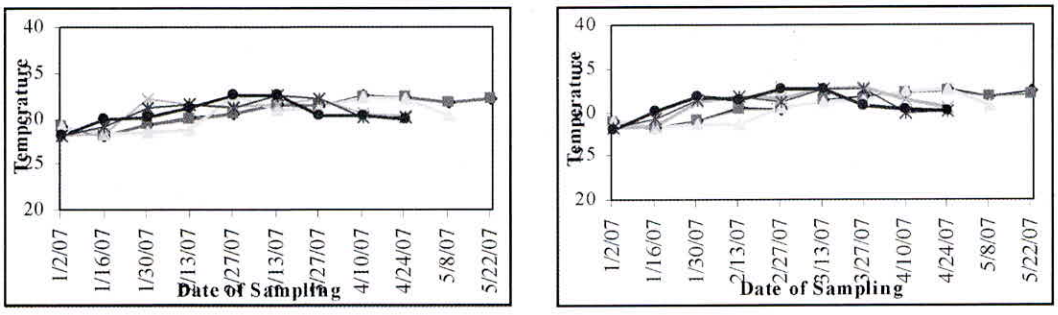

Fig. 3 : Changes in temperature of source and pond water

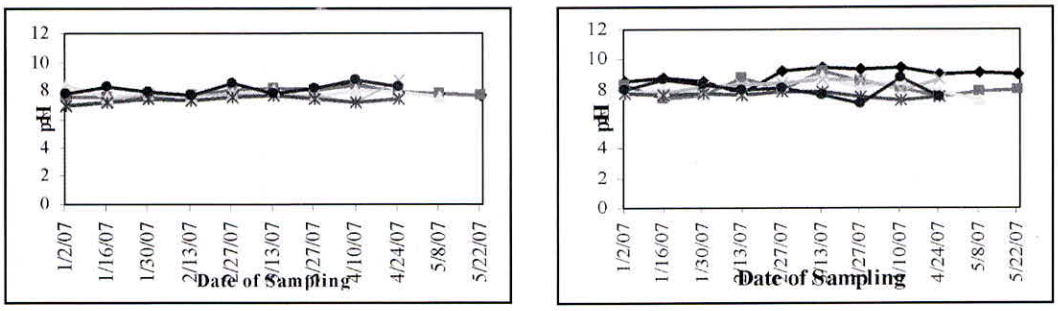

Fig. 4 : Changes in pH of source and pond water

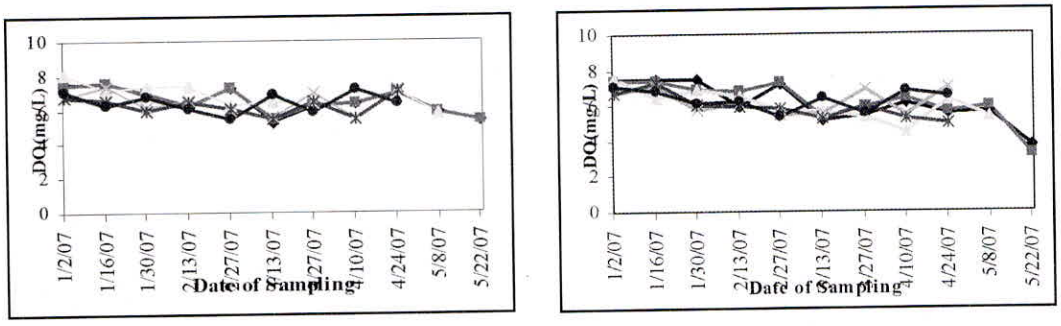

Fig. 5 : Changes in dissolved oxygen of source and pond water

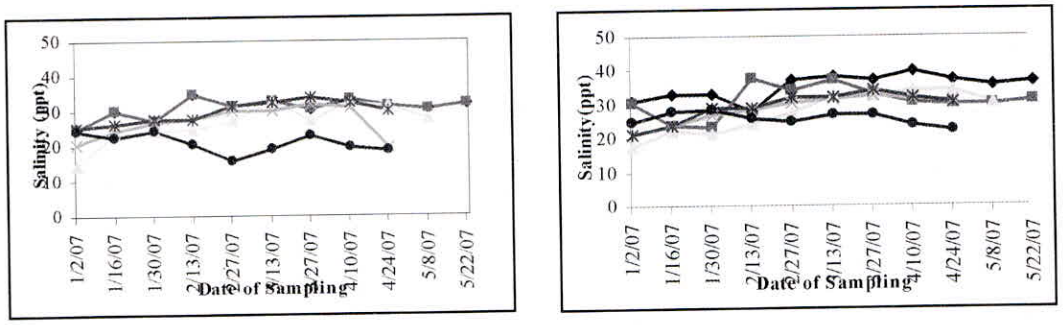

Fig. 6 : Changes in salinity of source and pond water

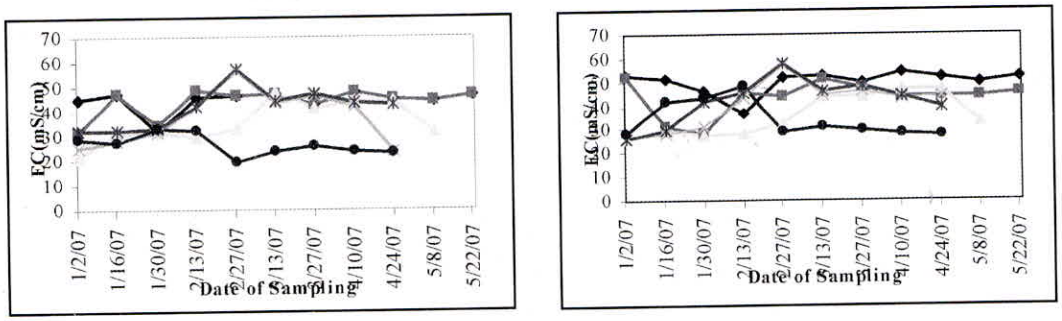

Fig. 7 : Changes in electrical conductivity of source and pond water

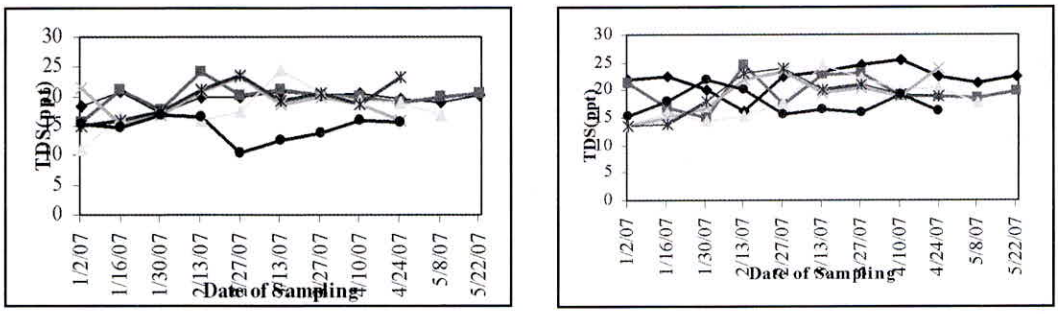

Fig. 8 : Changes in total dissolved solids of source and pond water

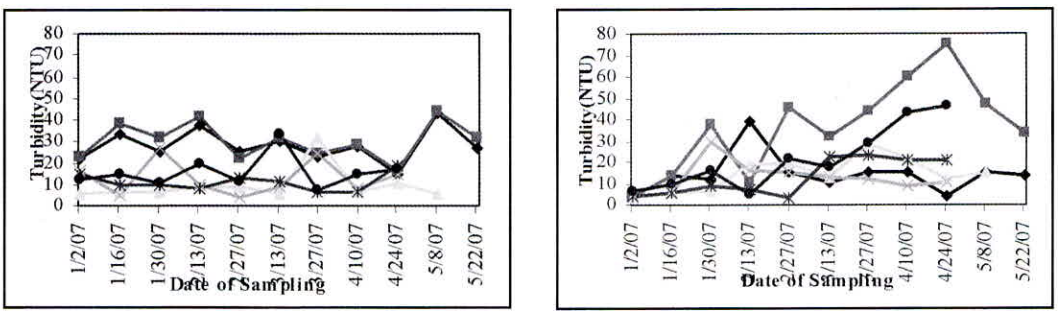

Fig. 9 : Changes in turbidity of source and pond water

mechanisms in fish, both under natural or artificial conditions (Hora, 1945).The highest temperature of source water is 32.6°C at Kollure river of Aarate and lowest of 28°C at Pavanje, Kollure and Shambhavi river of Pangalagudda, Aarate and Chitrapu locations were observed respectively. The temperature of source water increases during the culture period. The normal temperature required for brackishwater shrimp culture is 18°C to 32° C depending on species. The optimum level of temperature for most of the brackishwater *Penaeid* shrimp is 28°C to 32°C (C.I.B.A, 2001). The pH indicates acidic or basic nature of water. It is an index of the presence of metabolites, photosynthetic activity and the fertility of the pond water. The highest pH value of 8.73 and lowest of 7.02 is observed at Kollure river of Aarate and Pavanje river of Pangalagudda locations respectively. The normal range of pH required for brackishwater shrimp culture is 7-9. The pH should be in optimum level of 7.5 – 8.5 (C.I.B.A., 2001).The pH of the source water is almost uniform and within the desirable level during study period. The salinity ranges between 14.10 ppt and 34.8 ppt in the Seetha river at Moodahodu and Shambhavi river at Hoigegudda location respectively. The normal range of salinity required for brackishwater shrimp culture is 10-35 ppt. The optimum level of salinity required is 15-25 ppt (C.I.B.A., 2001). Dissolved oxygen concentration is a major factor which influences the survival and growth of *P. monodon* in culture ponds (Verghese, 1982). Among the chemical substances in natural waters,

oxygen is one of primary importance both as a regulator of metabolic process of plant and animal community and as an indicator of water condition. Hutchinson (1957) has aptly remarked that a series of oxygen determinations along with knowledge of turbidity and colour of water could provide more information about the nature of water than any other chemical data. The highest dissolved oxygen concentration of 8.08 mg/L and lowest of 5.3 mg/L are observed in the Seetha river at Moodahodu and Shambhavi river at Hoigegudda location respectively. Dissolved oxygen level should be maintained in the range of 3- 10 mg/L and the optimum level required for shrimp culture is 4 to 7 mg/L (C.I.B.A., 2001).

Electrical conductivity value indicates the total concentration of ionised constituents of a water sample. The highest electrical conductivity is 57.16 mS/cm and lowest being 19.41 mS/cm; the highest total dissolved solid of 24.40 ppt and lowest of 10.52 ppt are observed at Seetha river of Moodahodu and Kollure river of Aarate locations respectively. Total dissolved solids ranges from 15 to 25 ppt is considered as slight, 5 to 15 ppt as moderate and less than 5 ppt as severe (Hajek and Boyd, 1994).The salinity, electrical conductivity and TDS vary during the study period. The highest turbidity of 44.00 NTU and the lowest of 4.1 NTU are observed at Shambhavi river of Chitrapu and Pavanje river of Pangalagudda location. Hajek and Boyd, (1994) reported that turbidity ranges between 0 and 25 NTU is considered as slight, 25 and 100 NTU as moderate and more than 200 NTU as severe. Variation in turbidity of source water is observed during the period of study. All the above parameters of the source water are within the permissible limits.

The highest temperature of the pond water 32.8°C at Pangalagudda and the lowest of 28°C is observed at Chitrapu. Temperature of the pond water has increased as the culture period increases. No sharp peak was observed during the culture period and it has showed a seasonal variation up to 4.8°C. The highest pH value of 9.51 at Hoigegudda pond and the lowest of 7.01 is observed at Aarate pond. Because of rapid photosynthesis by phytoplankton, pond water can have pH values of 8.5 to 9.5 in the afternoon period. It should not vary more than 0.5 in a day. The highest value of salinity being 39.6 ppt and a minimum of 17.5 ppt at Hoigegudda and Moodahodu ponds are observed respectively. There is a gradual increase in the salinity of ponds water. In the brackishwater ponds, temperature, salinity and photosynthetic activity generally govern the dissolved oxygen concentration. The highest dissolved oxygen concentration of 7.53 mg/L at Moodahodu and lowest 3.2 mg/L at Chitrapu pond is observed. The decrease of dissolved oxygen level is observed among the ponds during culture. The highest electrical conductivity of 57.87 mS/cm at Garadimane pond and lowest of 25.86 mS/cm is observed at Pangalagudda pond. The highest total dissolved solid as 25.52 ppt at Hoigegudda pond and lowest of 13.42 ppt at Pangalagudda and Garadimane pond is observed. This also shows the similar trend as that of salinity and electrical conductivity of the pond water. The highest turbidity of 75.1 NTU at Chitrapu pond and minimum of 3.0 NTU at Moodahodu pond is observed.

Variation in turbidity among these ponds water is observed during culture period. Turbidity was rarely caused by plankton bloom because the water was renewed or diluted before any bloom formation in a fertilized pond could occur. Higher turbidity during monsoon months was due to high silt load of tidal water during this period as well as to the washings from the dykes by the rains.

Temperature of pond water remained higher during the study period when compared to source water. Wahab et al. (2001) reported that the temperatures of the inlets and out lets were always lower than that obtained inside. Higher temperature inside the ponds may be attributed to higher thermal conductivity of water due to lower water depth (Islam, 1998). The pH of pond water also more compared to the inlet water. It is due to photosynthesis activity by phytoplankton, accumulation of residual feed, dead algae and excreta during culture period. Chakraborthi et al. (1985) stated that many variations in pH usually do not occur in shrimp farms owing to the buffering capacity of brackish water. The salinity, electrical conductivity and total dissolved solids are also more in pond water compared to the source water. It is due to the evaporation and lower depth of pond water. Salinity, dissolved oxygen level and pH increased between source and effluent (Mc Intosh et al., 2003). Kaladharadan (1999) observed that the salinity, pH and hardness were highest in ponds, while these parameters in their inlets and out lets did not show much variation. Dissolved oxygen level in the pond water is less compared to the source water due to the consumption of oxygen from the aquatic animals and also decomposition of organic materials. According to Wahab et al. (2001), Mc Intosh et al. (2003) and Joseph (1995) dissolved oxygen level is always less in pond water compared to the source and outlet water. Turbidity is some times more in pond water compared to the source water because of the aerators used to increase the dissolved oxygen concentration in the pond water. But in some cases turbidity is less in most of the time compared to the source water which may be due to the aerators not being used.

COMPARISON OF POND AND DISCHARGE WATER

Water quality parameter of ponds and the discharge channels are given in Figures

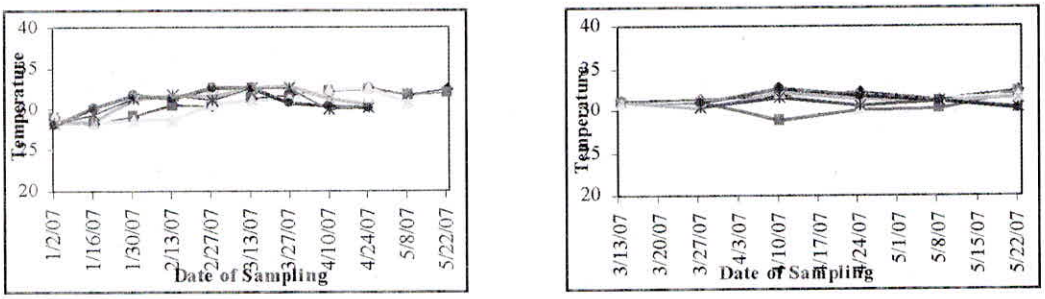

Fig. 10 : Changes in temperature of pond and discharge water

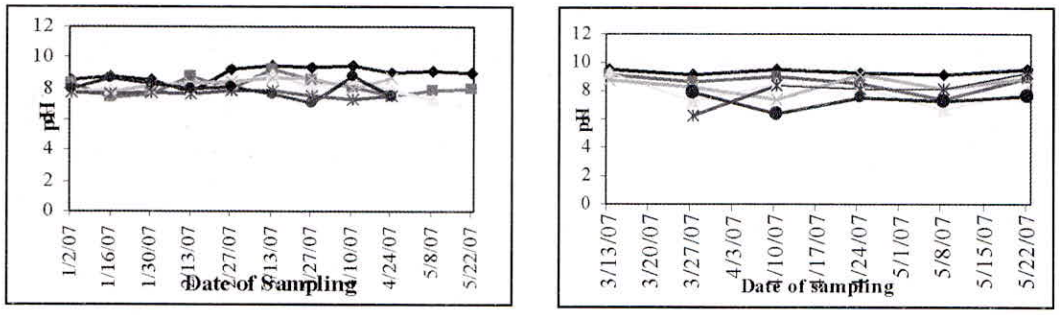

Fig. 11 : Changes in pH of pond and discharge water

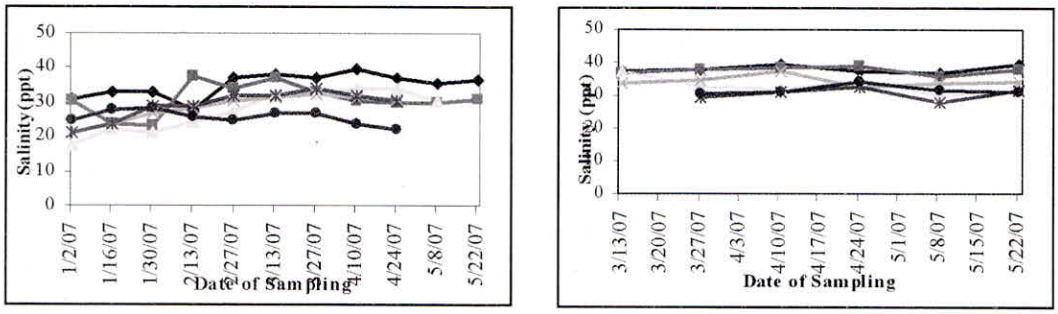

Fig. 12 : Changes in salinity of pond and discharge water

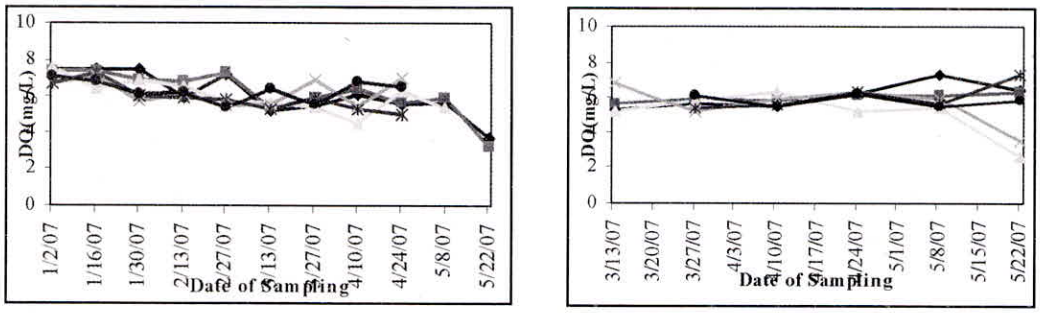

Fig. 13 : Changes in dissolved oxygen of pond and discharge water

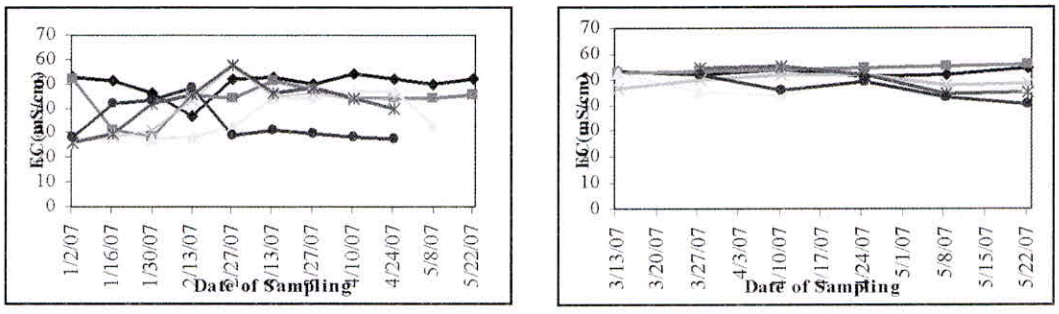

Fig. 14 : Changes in electrical conductivity of pond and discharge water

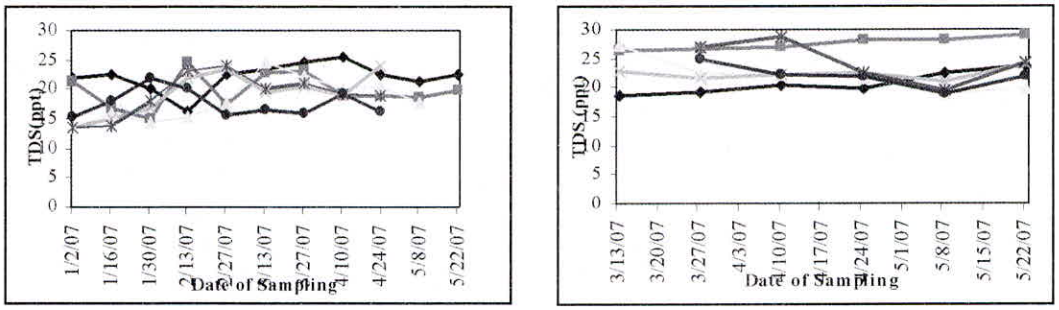

Fig. 15 : Changes in total dissolved solids of pond and discharge water

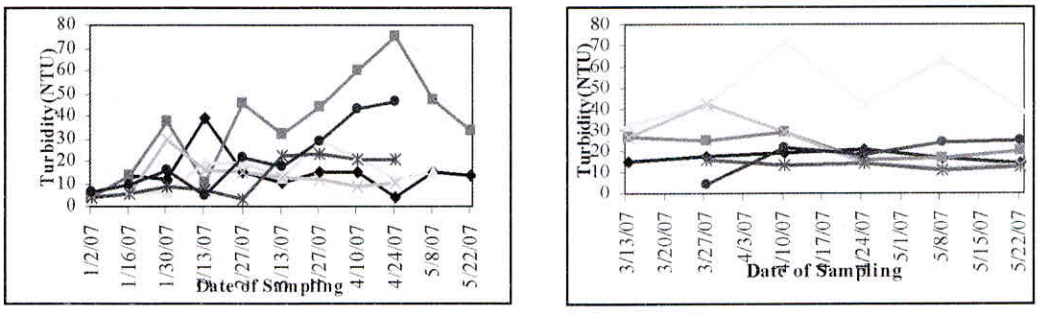

Fig. 16 : Changes in turbidity of pond and discharge water

10-16. In the present study the highest temperature of the discharge water is 32.6°C and the lowest 28.70°C is observed at Pangalagudda and Hoigegudda pond respectively. The higher and lower pH of 9.56 and 6.26 is observed at Hoigegudda and Pangalagudda pond discharge water respectively. The highest dissolved oxygen level of 7.32 mg/L and the lowest of 2.65 mg/L is observed at Hoigegudda and Chitrapu pond out going channel water respectively. The highest salinity of 39.4 ppt and lower of 27.8 ppt; the higher electrical conductivity of 56.10 mS/cm and lowest of 40.60 mS/cm are observed at Hoigegudda and Pangalagudda discharge water respectively. The highest total dissolved solids of 29.20 ppt and the lowest of 18.46 ppt is observed at Hoigegudda pond discharge water. The highest turbidity of 71.60 NTU and the lowest of 4.20 NTU is observed at Chitrapu and Pangalagudda pond discharge water respectively.

Comparing the temperature of the pond and discharge water it was found that temperature of pond water is almost high during most of the time. This may be due to heat exchange between the pond and the discharge water. The pH of pond water is normally more compared to the discharge water. Pond water pH is more due to photosynthesis activity by phytoplankton, accumulation of residual feed, dead algae and excreta during culture period. The salinity, electrical conductivity and total dissolved solids are found to be more during most of the period in discharge water compared to pond water. Dissolved oxygen level in the pond water is less compared to the discharge water in some period, due to the consumption of oxygen from the aquatic animals and also decomposition of organic materials. It is more in some period which may be due to the use of aerators during that period. The dissolved oxygen level is more during some period in discharge water may de due to absorption of oxygen content while releasing into discharge channel. Turbidity in pond water is less compared to the discharge water, due to the releasing of the water to out side it may erode the dykes and pond bed and become turbid. In the other ponds the turbidity level is more in pond water compared to the discharge water.

CONCLUSION

In the present study the results of water analysis from the source, culture ponds and discharge channels, it is observed that there was not much difference among source, pond and discharge water with regard to pH, temperature, salinity and dissolved oxygen. The variation of turbidity level is observed in pond and discharge water during culture. This may be indicative of the culture manipulations and management practices made within the ponds towards improving the shrimp production. Dissolved oxygen level in the pond water is less compared to the source and discharge water. All the water quality parameters were within the permissible range.

REFERENCES

1. Boyd, C. E. 1990. Water quality in ponds for aquaculture, Alabama Agricultural experiment station, Auburn University, Alabama, USA
2. Boyd, C. E. 1999. Aquaculture sustainability and environmental issues.World Aquaculture, 30 : 71-72
3. Chakraborthi, R.K., Ravichandran, P., Haider, D.D., Mandal, S.K and Sanfui.1985. Some physico- chemical characteristics of Kakdwip brackishwater ponds and their influence on the survival growth and production of *Penaeus monodon (Fabricius). Indian Journal of Fisheries*, 32 : 224-235
4. C.I.B.A., 2001. Soil and water quality management in brackishwater aquaculture. "Special publication number 13"pp 1-99
5. Hajek, B.F. and Boyd, C. E. 1994. Rating soil and water information for aquaculture, *Aquacultural Engineering*, 13: 115-128
6. Hora, S.L. 1945. Symposium on the factors influencing spawning of indian carps. Proc. Nat. Inst. Sci. India, 11 (3)
7. Hutchinson, G.E. 1957.A treatise on limnology. Geography, Physics and Chemistry, John Wiley and sons, Inc., Newyark
8. Islam, M.S., Aminul Islam, M., Alam, M.S and Reshma, B.Z. 1998. Effects of shrimp farming on physico- chemical qualities of water in some medium saline areas in greater Khulna district, *Bangladesh .J. Fish*, 21: 83-89
9. Joseph, K.O., Gupta, B.P., Alavandi, S.V., Mishra, S.S. and Sivakumar, G .1995. Impact of shrimp farming on the environment –A case study. *Proceedings of the National workshop on transfer of technology for sustainable shrimp farming* ,CIBA pp 127-134
10. Kaladharan, P., Nandakumar, A., Khambadkar, L.R and Selvaraj, G.S.D. 1999.Soil-water characteristics in certain shrimp farms along the coasts of Tamil Nadu and Pondicherry, India. *Journal of the Marine Biological Association of India,* **41** : 1-6
11. Mc Intosh, D and Fitzsimmons, K. 2003.Characterization of effluent from an inland, low salinity shrimp farm: what contribution could this water make if used for irrigation. *Aquacultural Engineering,* l27: 147-156
12. Verghese, P.V., Ravichandran, P. and Pillai, S.M. 1982. Growth and production of *Penaeus monodon* (Fabricius) in short term field rearing experiments. *Proc. Symp. Coastal. Aquaculture.*
13. Wahab, M.A., Bergheim, A., Braaten, B., Islam, M.S. and Rahman, M.M. 2001. Observation on some of the environmental parameters of selected shrimp farms in Khulna, Bangladesh, *Bangladesh Journal of Fisheries research,* 5: 75-84