Print ISSN: 0976-2876 Online ISSN: 2250-0138

Available online at: http://www.ijsr.in

INDIAN JOURNAL OF SCIENTIFIC RESEARCH

DOI:10.32606/IJSR.V13.I1.00007

Received: 22-02-2021 Accepted: 27-05-2022 Publication: 31-08-2022

Indian J.Sci.Res. 13 (1): 57-63, 2022 Original Research Article

A COMPREHENSIVE STUDY ON PHYSICOCHEMICAL PROPERTIES OF SEAWATER SAMPLE COLLECTED FROM THE SOUTHERN COASTAL AREAS OF TAMILNADU, INDIA

BABITA KUMARI[a], KOMAL SHARMA[b] AND ALKA KUMARI[c1]

[a]Department of Biotechnology, Sophitorium Institute of Technology and Life Skills, Khordha, Odisha, India

[bc]Department of Botany, Lucknow University, Lucknow, India

ABSTRACT

Seawater is essential to marine plants and animals to enhance water life hence it has been referred to as a universal solvent to complete the marine biota. The rapid growth of urban areas has adversely affected the seawater quality due to over exploitation of resources and improper waste disposal practices. In this study, the seawater samples were collected from sampling sites of Chennai, Rameshwaram, Kovalamand Mandapam areas of Tamilnadu Southeast Coast to analyzed to observe the fluctuations in the physicochemical studies during different climatic seasons. This study clearly demonstrated that the physicochemical parameters were critically influenced by geoclimatic factors and interference, interventions of humankind. Physico-chemical parameters such as pH, Alkalinity, Electrical conductivity, Total Dissolved Solids, Total Hardness, Calcium, Magnesium, Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, Fluoride, Chlorides, Nitrites, Ammonia, Phosphate, Trace metals like Iron and Manganese were analyzed and found variable along with seasonal changes. Present study also elucidates those three factors i.e. temperature, density and salinity influence the physico-chemical properties of sea water majorly.

KEYWORDS: Seawater, pH, TDS, Electrical conductivity, COD, BOD, Calcium, Magnesium, Sulphide, Fluoride

In earth, approximately 70% of biota covered by water. Water is considered as a significant impact to sustain life in worldwide concern. Literature survey showed that two-thirds of the human body is constituted of water. Seawater plays a dominant environment of these ecosystems. India is fortunate enough to be bestowed with a long coastline of about 5000 km and a fairly bright sunshine for about 6-9 months. The word “saline” is directly proportional to waters containing sodium chloride present in more than usual quantities. The rapid growth of population and technological and industrial boom has a toxic heavy element to be drain into the sea atmosphere. In course of time, Water gets contaminated with microbes through intestinal discharge of human and animals. It is to be noted that more than approximately 4000 toxic chemical contaminants of all kinds have been found in sea (John *et al.*, 1996, Mustafa *et al.*, 1985) Major constituents of the seawater are sodium chloride. Besides there, other salts such as $CaCO_3$, $CaSO_4$, $MgSO_4$, $MgCl_2$ and KCl are also present. There are a few constituents are iron oxide and magnesium carbonates. On the onset of Off shore waters of the oceans seems to havea salt concentration of approximate 30,000 to 36,000mg/lit of dissolved solids including 19,000 mg/lit of chloride,10,500mg/lit of sodium and 1270mg/lit of magnesium. Conceiving the important parameters, resulted the impact of study on the influence on the marine waters of Southeast Coast selected areas (Olaniva *et al.*, 1979, Duggal 2002, Elango *et al.*, 2003). The coastal regions in the Southeast coast of India are examples for the uncontrolled disposal of water and high pollution (Garg *et al.*, 1999, Ravikumar *et al.*, 2006, Strickland *et al.*, 1968) For the cooling of turbines, gallons of water are being siphoned in and the resulting warm water from the power plant is discharged into the river. The significance of the illustration of physicochemical parameters has been significantly approached by the related research work employed out along the Southeast coast. The selected region in this study seems to be highly polluted because of the discharge of the waste products/effluents into the water bodies, both by industries as well as by human beings. This resulted in alarming deterioration in the quality of the water. This is becoming a threat to the marine life. Thus, selected region was focused where a large number of industries and pilgrim’s population are located which also disposed their waste products into the water. Thus, in keeping mind of above problem, the selection of four ecologically polluted areas such as Chennai, Rameshwaram, Kovalam and Manadapam was chosen for physicochemical study.

[1]**Corresponding author**

MATERIALS AND METHODS

The water samples were collected from 4 areas of coastal sites of Southern areas of Tamilnadu, such as Chennai, Rameshwaram, Mandapam and Kovalam areas in January 2011 for physico-chemical studies. Seawater samples were collected in 1 litre pre-cleaned and sterilized bottles with necessary precautions. For measurement of other physico-chemical parameters, samples were brought to the laboratory. The pH was measured using pH meter. Dissolved oxygen was determined by Winkler's method. Chloride and salinity were estimated by Harvey's titration method. Free carbondioxide, alkalinity and hardness were analyzed as per standard procedure

SAMPLING SITES

Survey and Collection of Sample

A regular survey was taken around the coastal areas of South India. Chennai, Rameshwaram, Mandapam and Kovalam were chosen for collection of samples in the year 2011.

Collection of Sample

The samples were collected during low tide.

Rameshwaram Coast: The tide of Rameshwaram coast (9º14`N, 79º14`E) was high, having rocky seashore areas. There a major Lord Siva Temple called Rameshwaram Temple. This is one of the major Lord Siva Temples in India. This temple is in the center of town, right next to the sea (Fig. 1)

Mandapam Coast: During collection of material, the tide of (Lat. 78º11' to 79º15' E ; Lat. 8º49' to 9º15') coast was low. A few kilometer distance apart, there is Pamban bridge connected to Rameshwaram (Fig. 2).

Kovalamcoast: Kovalam is situated on the Southwest coast of Kerala about 5 km from Quilon town and lies between 8053'-8 057' North Latitude and 76032'–76034' East Longitude. The coast is rocky consisting of large granite boulders and interspersed with small sandy beaches ((Fig. 3).

Chennai is a large city and the south neighboring city of Tamilnadu State, the capital of Indian state of Tamil Nadu. It is a wonderful and very beautiful city located on Latitude13° 0' 12.1932" N and 80° 15' 18.1548" E (Fig. 4).

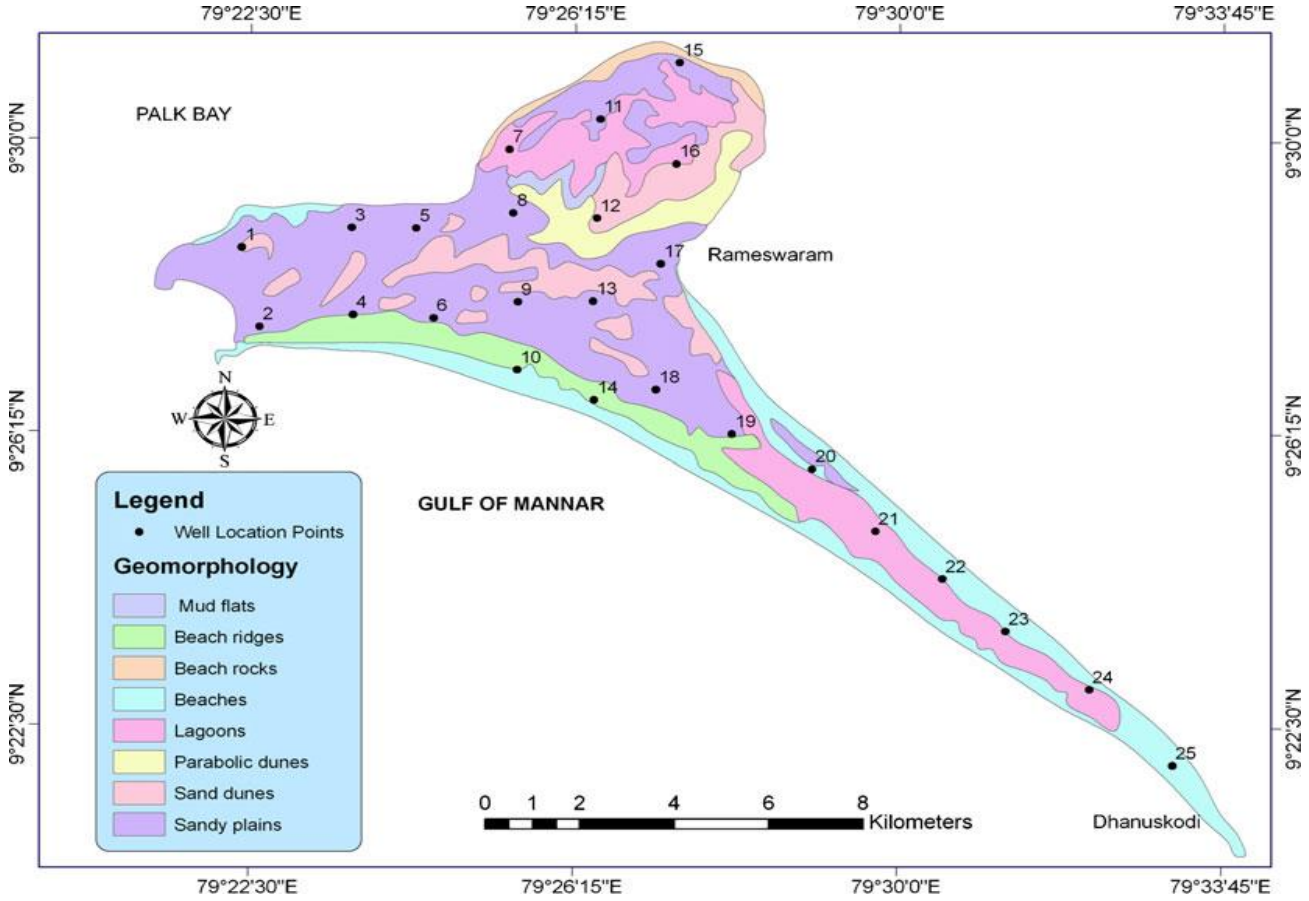

Figure 1: Map Showing the region of sample collection from Rameshwaram

Figure 2: Map Showing the sample collection site of Mandapam

Figure 3: Map Showing the sample collection site of Kovalam

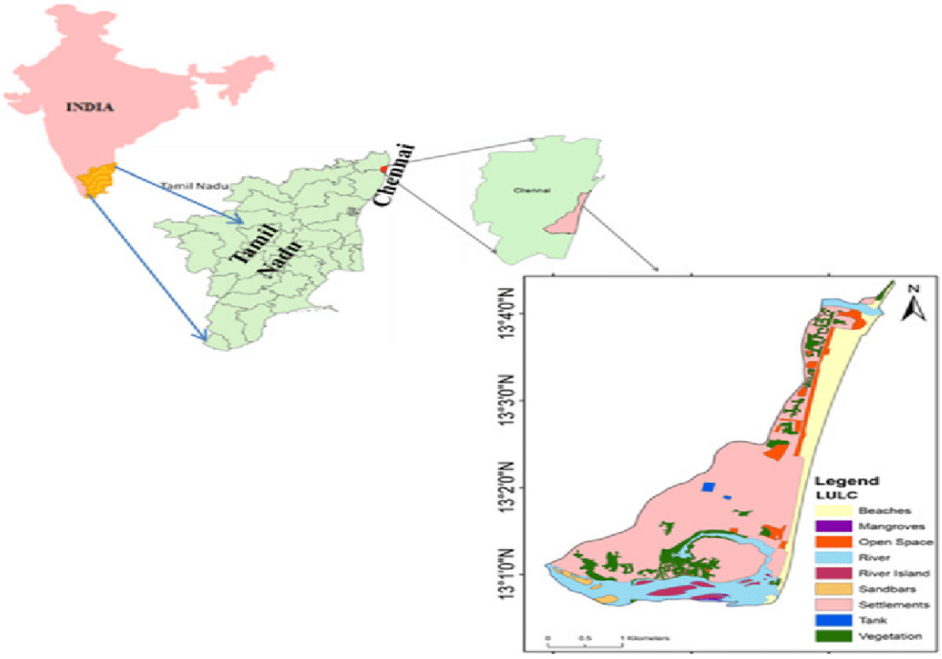

Figure 4: Map Showing the sample collection site of Chennai

RESULTS AND DISCUSSION

The aim of the present study is to determine the extent of seawater around the Southern coastal area of Tamilnadu by taking water samples from the seashore. The results of physico-chemical analysis of the overall result of Physicochemical study was shown in Table 1. In chemistry, pH, historically denoting "potential of hydrogen" is a scale used to specify the acidity or basicity of an aqueous solution. Acidic solutions are measured to have lower pH values than basic or alkaline solutions (APH, 1975). The results reveal that pH values of all the samples vary from 7.3 to 7.9. These values are within the permissible limit of 6.5 to 9.2. Rameshwaram has recorded high pH, TDS, Electrical conductivity, Alkalinity, Calcium, Sulphate, in comparison to Mandapam, Kovalam and Chennai. TDS in drinking-water originate from natural sources, sewage, urban run-off, industrial wastewater, and chemicals used in the water treatment process, and the nature of the piping or hardware used to convey the water, i.e., the plumbing. In the United States, elevated TDS has been due to natural environmental features such as mineral springs, carbonate deposits, salt deposits, and sea water intrusion, but other sources may include: salts used for road de-icing, anti-skid materials, drinking water treatment chemicals, stormwater, and agricultural runoff, as well as point/non-point wastewater discharges (Harish *et al.*, 2004). TDS in all the water samples exceed the permissible limit. In TDS analysis of seawater, samples are slightly higher than the permissible limit. Rameswaram has got excellent approach of TDS. Total hardness of water samples are beyond the permissible limits according to ICMR i.e.300 µmho/l. The electrical conductivity of all the water samples exceeded the domestic water standards of 300µmho/cm. These high values of electrical conductivity may be due to the high concentration of ionic constituents present in the water bodies and sea water intrusion (Jeyakumar *et al.*, 2003). So, these water samples cannot be used for drinking purposes. The alkalinity values are much less than the values of total hardness, neutral salts of calcium or magnesium such as sulphates and chlorides may be present because of the intrusion of sea water. The chemical determination of oxygen concentrations in seawater is based on the method first proposed and modified by Strickland *et al.*, 1968. Oxygen in the water sample oxidizes iodide ion (I-) to iodine (I2) quantitatively. The amount of iodine generated is then determined by titration with a standard thiosulfate (S2O3 -2) solution. The endpoint is determined by using starch as a visual indicator. The amount of oxygen can then be computed from the titer: one mole of O2 reacts with four moles of thiosulfate (Jain *et al.*, 2003). The DO permissible limit for all the domestic purposes is 4-6 ppms. The observed values for the seawater samples lies above the permissible limit. The higher the values of DO mean the rate of oxygen replenishment in seawater is greater than the oxygen utilization. This is healthy for almost all aqueous lives. Several literature surveys on COD done.

The WHO permissible limit for COD is 10mg/l for domestic water. COD values in the collected samples of seawater samples slightly exceed the permissible limit and the value is high. This may be due to the discharge of the chemicals from the industry situated nearby coastal areas. Most of the water samples have high calcium concentration and magnesium concentration of most of the samples lie within the permissible limits i.e. 75mg/l for calcium and 50 mg/l for magnesium. The chloride concentration of most of the water samples exceed the limit of 250 mg/l. These higher concentrations of chloride may be due to the intrusion of sea water, brines, sewages or industrial effluents such as those from paper works, galvanizing plants, water softening plants and petroleum refineries. Sulphate concentration in the study area is found to vary from 55 to 370 mg/l recorded highest in Rameshwaram in contrast to Kovalam, Mandapam and Chennai. A high amount of sulphate imparts a bitter taste to the water and it also causes gastric intestinal irritation. The permissible limit for fluoride concentration is 1 to 1.5 mg/l. This indicates that desirability of fluoridation of water supply to prevent the dental decay in children. All the water samples have the fluoride content less than 2 mg/l. So, all the water samples cause dental fluorosis and skeletal fluorosis. The Nitrates are the end products of the aerobic stabilization of organic nitrogen and occur generally in high levels in some seawater. Even though there are many chemical fertilizer-manufacturing plants are near the study area, all the water samples lay within the permissible limit ranges from 1 to 14 mg/l. This may be due to their cycling of effluents discharged from the industries. The ammonia content present in seawater samples should not exceed 0.05 mg/l. This may be due to the pollution of water with sewage because sewage is rich in ammonia. The present study shown higher concentration in Kovalam than Rameswaram in contrast to Mandapam and Chennai (Table 2 and 3).

On the contrary to the water sample collected from Chennai, Rameshwaram, Mandapam and Kovalam respectively. Throughout the sampling period, all the samples were slightly alkaline. Among the samples, the highest COD analysis, Chennai was observed with samples followed by Kovalam, Mandapam and

Rameshwaram. However, in order to higher Biological Oxygen Demand studies, Maximum fluctuations were observed in Rameshwaram more with stable pH. This data shows clearly that there is a cyclic sequence of variation of pH with the season throughout the year.

Table 1: Parameters of Physico-chemical characteristics of sea water in winter/spring season

Parameters	Chennai	Rameshwaram	Kovalam	Mandapam
Temperature ºC	22	21	20	18
Salinity (mg. L^{-1})	13	12	13	11
Density (kg/m3)	856	891	844	879
pH	7.1	7.5	7.2	7.4
Electrical conductivity (µS/m)	500	300	250	350
TDS (mg. L^{-1})	600	988	780	850
Alkalinity (mg val. L^{-1})	200	320	220	300
Total Hardness (mg Ca.L^{-1})	300	480	320	500
Calcium (mg. L^{-1})	75	100	85	95
Magnesium (mg. L^{-1})	50	45	35	55
Sulphate (mg. L^{-1})	200	370	300	280
Fluoride (mg. L^{-1})	1.3	1.0	0.7	1.0
Nitrate (mg. L^{-1})	45	65	75	60
Dissolve Oxygen (mg. L^{-1})	1.9	1.5	1.4	1.6
COD (mg. L^{-1})	4.0	1.0	1.7	1.6
BOD (mg. L^{-1})	10	20	11	17

Table 2: Parameters of Physico-chemical characteristics of sea water in summer season

Parameters	Chennai	Rameshwaram	Kovalam	Mandapam
Temperature ºC	27	28	27	27
Salinity (mg. L^{-1})	25	23	24	22
Density (kg/m3)	979	1011	997	985
pH	6.9	6.7	6.5	6.6
Electrical conductivity (µS/m)	500	300	250	350
TDS (mg. L^{-1})	600	988	780	850
Alkalinity (mg val. L^{-1})	200	320	220	300
Total Hardness (mg Ca.L^{-1})	300	480	320	500
Calcium (mg. L^{-1})	75	100	85	95
Magnesium (mg. L^{-1})	50	45	35	55
Sulphate (mg. L^{-1})	200	370	300	280
Fluoride (mg. L^{-1})	1.3	1.0	0.7	1.0
Nitrate (mg. L^{-1})	45	65	75	60
Dissolve Oxygen (mg. L^{-1})	1.9	1.5	1.4	1.6
COD (mg. L^{-1})	4.0	1.0	1.7	1.6
BOD (mg. L^{-1})	10	20	11	17

Table 3: Parameters of Physico-chemical characteristics of sea water in rainy season

Parameters	Chennai	Rameshwaram	Kovalam	Mandapam
Temperature ºC	24	25	23	24
Salinity (mg. L^{-1})	33	38	35	37
Density (kg/m3)	1025	1028	1023	1021
pH	5.6	5.7	5.5	5.6
Electrical conductivity (µS/m)	500	300	250	350
TDS (mg. L^{-1})	600	988	780	850

Alkalinity (mg val. L^{-1})	200	320	220	300
Total Hardness (mg Ca.L^{-1})	300	480	320	500
Calcium (mg. L^{-1})	75	100	85	95
Magnesium (mg. L^{-1})	50	45	35	55
Sulphate (mg. L^{-1})	200	370	300	280
Fluoride (mg. L^{-1})	1.3	1.0	0.7	1.0
Nitrate (mg. L^{-1})	45	65	75	60
Dissolve Oxygen (mg. L^{-1})	1.9	1.5	1.4	1.6
COD (mg. L^{-1})	4.0	1.0	1.7	1.6
BOD (mg. L^{-1})	10	20	11	17

CONCLUSION

The results revealed that seasonal changes greatly influence the physico-chemical properties of marine water. Three major factors i.e., temperature, salinity and density determine all the parameters of physico-chemical characteristics of the sea water. There is a cyclic sequence of variation in the physicochemical parameters with the different seasons of the sampling period. The parameters are proved to have, variations in the pH directly related to the seasonal changes irrespective of the sampling sites. Salinity affects density significantly when in the polar areas if the ocean. Some of the water with the highest density in the world is cold water that has a high salinity. Temperature and salinity, along with the density of the water varies with depth. **Temperature is** most important factor in affecting the density of the seawater which is inversely proportional to density.

ACKNOWLEDGEMENTS

The authors are thankful to the native people who helped during sampling of ocean water and the first author is thankful to DST, New Delhi for financial support under WOS-A scheme.

REFERENCES

APHA, 1975. Standard methods for the examination of water and waste water, APHA Inc., New York: 1193.

Duggal K.N., 2002. Elements of Environmental Engineering. S.Chand and Company Ltd., New Delhi.

Elango L., Sureshkumar S. and Rajmohan N., 2003. Hydrochemical studies of ground water in Chengalpet Region, Ind. J. Env. Prot., **23**(6): 624–632.

Garg V.K., Chaudhary A., Deepshikha K. and Dahiya S., 1999. An Appraisal of Groundwater Quality in some villages of District Jind, Ind. J. Env. Prot., **19**(4): 267–272.

Harish Babu K., Puttaiah E.T., Vijayakumar T. and Shashi Shekar T.R., 2004. Evaluation of Ground water Quality in Tarikere Taluk, Ind. J. Env. Prot., **24**(9): 684–688.

JeyakumarT., Indira S. and ThillaiArasu P., 2003. Status of Ground Water Quality and Public Health aroundTiruchendur, Ind.J.Env. Prot., **23**: 256-260.

Jain C.K., Bhatia K.K.S., Kumar C.P. and Purandara B.K., 2003. Ground water Quality in Malaprabha Sub-basin, Karnataka, Ind. J. Env. Prot., **23**(3): 321–329.

John H. and Jada B.D., 1996. Holy Places and Temples of India, Spiritual Guides, Practical Travel, New Delhi.

Kataria H.C., Iqbal S.A. and Shandilya A.K., 1996. Limno-chemical studies of Tawa Reservoir, Ind. J. Env. Prot., **16**(11): 841–846.

Mustafa S. and Ahmad Z., 1985. Environmental factors and Planktonic Communities of Baigal and Nanaksagar reservoirs, Nainital, J. Bombay Nat. Hist. Soc., **82**(1): 13–23.

Olaniya M.S., Sharma H.C. and Saxena K.L., 1979. Turbidity and bacterial removal from tank water during natural filtration, The Symposium on Environmental Biology, Muzaffarnagar, Proceedings, pp.419–428.

Ravikumar M., Manjappa S., Kiran B.R., Puttaiah E.T. and Patel A.N., 2006, Physicochemical characterization of Neelgunda Tank Near Harapanahalli, Davanagere, Ind. J. Env. Prot., **26**(2): 125–128.

Ramamurthy N., Subashini J. and Raju S., 2005. Physico-Chemical properties of Palar River in Tamilnadu, Ind. J. Env. Prot., **25**(10): 925–928.

Strickland J.D.H. and Parsons T.R., 1968. Determination of dissolved oxygen. in A Practical Handbook of Seawater Analysis. Fisheries Research Board of Canada, Bulletin, **167**: 71–75.

Shanmugha Prasad C.K. and UmayoruBhagan V., 2004. Physico-chemical characteristics of underground water in Nagercoil Town (South), Ind. J. Env. Prot., **24**(1): 53–56.

Sharma B.K. and Haur K., 1994. Water Pollution, Goel Publishing House, Krishna Prakasam media (P) Ltd., Meerut.