ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 9, Issue, 6(G), pp. 27702-27706, June, 2018

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

THE INVESTIGATION OF SOME PHYSICO-CHEMICAL PARAMETERS IN MARINE ONSHORE AND OFFSHORE WATER AT KULASEKARANPATTINAM, THOOTHUKUDI DISTRICT, INDIA

Esther Isabella Eucharista F*

Zoology Department, Aditanar College of Art's & Science, Tiruchendur

DOI: http://dx.doi.org/10.24327/ijrsr.2018.0906.2314

ARTICLE INFO

Article History:

Received 15th March, 2018
Received in revised form 25th April, 2018
Accepted 23rd May, 2018
Published online 28th June, 2018

Key Words:

Physico-chemical parameters; onshore; offshore and Kulasekaranpattinam.

ABSTRACT

Our work is a contribution to assessing the health of the marine ecosystem of Kulasekaranpattinam, which is not yet studied .Two samplings campaigns were conducted during January- March 2018 in onshore and offshore. Kulasekaranpattinam is a very good tourist place in Tamil Nadu. A systematic study has been carried out to analyze the physic-chemical characters through the standard protocol suggested by APHA. Statistical analyses such as Pearson correlation matrix and Regression analysis were performed to the data set to know the relationship among the studied parameters. pH and nitrate were maximum in the onshore, while the parameters such as turbidity, salinity and phosphate were maximum in the offshore. Our study highlighted the strengthening of the surveillance of the coast in the framework of a monitoring strategy and effective protection on the marine ecosystem.

INTRODUCTION

Water is the dominant environment of these ecosystems Ponnusamy Thillai Arasu and Arumugam Murugan (2013). Physico-chemical and micro-biological characteristics may describe the quality of water (Tivedi Priyanka *et al*. 2009). In the near shore waters and estuaries, exhibit considerable seasonal variations depending on the local conditions of rain fall, tidal incursions, various abiotic and biotic processes, quantum of fresh water inflow affecting the nutrient cycle in the coastal environments Tiwari *et al* (1993). Coastal water is one of the nation's most important natural resources, valued for their ecological richness as well as for the many human activities they support Mack *et al* (2006). Sea water resources are considered to be one of the major components of environmental resources that are under threat either from over exploitation or pollution, caused by human activities (Efe 2001). Coastal area is the most dynamic and productive ecosystems and are also foci of human settlements, industry and tourism (Xiaojun 2008). In order to protect the aquatic life community, comprehensive methods for identifying and assessing the physic-chemical parameters was carried out on marine water onshore and offshore at kulasekaranpattinam.

Objectives of the Study

The main objectives of this current study are;

- To assess the physico-chemical parameters of the marine water at kulasekaranpattinam.
- To determine the standard deviation.
- To estimate Pearson correlation matrix of the sea water.
- To evaluate the regression analysis.

METHODOLOGY

Study Area

The study area is geographically located in the southern part of Thoothukudi district lying between latitude 8˚4′N and longitude 78˚06′8″ E in Tamil Nadu, India (Figure-1). Kulasekaranpattinam was an ancient port dating to the 1st centuries of the Christian era and was contemporaneous to the existence of Kollam, Cheranport, and another Pandyan port. Kollam served the pandyas on the West coast while kulasekaranpattinam served them on the east coast connecting them to Ceylon and the pearl fisheries in the Gulf of Mannar facing the Thoothukudi coast. It is a very good tourist place in Tamil Nadu. Kulasekaranpattinam the name is derived from Pandyan ruler Maravarman Kulasekara Pandiyan I. In this coastal village a famous festival known as Dasara which is

Corresponding author:* **Esther Isabella Eucharista F
Zoology Department, Aditanar College of Art's & Science, Tiruchendur

celebrated with pomp at the Mutharaman temple in a grand scale every year during October. This temple is nearly 300 years old. Folk artistes from all over the state converge here to participate in the 10days Dasara festival. The village is located along the Kulasekaranpattinam in the east coast of south Tamil Nadu. This small fishing village in Thoothukudi district is known for its fishery resources. Kulasekaranpattinam coast connects the Tiruchendur coast which is in the north east and Manapadu coast which is in the south east, further it drains into the Bay of Bengal. There is an estuary namely Karumeni which confluence between Manapadu coast and Kulasekaranpattinam coast.

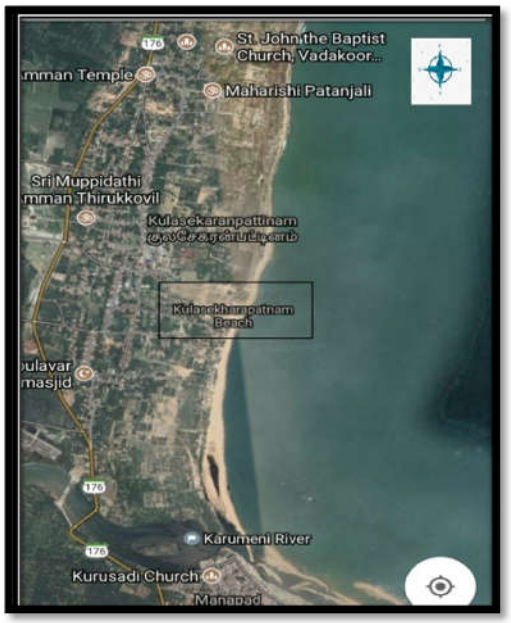

Figure 1 Satellite map showing the location of kulasekaranpattinam Coastal area

Mode of Sampling

Marine water was sampled monthly in onshore and offshore from January 2018 to March 2018. Sampling was usually carried out between the hours of 6.00 A.M to 8.00 A.M. The onshore was located farther from the seashore coast of about 2m. The average depth of the onshore is 0.5m. The offshore was situated far away from the coastline of about 15Km. The average depth of the offshore is 25m. Water samples were collected in 1 litre high density polyethylene plastic vials pre-treated with 4M HNO_3 and properly rinsed with de-ionized water followed by doubly distilled water before use. After the collection they were immediately kept in ice box and transported to the laboratory for determining the physical and chemical parameters.

Physico- chemical characteristics of seawater were assessed through the standard protocol suggested by APHA (2005). The P^H was measured by using HACH portable P^H meter. Turbidity was estimated by Turbidimeter. Salinity was estimated by digital Refractometer. Inorganic Phosphate and Nitrate was analyzed by UV Spectrophotometer.

Figure-2 The process of collection of onshore water samples

Figure 3 The process of collection of offshore water samples

Statistical Analysis

The results for the physico-chemical analysis, mentioned above, are represented by the Mean (Mean ± SD). Pearson correlation analysis and Regression were also performed to find out relationship between various physico- chemical parameters of onshore and offshore, Kulasekaranpattinam. All Statistical analysis were carried out using Microsoft excel version 2007.

RESULTS AND DISCUSSIONS

P^h

Onshore site pH was varied from 7.1 ± 0.492 to 7.5 ± 0.397.The higher mean concentrations were recorded as 7.5 ± 0.397 during March 2018 (Figure-4) and lower mean concentrations were recorded as 7.1 ± 0.492 during January 2018.

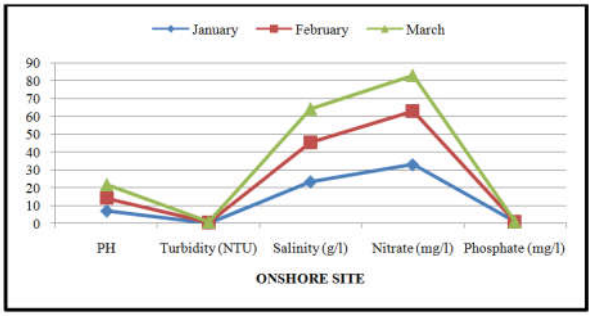

Figure 4 Monthly Variations in Physico-Chemical Characteristics of Onshore water from Kulasekaranpattinam coast

The onshore water samples however indicated positive correlation between pH and turbidity (r=0.114) and while highly significant

negative correlation was observed between pH and Salinity (r=-0.980) ($p<0.01$), pH and NO_3 (r=-0.994) ($p<0.01$) and while negative correlation was observed pH and PO_4 (r=-0.565) (Table-1). The offshore water samples however indicated highly significant negative correlation was observed between pH and turbidity (r=-1) ($p<0.01$), pH and Salinity (r=-0.980) ($p<0.01$) and pH and NO_3 (r=-1) ($p<0.01$) while negative correlation was observed between pH and PO_4 (r=-0.668).

Table 1 Pearson correlation matrix of physico-chemical parameters of onshore water

Parameters	p^H	Turbidity	Salinity	Nitrate	Phosphate
p^H	1				
Turbidity	0.114	1			
Salinity	-0.980*	-0.305	1		
Nitrate	-0.994**	-0.220	0.996**	1	
Phosphate	-0.565	-0.884*	0.715	0.650	1

**Correlation is highly significant at the 0.01 level *Correlation is significant at the 0.05 level

The highest pH concentration reported in the onshore indicated the presence of organic acid, biological processes (Photosynthesis and respiration) and physical processes (turbulence and aeration), which can alter concentration of dissolved carbon dioxide that affect pH level in the seawater. Similar literature was available by Sunday Akinde and Omokaro Obire (2011).

Regression analysis in the onshore indicated that there is a highly significant relationship between different pairs of parameters except pH and Nitrate (pH=6.073+0.039 NO_3) had a significant relationship during the month of January (Table-2).

Table 2 Regression Equations for different water quality variables during January in the onshore

Pairs of parameters	a	b	Regression equation (Y=a+bX)	R^2	P-Value	F-value
pH-Turb	7.29	-0.5	pH=7.29-0.5Turb	0.025	0.001**	0.079
pH-Sal	10.928	-0.161	pH=10.928-.161Sal	0.875	0.001**	21.040
pH-NO_3	6.071	0.039	pH=6.073+0.039 NO_3	0.161	0.023*	0.578
pH-PO_4	6.747	0.751	pH=6.747+0.751PO_4	0.135	0.001**	0.471
Turb-Sal	-0.329	0.026	Turb=-0.329+0.026 Sal	0.234	0.651*	0.921
Turb-NO_3	0.706	-0.015	Turb=0.706-0.015NO_3	0.227	0.205*	0.884
Turb-PO_4	0.235	0.124	Turb=0.235+0.124PO_4	0.035	0.343*	0.111
Sal-NO_3	30.980	-0.281	Sal=30.980-0.281NO_3	0.240	0.029*	0.947
Sal-PO_4	24.689	-2.375	Sal=24.689-2.375PO_4	0.040	0.007**	0.126
NO_3-PO_4	19.021	14.900	NO_3=19.021+14.900PO_4	0.525	0.025*	3.317

* indicates significance at the 1% level ** indicates highly significance at 5% level

During the month of February it is noticed there is a highly significant relationship between different pairs of parameters except pH and Salinity (pH=0.470+0.298sal) (Table-3) had a significant relationship.

Table 3 Regression Equations for different water quality variables during February in the onshore

Pairs of parameters	a	b	Regression equation (Y=a+bX)	R^2	P-Value	F-value
pH-Turb	6.382	1.011	pH=6.382+1.011 Turb	0.294	0.001**	1.251
pH-Sal	0.470	0.298	pH=0.470+0.298Sal	0.922	0.697*	35.639
pH-NO_3	7.652	-0.024	pH=7.652-0.024 NO_3	0.055	0.014**	0.175
pH-PO_4	7.709	-7.226	pH=7.709-7.226 PO_4	0.254	0.001**	1.026
Turb-Sal	-1.965	0.118	Turb=-1.947+0.117Sal	0.506	0.278*	3.075
Turb-NO_3	1.448	-0.032	Turb=1.484-0.032 NO_3	0.354	0.111*	1.644
Turb-PO_4	1.082	-4.726	Turb=1.084-4.726 PO_4	0.379	0.049*	1.832
Sal-NO_3	25.588	-0.139	Sal=25.588-0.139NO_3	0.177	0.010**	0.645
Sal-PO_4	24.189	-23.287	Sal=22.189-23 .28PO_4	0.255	0.001**	1.027
NO_3-PO_4	29.212	-36.301	NO_3=29.212-36.301PO_4	0.067	0.030*	0.218

* indicates significance at the 1% level
** indicates highly significance at 5% level

During the study period March observed that there is a highly significant relationship between different pairs of parameters except the pair such as pH-Salinity (pH=7.771-0.038sal) and pH-Nitrate (pH=5.568+0.076 NO_3) (Table-4) had a significant relationship.

Table 4 Regression Equations for different water quality variables during March in the onshore

Pairs of parameters	a	b	Regression equation (Y=a+bX)	R^2	P-Value	F-value
pH-Turb	7.142	-0.164	pH=7.142-0.16 Turb	0.016	0.001**	0.050
pH-Sal	7.771	-0.038	pH=7.771-0.038Sal	0.046	0.027*	0.146
pH-NO_3	5.568	0.076	pH=5.568+0.076 NO_3	0.286	0.025*	1.202
pH-PO_4	5.965	10.75	pH=5.965+10.75PO_4	0.731	0.001**	8.169
Turb-Sal	0.907	0.081	Turb=0.907+0.081Sal	0.330	0.523*	1.482
Turb-NO_3	-0.614	0.064	Turb=-0.614+0.064NO_3	0.328	0.592*	1.464
Turb-PO_4	0.395	2.25	Turb=-0.395+2.25 PO_4	0.052	0.541*	0.165
Sal-NO_3	15.414	0.176	Sal=15.414+0.176NO_3	0.049	0.173*	0.156
Sal-PO_4	18.315	4.972	Sal=18.315+4.972PO_4	0.005	0.021*	0.015
NO_3-PO_4	11.45	77.5	NO_3=11.45+77.5 PO_4	0.780	0.018**	10.638

* indicates significance at the 1% level ** indicates highly significance at 5% level

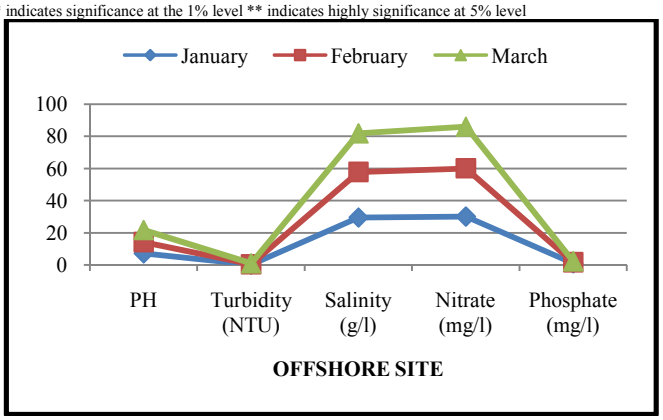

Figure 5 Monthly Variations in Physico- Chemical characteristics of Offshore water from Kulasekaranpattinam coast

Offshore site was varied from 7.1 ± 0.266 to 7.4 ± 0.549. The higher mean concentration was recorded as 7.4 ± 0.549 during March 2018 and lower mean concentration was recorded as 7.1 ± 0.266 during January 2018 (Figure-5).

Regression analysis in the offshore indicated that there is a highly significant relationship occurred in all the pairs of parameters during the month of January (Table-5).

Table 5 Regression Equations for different water quality variables during January in the offshore

Pairs of parameters	a	b	Regression equation (Y=a+bX)	R^2	P-Value	F-value
pH-Turb	7	-0.4	pH=7-0.4Turb	0.048	0.000**	0.153
pH-Sal	5.637	0.053	pH=5.637+0.053Sal	0.723	0.001**	7.842
pH-NO_3	9.197	-0.068	pH=9.197-0.068NO_3	0.906	0.000**	28.919
pH-PO_4	8.571	-1.616	pH=8.571-1.616PO_4	0.743	0.001**	8.684
Turb-Sal	0.834	-0.019	Turb=0.832-0.019Sal	0.308	0.171*	1.337
Turb-NO_3	-0.132	0.014	Turb=-0.132+0.014NO_3	0.128	0.852*	0.444
Turb-PO_4	0.261	0.042	Turb=0.261+0.042PO_4	0.001	0.662*	0.005
Sal-NO_3	60.358	-1.089	Sal=60.358-1.089NO_3	0.916	0.001**	32.830
Sal-PO_4	48.513	-23.513	Sal=48.513-23.513PO_4	0.633	0.013**	5.190
NO_3-PO_4	8.905	23.713	NO_3=8.905+23.713PO_4	0.835	0.205*	15.210

* indicates significance at the 1% level ** indicates highly significance at 5% level

During the investigation in the month of February revealed there is a highly significant relationship between different pairs of parameters except pH and Salinity (pH=4.622+0.076sal) (Table-6) had a significant relationship.

Table 6 Regression Equations for different water quality variables during February in the offshore

Pairs of parameters	a	b	Regression equation (Y=a+bX)	R^2	P-Value	F-value
pH-Turb	7.202	-0.825	pH=7.202-0.825Turb	0.294	0.000**	1.253
pH-Sal	4.622	0.076	pH=4.622+0.076Sal	0.109	0.285*	0.370
pH-NO_3	4.693	0.069	pH=4.693+0.069NO_3	0.655	0.013**	5.700
pH-PO_4	7.932	-1.386	pH=7.932-1.386PO_4	0.301	0.004**	1.292
Turb-Sal	1.507	-0.035	Turb=1.507-0.035Sal	0.054	0.577*	0.174
Turb-NO_3	0.548	-0.001	Turb=0.548-0.001NO_3	0.001	0.618*	0.002
Turb-PO_4	-0.855	1.645	Turb=-0.855+1.645PO_4	0.979	0.005**	140.20
Sal-NO_3	22.762	0.184	Sal=22.762+ 0.184NO_3	0.245	0.027*	0.977
Sal-PO_4	29.410	-1.318	Sal=29.410-1.318PO_4	0.014	0.011**	0.044
NO_3-PO_4	30.701	-0.608	NO_3=30.701-0.608PO_4	0.000	0.118*	0.001

* indicates significance at the 1% level
** indicates highly significance at 5% level

During the study period March observed there is a highly significant relationship between pH and Phosphate (pH=9.153-3.527PO_4) (Table-7) where as the remaining pairs of parameters exhibited significant relationship.

Table 7 Regression Equations for different water quality variables during March in the offshore

Pairs of parameters	a	b	Regression equation (Y=a+bX)	R^2	P-Value	F-value
pH-Turb	7.616	-1.359	pH=7.616-1.359Turb	0.723	4.331*	7.884
pH-Sal	5.454	0.072	pH=5.454+0.072Sal	0.091	0.188*	0.303
pH-NO_3	9.544	-0.091	pH=9.544-0.091NO_3	0.146	0.060*	0.516
pH-PO_4	9.153	-3.527	pH=9.153-3.527PO_4	0.822	0.000**	13.945
Turb-Sal	-0.523	0.033	Turb=-0.523+0.033Sal	0.049	0.815*	0.157
Turb-NO_3	2.243	0.099	Turb=2.243+0.099NO_3	0.446	0.263*	2.417
Turb-PO_4	-0.877	2.134	Turb=-0.877+2.134PO_4	0.769	0.103*	9.993
Sal-NO_3	7.818	0.652	Sal=7.818+0.652NO_3	0.426	0.533*	2.232
Sal-PO_4	24.355	0.081	Sal=24.355+0.081PO_4	0.497	0.019**	7.493
NO_3-PO_4	18.992	11.692	NO_3=18.992+11.692PO_4	0.515	0.014**	3.187

* indicates significance at the 1% level
** indicates highly significance at 5% level

Turbidity

Onshore turbidity was varied from 0.2 ± 0.158 NTU to 0.4 ± 0.207 NTU. The higher mean concentration was recorded as 0.4 ± 0.207 NTU during February 2018 and lower mean concentration was recorded as 0.2 ± 0.158 NTU during January 2018. The onshore water samples indicated significant negative correlation was observed between turbidity and PO4 (r=-0.884) ($p<0.05$) and while negative correlation was observed turbidity and Salinity (r=-0.305), turbidity and NO_3 (r=-0.220).

Offshore site was varied from 0.2±0.158 NTU to 0.5±0.325 NTU. The higher mean concentration was recorded as 0.5±0.325 NTU during March 2018 and lower mean concentration was recorded as 0.2 ± 0.158 NTU during January 2018.The offshore water samples however indicated highly significant positive correlation was observed between Turbidity and Salinity (r=1) ($p<0.01$), Turbidity and NO_3 (r=0.981) ($p<0.01$) and while positive correlation was observed between Turbidity and PO_4 (r=0.669) (Table-8).

Table 8 Pearson correlation matrix of physico-chemical parameters of offshore water

Parameters	P^H	Turbidity	Salinity	Nitrate	Phosphate
pH	1				
Turbidity	-1	1			
Salinity	-0.980**	1	1		
Nitrate	-1**	0.981**	0.981**	1	
Phosphate	-0.669	0.669	0.802	0.669	1

**Correlation is highly significant at the 0.01 level *Correlation is significant at the 0.05 level

Presence of high turbidity in the offshore indicated the presence of colloidal particles arising from high riverine sediment lodes adversely affect; the coastal area., by increasing water turbidity when reduces the light penetration, the primary production, then the secondary and tertiary biological production, including fish and the sedimentation. Similarly reported by Ajibare Adefemi Olatayo 2014.

The regression analysis revealed that during the study period Turbidity exhibited a significant relationship between all the pairs of parameters in both the onshore and offshore.

Salinity

Onshore salinity was varied from 18.813± 2.205 g/l to 23.45±2.854 g/l. The higher mean concentration was recorded as 23.45 ±2.854 g/l during January 2018 and lower mean concentration was recorded as 18.813 ± 2.205 g/l during March 2018.

The onshore water samples however indicated highly significant positive correlation was observed between salinity and NO_3 (r=0.996) ($p<0.01$) and while positive correlation was observed salinity and PO_4 (r=0.715).

The recorded higher values could be attributed higher rate of evaporation and also due to neritic water dominance. Observations just like to present study were reportable earlier by Palpandi 2011 in Vellar estuary. Available literatures were made by Balasubramanian and Kannan, 2005; Sridhar *et al* 2006.

Regression analysis in the onshore indicated that there is a highly significant relationship between salinity and Phosphate and significant relationship between Salinity and Nitrate during the month of January. During February it exhibited highly significant relationship and during March revealed significant relationship between different pairs of parameters.

Offshore was varied from 24.00±2.429 g/l to 29.45±4.510 g/l. The higher mean concentration was recorded as 29.45±4.510 g/l during January 2018 and lower mean concentration was recorded as 24.00± 2.429 g/l during March 2018.

The offshore water sample however indicated highly significant positive correlation was observed between salinity and NO_3 (r=0.981) ($p<0.01$) and while positive correlation was observed salinity and PO_4 (r=0.802).

Regression analysis in the offshore indicated that there is a significant relationship between different pairs of parameters during the month of January. During the month of February and March it is noticed that there is a significant relationship between salinity and phosphate and significant relationship between salinity and nitrate.

Nitrate

Onshore Nitrate was varied from 20± 2.774 mg/l to 33±4.969 mg/l. The higher mean concentration was recorded as 33±4.969 mg/l during January 2018 and lower mean concentration was recorded as 20 ±2.774 mg/l during March 2018. The onshore water samples indicated significant positive correlation between NO_3 and PO_4 (r=0.650).

Regression analysis in the onshore indicated that there is a highly significant relationship between Nitrate and Phosphate

during March while in January and February indicated significant relationship.

Offshore Nitrate was varied from 26±2.302 mg/l to 30±3.962 mg/l. The higher mean concentration was recorded as 30±3.962 mg/l during January 2018 and lower mean concentration was recorded as 26± 2.302 mg/l during March 2018. The onshore water samples indicated significant positive correlation between NO_3 and PO_4 (r=0.669).

Regression analysis in the offshore indicated that there is a highly significant relationship between Nitrate and Phosphate during March while in January and February indicated significant relationship.

During the study period the higher value of nitrate may be due to enrichment of terogenous deposit of mineralization through evaporation and organic decomposition from the high freshwater inflow. Available literature as observed by Janet *et al*, 1987.

Phosphate

Onshore site Phosphate was varied from 0.1± 0.027mg/l to 0.81±0.241 mg/l. The higher mean concentration was recorded as 0.81±0.241 mg/l during January 2018 and lower mean concentration was recorded as 0.1 ±0.027 mg/l during February 2018.

Offshore Phosphate was varied from 0.56± 0.141 mg/l to 0.97±0.152 mg/l. The higher mean concentration was recorded as 0.97±0.152 mg/l during January 2018 and lower mean concentration was recorded as 0.56±0.141 mg/l during March 2018.

Higher phosphate value was observed during January in the offshore might have resulted from the regeneration of phosphate from the bottom mud and subsequent release of the same in water column by turbulence and mixing caused by heavy winds. Observations just like to present study as reportable earlier by Rajasegar 2003 in Tuticorin seawater.

CONCLUSION

The fisheries activities were carried out in the region and it was known that the physical and chemical properties are important for the food chain in the aquatic environment. The estimation of the physico chemical parameters will support the studies such as primary and secondary productivity of both the onshore and offshore. The mean values recorded for all the parameters could support aquatic life. However there is a need for regular physico- chemical parameters monitoring in view of the importance of fish production in Kulasekaranpattinam.

Recommendations

- Coordination between the governmental and private institutions and academic programs in scientific research directing scientific research at academic institutions to improve beach monitoring programs and the sea water quality.
- Pass a law to protect the marine environment and punishing those who contribute to the spoil the marine ecosystem.
- Direct national investment to ensure quality and protect the marine environment.

References

1. Ponnusamy Thillai Arasu and Arumugam Murugan (2013). Physico Chemical Study On The Sea Water Intrusion In Tuticorin Coastal Area. *International Journal of ChemTech Research CODEN(USA): IJCRGG ISSN : 0974-4290 Vol.5, No.4, pp 1824-1828*
2. Trivedi Priyanka, Bajpai Amita and Thareja Sukarma (2009), 'Evaluation of Water Quality: PhysicoChemical characteristics of Ganga river at Kanpur by using correlation study', *Nature and Science 1(6), pp 91-94*.
3. Tiwari L.R. and Nair V.R (1993) 'Zooplankton composition in Dharamtar creek adjoining Bombay harbor' *Indian Journal Marine Science, Vol.22, pp. 63-69*.
4. Mack J.J. Micacchion M. (2006) "An ecological assessment of Ohio mitigation banks: Vegetation, amphibians, hydrology, and soils. Ohio EPA Technical Report WET/2006-1. Columbus OH: Ohio Environmental Protection Agency.
5. Efe S.T. (2001) 'Urban warming in Nigerian cities' *The case of warri metropolis, African Journal Environment Studies, 2(2) pp. 6.*
6. Xiaojun Y. (2008) 'Remote sensing and GIS for Coastal Ecosystem Assessment and Management' *ISPRS J. Photogra. Remote Sens, Vol.63 No.5, pp. 485-487*.
7. Sunday Akindei B. and Omokaro Obire (2011) 'In-situ Physico-chemical properties of the Deep Atlantic Ocean Water column and their implications on Heterotrophic Bacterial Distribution in the Gulf of Guinea' *Advances in Applied Science Research, Vol. 2, No. 6 pp. 470-482.*
8. Ajibare Adefemi Olatayo (2014), 'Assessment of Physico-chemical parameters of waters in Ilaje Local Government Area of Ondo state, Nigeria' *International Journal of Fisheries and Aquatic Studies, Vol. 1, No.5, pp. 84-92.*
9. APHA (2005). Standard methods for examination of water wastewater, American Public Health Association, New York.
10. Palpandi. P (2011). "Hydro biological parameters, pollution density and distribution pattern in the gastropod Nerita (dostia) crepidularia Lamark, 1822, from mangroves of Vellar estuary, southeast India", *Int. Biodivers. Conserved*, *vol. 3 (4), pp. 121-130*.
11. Balasubramanian.R and Kannan.L(2005). "Physico-chemical characteristics of the coral reef environs of the Gulf of Mannar Biosphere Reserve", India*, Int. j. Ecol. Environ. Sci., vol. 31, pp. 265-271.*
12. Sridhar R. Thangaradjou T. Senthil Kumar S. Kannan L. (2006) *Journal Environmental Biology, Vol.27, pp. 561-566.*
13. Rajasegar, M. (2003). Physico – Chemical characteristics of the Vellar estuary in relation to shrimp P. Sampathkumar *et al., IJSIT, 2015, 4(1), 001-014 IJSIT, Volume 4, Issue 1, January-February 2015 13 farming. J. Environ. Biol., 24, 95-101.*

****