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PHYSICO-CHEMICAL VARIATIONS IN BAY OF BENGAL COASTAL WATERS, SOUTH EAST COAST OF INDIA

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Abstract - The present investigation carried out to assess the monthly variations of physico-chemical parameters were studied at different stations of the Bay of Bengal coastal waters during December 2015 to March 2016. Monthly variations of the physico-chemical parameters investigated were as follows Surface water Temperature (^{0}C), Turbidity (NTU), Salinity (‰) , pH, EC (dsm^{-1}), BOD (mg/l) and COD (mg/l) values ranged from 24-32 (S1), 23-30 (S2), 22-29 (S3); 10-50 (S1), 15- 65 (S2), 10-30 (S3); 20-29 (S1),18-26 (S2), 17-25 (S3); 7.49-7.84 (S1), 7.46-7.82 (S2), 7.48-7.76 (S3); 2.15-2.46 (S1), 2.13-2.45 (S2), 2.22-2.45 (S3); 119-146 (S1), 118-145 (S2), 117-142 (S3); 75-93 (S1), 72-87 (S2), 72-86 (S3). Electrical conductivity showed very narrow changes between 2.13 to 2.46 dsm^{-1} in all the three stations as well as months. The inorganic nutrient such as Sulphate (mg/l), Phosphate (mg/l), Silicate (mg/l), and Nitrate (mg/l) values ranged from 112-148 (S1), 112-129 (S2), 109-128 (S3); 0.02-0.08 (S1), 0.02-0.06 (S2), 0.02-0.04 (S3); 2.59-5.42 (S1), 2.58-5.36 (S2), 2.54-5.32 (S3); 1.24-4.35 (S1), 1.06-3.15 (S2), 0.59-2.1 (S3) was respectively. The physico-chemical parameters such as temperature, pH, BOD and EC were increased during Post-Monsoon season. In contrast, an increase in turbidity, TDS, COD and nutrients (sulphate, phosphate, silicate and nitrate) were observed during Monsoon season. The physico-chemical properties have exposed reasonable seasonal and spatial variations.

Keywords: Physico-chemical parameters, Nutrients, Season, Cuddalore, Pondicherry, Parangipettai, Bay of Bengal, East coast of India

1. INTRODUCTION

Water is very essential for all living being. It is available in different forms in our environment. Without the knowledge of water quality, it is difficult to understand the biological phenomenon fully, because the chemistry of water reveals much about the metabolism of the ecosystem and explain the general hydro biological interrelationship. The physico-chemical parameters of water and the dependence of all life process of these factors make it desirable to take water as an environment. The entire life of the world depends going on water and therefore the hydrological study is very greatly essential to comprehend the relationship among its diverse tropic levels and food webs (Soundarapandian *et al*., 2009). Maintenance of good water quality is essential for the survival of aquatic communities in the coastland and wetland environments (Padhi, M. and S. Padhi, 1999). Coastal marine environments are reported to have greater biodiversity than open ocean regions and majority of world's most productive marine ecosystems are found within coastal environments and owe their productivity, diversity and wealth of life to their terrestrial adjacency (Bierman *et al*., 2009). Therefore marine water quality plays a vital role in the conservation of marine resources, which give to the stability of the marine ecosystem. Generally Marine surroundings could be an advanced system and chiefly influenced by numerous Physico-chemical and organic process. The open ocean is a lot of stable compare to the close to shore waters wherever the interaction with terrestrial and makes the variations in hydro graphic properties. The water quality depends on each natural processes, like precipitation, erosion, weathering of crustal materials and evolution processes like urbanization, industrialization, mining and agricultural activities.

Coastal water has become a major concern because of its values for socioeconomic development and human health. With the growth of human populations and commercial industries, marine water has received large amounts of pollution from a spread of sources such as recreation, fish culture, bathroom flushing and the assimilation and transport of pollution effluents (Zhou *et al*. 2007). Human activities have already negatively influenced water quality and aquatic ecosystem functions. Physico-chemical parameters are accountable for the spatiotemporal variations of all aquatic organisms. The interactive physical, chemical, and biological processes operation in the coastal ecosystems sustain higher resulting in richness in diversity. The amount of nutrients determines the potential fertility of the water masses and thus it is necessary to collect several data regarding their distribution and behaviour in many coastal ecosystem. It is essential to

grasp the interrelationships between the organism and performance of the coastal ecosystem. The Physico-chemical characteristics has been carried out by many researchers (Rajesh *et al*., 2002, Rajasekar *et al*., 2005; Sridhar *et al*., 2006; Anilakumary *et al*., 2007, Pradhan *et al*., 2009, Damotharan *et al*., 2010, Prasanna and Ranjan, 2010). The Coastal ecosystem is the vibrant host for fauna and flora and it is the most important resource to provide a good platform for the coastal life. There are various sources which are responsible to change the biodiversity of the coastal ecosystem. The modern urbanization is the root cause for the coastal water pollution [A. K. Sinha *et al*., 1992]. In India the coastal zone is more significant because of renewable and non-renewable natural resources discharge of waste effluents and also polluted by municipal sewage, industries and of recreational activities. Henceforth, the protection of the coastal environment and continuous monitoring is needed. The Physico-chemical parameters, which is useful to evaluate the health of the coastal system. Hence the present study was conducted to study the Physico - chemical properties of water in some place of southeast coast of Tamil Nadu, during December 2015 to March 2016.

2. MATERIALS AND METHODS

2.1 Descriptions of study area

The study area consists of three different locations (S1) Cuddalore (Lat. 11° 42'31" N and Long. 79° 47'80" E) is found on the five fathom line within the close to shore waters of the Bay of geographical area at Cuddalore fishing harbour and is concerning 2km far from the Cuddalore harbour, (S2) Pondicherry (Lat. 11° 90' 63"N and Long. 79° 83'83" E) the Union Territory of Pondicherry incorporates an outline of 45 kms, stretching on the Bay of geographical area and (S3) Parangipettai (Lat. 11° 30'79" N and Long. 79° 47''92" E) is found on the five fathom line within the close to shore waters of the Bay of geographical area at Parangipettai and is concerning 2 km far from the mouth of Vellar estuary. Water samples were collected from the three stations for a period of four months during December 2015 to march 2016.The sampling location shown in a fig -1. Samples were collected every month with a sterilized plastic bottle and immediately kept in an ice box and transported to the laboratory for determining the physical and chemical parameters. The temperature was measured using a standard mercury centigrade thermometer and the measurement of pH was made on a portable pen pH meter. The physico - chemical parameters such as water temperature, turbidity, total dissolved solids, pH, electrical conductivity, biological oxygen demand, chemical oxygen demand, sulphates, phosphate, silicate, and nitrate were analyzed by following standard methods prescribed by APHA 1998.

2.2 Statistical Analysis

The data are obtained statistically analyzed mean ± standard Deviation. All the data were analyzed statistically applying for all the studied parameters.

3. RESULT AND DICUSSION

3.1 Temperature

The temperature was basically important for its effects on the chemistry and biological activities of organisms in water. The coastal water temperature varied between 24 to 32 ^{0}C , 23 to 30 ^{0}C and 22 to 29 ^{0}C was respectively at the three stations minimum, maximum mean values of 27.25±3.94 ^{0}C , 26±2.94 ^{0}C and 25.5±2.88 ^{0}C (Fig. 1). The maximum temperature was recorded in station 1 during March, Post-monsoon season and minimum was recorded in station 3 during December, Monsoon season. Less solar radiations with misty sky and moderate rainfall during the Monsoon season may greatly reduce the water temperature (Karuppasamy *et al*., 1999). Similar observations have been previously reported by Anandhan (1995) and Prabhar (2000). The gradual increase in water temperature is directly related to atmospheric conduction and radiation (Sundaramanickam (2004) and Ganesan (1992)).

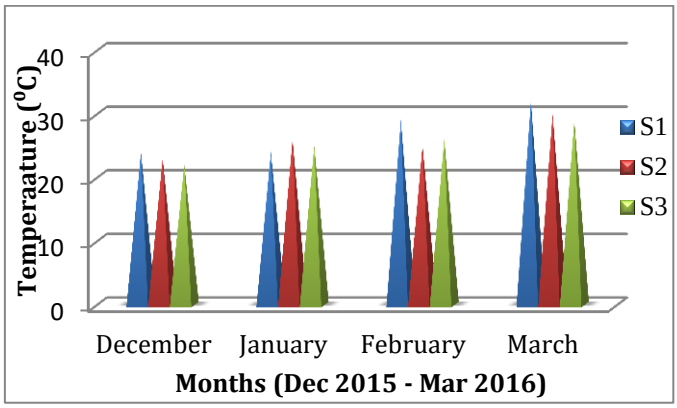

Fig - 1: Monthly variations of Surface Water temperature in three stations

3.2 Turbidity

Turbidity could be a measure of water clarity what quantity the fabric suspended in water decreases the passage of Sunshine through the water. In the present study water turbidity varied between 10-50 NTU, 15-65 NTU and 10-30 NTU was respectively at the three stations minimum, maximum mean values of 23.75±17.96, 28.75±24.28 and 17.5±9.57 NTU (Fig. 2). The maximum turbidity was recorded in station 2 during December, Monsoon season and the minimum was observed in station 3 during the month of February and March, Post-monsoon season. This study agreement with previous studies (Saravana kumar *et al*., 2008).The results supported by Garg *et al* (2010) Medudhula *et al*., (2012) have also reported high turbidity during rainy season. During rainy season silt, clay and other suspended particles contribute to the turbidity values, while during winter and summer seasons settlement of silt, clay results low turbidity.

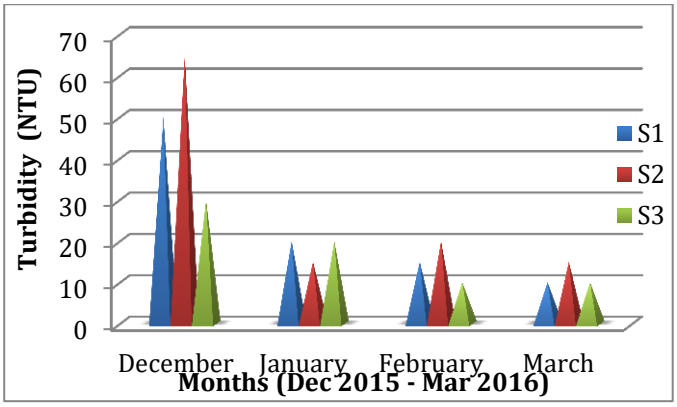

Fig - 2: Monthly variations of turbidity in three stations

3.3 Salinity

The salinity act as a vital factor among the most earnest environmental parameters in the distribution of living organisms. Fluctuations in salinity affect fauna of the coastal areas and determine the succession of species. The monthly variation of observed salinity values are ranged between 20-29‰, 18-26‰ and 17-25‰ was respectively at the three stations minimum, maximum mean values of 23.75±3.86‰, 21.25±3.40‰ and 20.25±3.40‰ (Fig. 3). The maximum salinity was recorded in station 1 during March, Post-monsoon season and the minimum was recorded in station 3 during December, Monsoon season. The ascertained higher values might be attributed to the low quantity of rainfall, higher rate of evaporation and additionally as a result of neritic water dominance (Balasubramanian and Kannan, 2005; Sridhar *et al*., 2006).Observations just like to present study were reportable earlier by Palpandi (2011) in Vellar estuary.

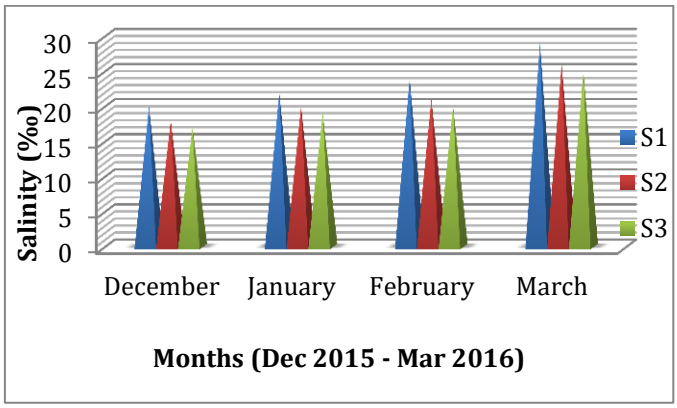

Fig – 3: Monthly variations of Salinity in three stations

3.4 pH

The pH value depends upon the salinity and temperature of the water and the climatic conditions present in that area. The chemical and biological condition of water also places a role in the control of pH concentrations. Water pH was recorded more or less similar in all the stations as well as months. The pH for the water samples varied between 7.49 to 7.84, 7.46 to 7.82 and 7.48 to 7.76 was respectively at the three stations minimum, maximum mean values of 7.65±0.15, 7.62±0.158 and 7.59±0.129 (Fig. 4).The maximum value was recorded in station1 during March, Post-monsoon season and the minimum was recorded in station 3 during December, Monsoon season. The low pH observed during the month of November to January may be due to the influence of fresh water, dilution of seawater, low temperature and organic matter decomposition as suggested by Ganesan (1992). Similar result was already reported by Palpandi (2011), Santhanam and Perumal (2003) in Vellar estuary and Ananthan (1994) from Pondicherry.

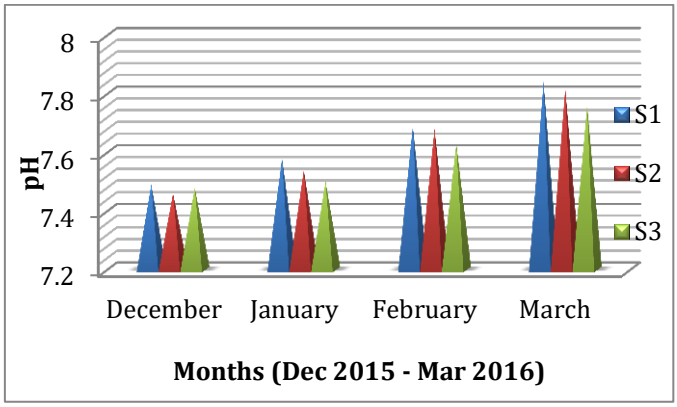

Fig – 4: Monthly variations of pH in three stations

3.5 Electrical Conductivity

The electrical conductivity shows seasonal variation with respect to different study sites. It chiefly depends on the amount of dissolved solids in water. The conductivity of water is affected by the suspended impurities and also depends up on the amount of ions in the water. In the present study the electrical conductivity was showed very narrow changes in all stations as well as months. The EC values varied between 2.15 to 2.46 dsm^{-1}, 2.13 to 2.45 dsm^{-1} and 2.22 to 2.45 dsm-^{1}with minimum and maximum values of 2.31±0.13 dsm^{-1}, 2.29 ± 0.134 dsm^{-1} and 2.35 ± 0.098dsm^{-1} (Fig. 5). The maximum value was recorded in station 1 during March, Post-monsoon season and the minimum in station 2 during December, Monsoon season. The present study agrees with earlier reported by (Surana Ranjana *et al.*, 2013).

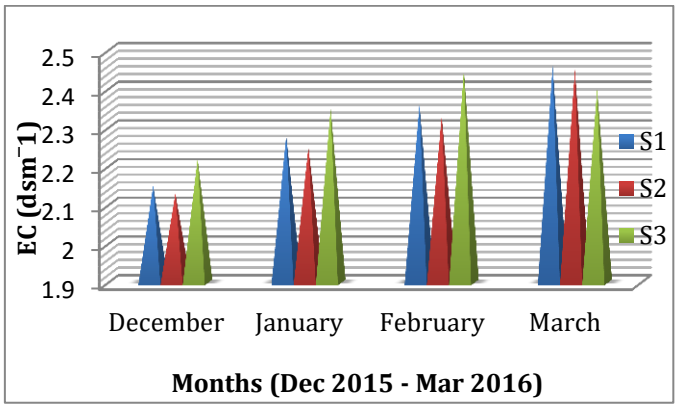

Fig - 5: Monthly variations of Electrical Conductivity in three stations

3.6 Biological Oxygen Demand

The BOD values varied between 119 to146mg/l, 118 to 145mg/l and 117 to 142mg/l was respectively at the three stations minimum, maximum mean values of 132.5±11.38mg/l, 131.25±14.22mg/l and 132.75±10.874mg/l (Fig. 6). The minimum BOD was recorded station 3 during December, Monsoon season and the maximum was observed in station 1 during March, Post-monsoon season. Anitha *et al*., 2013 has also made similar observations in Thengapattanam estuary and Tamil Selvan *et al*., 2016 has also made similar observations in Adayar estuary.

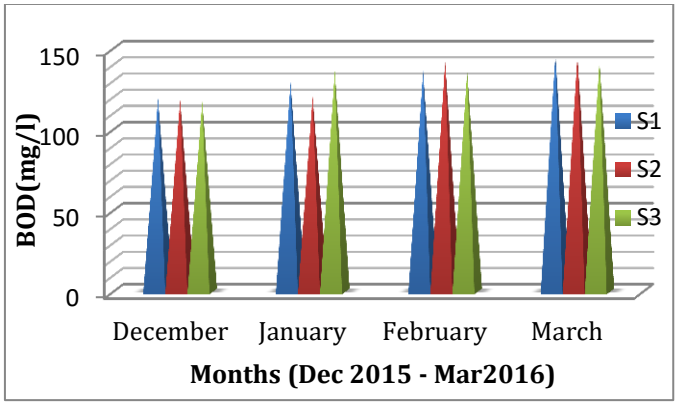

Fig – 6: Monthly variations of BOD in three stations

3.7 Chemical Oxygen Demand

The COD values varied between 75 to 93mg/l, 72 to 87mg/l and 72 to 86mg/l was respectively at the three stations minimum, maximum mean values of 83.75±7.45mg/l, 80.5± 6.55mg/l and 79.75±6.13mg/l (Fig. 7). The maximum COD was recorded in station 1 during December, Monsoon season and the minimum was observed in station 2 and 3 during March, Post-monsoon season**.** The rapid monitoring of COD in seawater discharge presents an opportunity for users to both comply with regulatory standards and control process costs by eliminating the unwanted discharge of processing chemicals (Zhang 2004). The COD of water increases with increasing concentration of organic matter (Boyd, 1981).The present finding is similar to the Tamil Selvan *et al*., (2016).

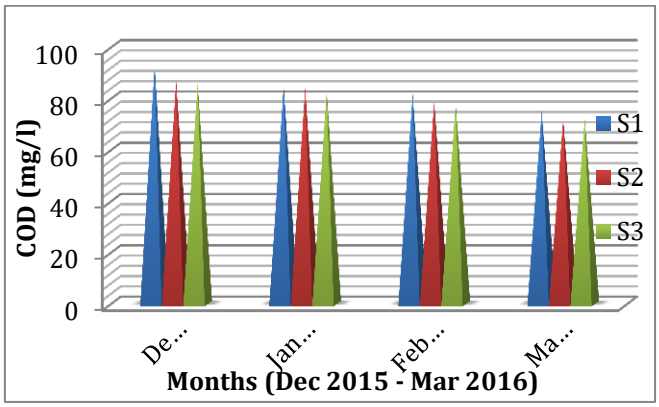

Fig – 7: Monthly variations of COD in three stations

3.8 Nutrients

Nutrients are the necessary parameters within the coastal waters that influence the growth, reproduction and metabolic activities of biotic components. Distribution of nutrients is principally supported season, tidal conditions, fresh water influx and land runoff, chemical effluents and flushing of chemical employed in the agricultural fields. The most explanation for eutrophication involves the enrichment of water by excess nutrients. This study reveals the minimum concentrations of nutrients observed during March month and maximum concentrations of nutrients observed during December month. Similar nutrient fluctuations were reported in Tranqubar – Nagapattinam coastal areas Sampathkumar and Kannan (1998) and in Madras to Kovalam coastal zone (Rajendran, 1992).

3.9 Sulphate

The sulphate content was fluctuated between the stations also because the months. The sulphate values varied between 112 to 148mg/l, 112 to 129mg/l and 109 to 128 mg/l was respectively at the three stations minimum, maximum mean values of 125±16.12 mg/l, 119.75±7.71mg/l and 117.75±8.18 mg/l (Fig. 9). The maximum value was determined in station 1 during December, Monsoon season and the minimum in station 3 during March, Post-monsoon season. The concentration of the sulphate is more than that obtained from Water Lab and by comparing with other stations value (J. A. DAJI 1968). The higher value of sulphates recorded in December month and lower value of sulphates measured in March month. These result determined by Kirubavathy *et al.,* (2005), Khare *et al.,* (2007).

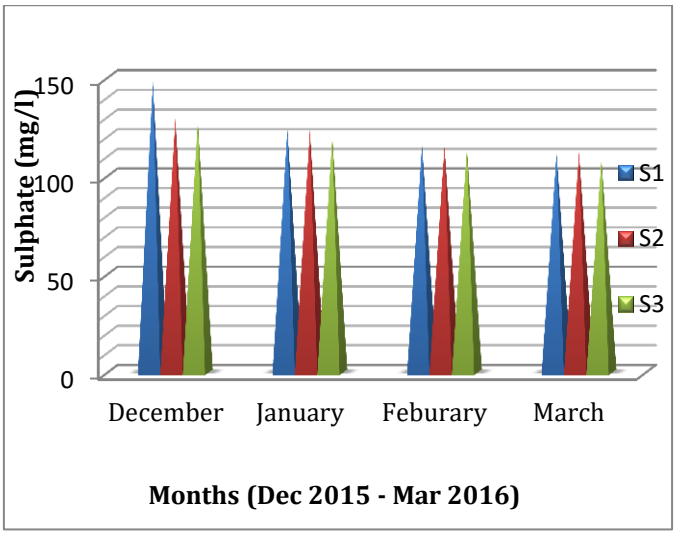

Fig – 9: Monthly variations of sulphate in three stations

3.10 Phosphate

Phosphate concentration is helpful index of eutrophication within the coastal water. In the present study the phosphate value was fluctuated between the stations also because the month. The phosphate values varied from 0.02 to 0.08mg/l, 0.02 to 0.06mg/l and 0.02 to 0.04mg/l was respectively at the three stations minimum, maximum mean values of 0.047±0.027mg/l, 0.04±0.018mg/l and 0.03±9.57mg/l (Fig. 10). The maximum value was observed in station1 during December, Monsoon season and minimum in all station during March, Post-monsoon season. The discovered high Monsoonal phosphate value might be due to the regeneration and release of total phosphorus from bottom mud in to the water column by turbulence and mixing (Saravanakumar *el al*., 2008). Low values of phosphate observed during post Monsoon season may be due to the reduction of land drainage, sewage and fertilizer disposal from the land drainage. Similarly maximum value in Monsoon and minimum value in Post Monsoon season were also document from Tranquebar - Nagappattinam coast (Sampathkumar, 1992), Nedumaran *et al.,* (2001) in Vellar estuary.

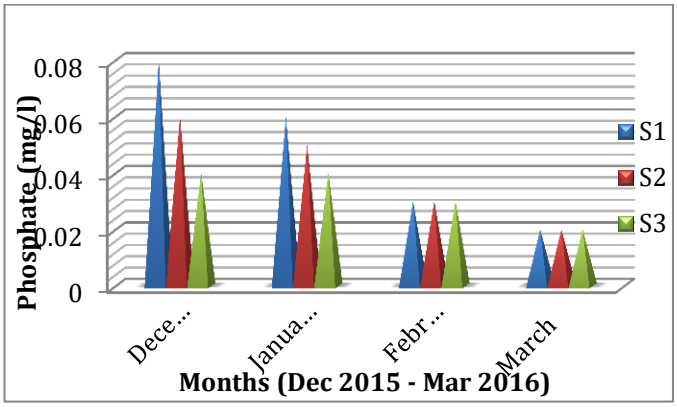

Fig – 10: Monthly variations of Phosphate in three stations

3.11 Silicate

Reactive silicate content was over that of the opposite nutrients and therefore the recorded high value throughout Monsoon season. The silicate content was fluctuated between the stations also because the months. The silicate values varied from 2.59 to 5.42mg/l, 2.58 to 5.36mg/l and 2.54 to 5.32mg/l was respectively at the three stations minimum, maximum mean values of 4.52±1.30mg/l, 4.36±1.268mg/l and 4.31±1.268mg/l (Fig. 11). The maximum value was observed in station1 during December, Monsoon season and minimum in station 3 during March, Post-monsoon season. Generally silicate content was higher than other nutrients. Maximum value recorded in Monsoon season chiefly within the month of December. Could be due to significant flow of Monsoonal fresh water derived from land drainage carrying silicate leached out from rocks and sediment have been exchanged with superimposed water within the coastal environment (Govindasamy *et al*., 2000).The low value of silicate recorded during Post-monsoonal season could be attributed to uptake of silicates by phytoplankton for their biological activity (Saravanakumar *et al*., 2008). Similar maximum value in Monsoon and minimum in summer season were additionally recorded by Nair *et al*. (1983) in Ashtamudi estuary.

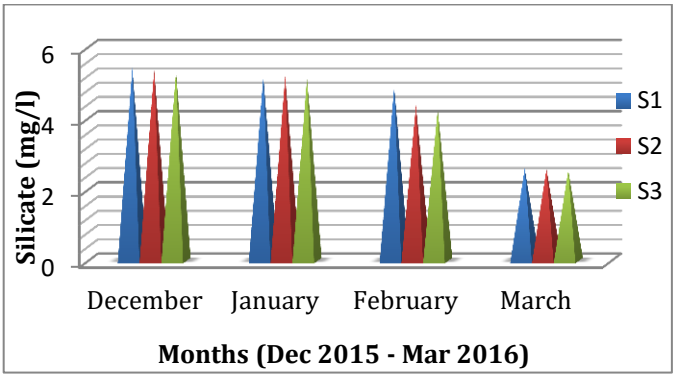

Fig – 11: Monthly variations of Silicate in three stations

3.12 Nitrate

Nitrate is one of the great indicators of pollution of water which shows the topmost oxidised form of nitrogen. Its plays a vital role in strengthening the aquatic life in coastal ecosystem. The nitrate values varied from 1.24 to 4.35mg/l, 1.06 to 3.15mg/l and 0.59 to 2.1mg/l was respectively at the three stations minimum, maximum mean values of 2.71±1.346mg/l, 2.13±0.854mg/l and 1.2±0.063mg/l (Fig. 12). The maximum nitrate value was recorded in station 1 during December; Monsoon season is due to fresh water influx and terrestrial overflow during the Monsoon season (Santhanam and Perumal, 2003).The nitrate content was fluctuated between the stations as well as the months. The minimum value was observed in station 3 during March, Post-monsoon season. The low nitrate content encountered may be due to the less usage of nitrogen fertilizers and less disposal of wastes around these stations. The present study agrees earlier reported by Bragadeeswaran *et al*. (2007) in Arasalar estuary, Hari Muraleedharan *et al*., (2010) in Thondi coastal water.

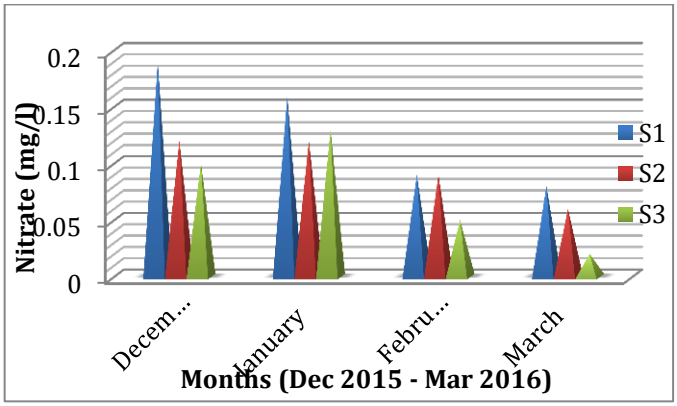

Fig.12. Monthly variations of Nitrate in three stations

4. CONCLUSION

The study aims to know the physico-chemical characteristics in the water quality based on season and anthropogenic inputs. The seasonal fluctuation in physico-chemical parameter the seasonal tidal amplitude and fresh water influx leading to the continual exchange of organic, inorganic, plant and animal matters in the coastal water. However, the three stations the water quality parameters such as temperature, pH, BOD and EC were increased during Post Monsoon season. In contrast, an increase in turbidity TDS, COD and nutrients (sulphate, phosphate, silicate and nitrate) were observed during, Monsoon season. Thus, the precipitation received during the Monsoon long and short rainy periods, were found have appreciable impact on coastal water characteristics at this location. Distributions of nutrient levels were also altered by the seasonal variation. The study exposed the present status of the Physico-chemical parameter which is very helpful for Policy makers to take precautionary measures for save the coastal ecosystem from the anthropogenic inputs.

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