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Studies on Special and Temporal Variations in Physico-Chemical Parameters of Ratnagiri Coast, (MS) India of Arabian Sea

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Abstract: ***The present study carried out to assess the monthly variations of physico-chemical parameters studied at different stations of the Ratnagiri coastal waters during March 2015 to February 2017. The physico-chemical parameters such as temperature, BOD and salinity were increased during summer season, whereas TDS, DOand total hardness were increased during Monsoon season. The physico-chemical properties have exposed reasonable spatial and temporal variations at Ratnagiri coast. The study of physico-chemical parameter which is very helpful for Policy makers to take precautionary measures for save the coastal ecosystem.***

Keywords: Phisico-chemical parameters, spatial and temporal variation, pH, TDS, Nutrients.

I. INTRODUCTION

The marine environment is a complex system mainly influenced by physical, chemical and biological processes. Estuarine and coastal areas are complex and dynamic aquatic environment (Morris, *et. al*. 1995). Ratnagiri district is one of the most important maritime districts of the state with the coastal belt extending to about 200 Km. Ratnagiri is an important coastal area of Maharashtra with average rainfall about 2500 mm. The Arabian Sea is considered as one of the most productive zones in the world oceans (Qasim, 1997, De Sousa, 1996). This coastline is known for its rich marine life especially intertidal biota in its extended intertidal and subtidal areas (Shukla and Misra, 1977).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 their productivity, diversity and wealth of life to their terrestrial adjacency (Biermane*t 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.The interactive physical, chemical, and biological processes operation in the coastal ecosystems sustain higher resulting in richness in diversity.

Studies of the water quality through the appropriate control measures, and monitoring of diverse quality parameters have become very important and essential to ensure the sustainable development and management of the coastal systems and their resources (Srinivas, *et al.,* 2003,Shridhare*t al.,* 2006, Mishra, 2007). The nature and distribution of the flora and fauna in the aquatic system are mainly controlled by the fluctuations in the physical and chemical characteristics of the water body (Sundaramanickam, *et al*., 2008). Marine water quality has become a matter of serious concern because of its effects on human health and aquatic ecosystems including marine life (Gupta, *et al*., 2009).

An industrial development has led to an increased discharge of chemical effluents into the aquatic ecosystem, leading to damage of marine habitats. Rivers plays a major role in assimilation of municipal and industrial waste water and runoff from agricultural lands. When river water mixes with sea water, large numbers of physical and chemical processes take place which may influence water quality (Kumar and Achyuthan, 2007).Pollution of marine water was effect on biodiversity of mangroves and other aquatic flora and fauna (Naikwade and Sankpal 2012, Naikwade*et al*., 2012). Physico-chemical characteristics are indeed vital water quality parameters for monitoring due to their instability, where significant variations in physico-chemical parameters affect the quality of water resources (Vaghela, *et al*., 2010).The present study evaluates the influence of various physicochemical parameters on coastal water quality of Ratnagiri coast.

II. MATERIALS AND METHODS

The study was conducted on three different stations of Ratnagiri coast, (S1) Undi (17° 13'38.29 N, 73° 14'16.93 E), (S2) Alawa (17° 01'29.32 N, 73° 16'08.89 E), (S3)Wayangani (16° 55'42.12 N, 73° 16'57.01 E) during March 2015 to February 2017.Water samples for physical and chemical parameter determination were collected monthly during high tides from the sampling station.Selected physicochemical parameters such as Temperature, pH, Conductivity, Total dissolve solids (TDS), Turbidity, Salinity, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Total Hardness, Calcium and Magnesium were analysed

according to APHA (1998), Trivedy and Goel(1984) and Strickland and Parsons (1972).Pearson's Correlation coefficients analysis was also performed to find out relationship between various water quality parameters within a sampling site for the test of significance 'r' value at ($P<0.05$) level.The data are obtained statistically analysed mean ± standard Deviation.

III. RESULTS AND DISCUSSIONS

The chemical, physical and biological properties of water quality parameters are interrelated and must be considered together. Clearly visible seasonal changes in the concentration of the various seawater quality parameters were observed during the present study. **S**ampling sites were on the open sea coastline off Arabian Sea, Which situated more than fifty kilometres away of each other but shared the common open coastline.

The temperature was basically important for its effects on the chemistry and biological activities of organisms in water. The coastal water temperature varied between 25.2 to 30^0 C , 25.2 to 30.2^0C and 25 to 29.8^0C was respectively at the three stations minimum, maximum mean values of 26.72±1.51(S1), 26.61±1.52(S2) and 26.59±01.43(S3)^{0}C(Fig. 1). The maximum temperature was recorded in station 2 during April, summer season and minimum was recorded in station 3during August, monsoon season. Less solar radiations with misty sky and moderate rainfall during the Monsoon season may greatly reduce the water temperature (Karuppasamyet 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)).The recorded high value during summer could be attributed to high solar radiation (Ajithkumaret al., 2006; Ashok Prabuet al., 2008; Rajkumaret al., 2009).Temperature is one of the most important factors in the coastal ecosystems, which influences the physicochemical characters of coastal water (Sundaramanickam, 2008).

The pH value depends upon the salinity and temperature of the water and the climatic conditions present in that area. Variation in the pH value can affect the rate of biological reactions. The pH of coastal water responds to changes in dissolved carbon dioxide concentration, alkalinity, and hydrogen ion concentration and in a small way to temperature. The pH for the water samples varied between 7.5 to8.4, 7.6 to 8.3 and 7.7 to 8.4 was respectively at the three stations minimum, maximum mean values of 8.07±0.29(S1), 8.03±0.23(S2) and 8±0.27(S3)(Fig. 2).The maximum value was recorded in station 1 and 3 during April, summer season and the minimum was recorded in station 1 and 3 during July, Monsoon season. The low pH observed during the month of June to August may be due to the influence of fresh water, dilution of seawater, reduction of salinity and temperature, and decomposition of organic mattersuggested by Ganesan (1992) and Zingde, et al.,(1985). In present study the pH value remains alkaline throughout the year. The recorded high pH values might be due to the influence of seawater penetration and high biological activity (Balasubramanian and Kannan, 2005).The pH of water is important because many biological activities can occur only within narrow range (Shephered&Bromage, 1992). The conductivity of an aqueous medium is an indication of its ability to conduct an electric current. It chiefly depends on the amount of dissolved solids in water. In the present study the electrical conductivity was showed very narrow changes in all stations as well as months. The conductivity values varied between 17.1 to 18.8µS/cm, 17.2 to 18.7µS/cmand 17.4 to 18.5µS/cmwith minimum and maximum values of 17.91±0.49(S1), 17.96 ± 0.44(S2), and 18.02 ± 0.39(S3)µS/cm(Fig. 3). The maximum value was recorded in station 1during May, summer season and the minimum in station 1 during February, winter season. Boyd (1981) suggested that the fluctuation in electric conductivity was due to fluctuation in total dissolved solids and salinity.The rough tidal activity possibly increased the solid levels which probably been responsible for the variations in the conductivity values (Vaghela, et al., 2010).

Total dissolve solids (TDS) varies between 39.6to 48.3g/l, 39.2 to 49.2g/l and 38.9 to 49.5g/l was respectively at the three stations minimum, maximum mean values of 43.28±2.88(S1), 43.68±3.02(S2), and 43.84±3(S3)g/l(Fig. 4). The maximum TDS was recorded in station 3 during July, Monsoon season and the minimum was observed in station 3 during the month of February, winter season. 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 7.5 to 9.7 NTU, 7.6 to 9.5 NTU and 7.5 to 9.2 NTU was respectively at the three stations minimum, maximum mean values of 8.5±0.74(S1), 8.45±0.62(S2), and 8.26±0.58(S3) NTU (Fig. 5). The maximum turbidity was recorded in station 1 during December, winter season and the minimum was observed in station 1 and 3 during the month of April, summer seasondue to the movement of water in and out of the estuary by tidal influence. This study agreement with previous studies (Saravanakumaret al., 2008).High turbidity value during post monsoon may be due to fresh water discharges, which carried lot of terrigenous materials and low solar radiation (Kalaiarasiet al., 2012).

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 28.6to 36.8‰, 28.9 to 36.6‰ and 28.7 to 36.3‰ was respectively at the three stations minimum,

maximum mean values of 33.09±2.59(S1), 33.04±2.61(S2), and 32.92±2.56(S3)‰ (Fig. 6). The maximum salinity was recorded in station 1during April, summer season and the minimum was recorded in station 1 during July, 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.High evaporation rates in the presence of low freshwater inflow can lead to higher values of salinity. (Balasubramanian and Kannan, 2005; Sridhar et al., 2006; Asha and Diwakar, 2007).

The monthly variation of observed dissolved oxygen values are ranged between 6.3 to 8.2mg/L, 6.5 to 8.6mg/L and 6.9 to 8.7mg/L was respectively at the three stations minimum, maximum mean values of 7.19±0.59(S1), 7.43±0.61(S2), and 7.62±0.51(S3)mg/L (Fig. 7).The maximum dissolved oxygen was recorded in station 3 during July, monsoon season and the minimum was recorded in station 1 during May, summer season. Higher dissolved oxygen observed during the monsoon season might be due to the cumulative effect of higher wind energy coupled with heavy rainfall and the resultant fresh water mixing Similar results were reported by (Vijaya kumara et al., 2011) (Manikannanet al., 2012),and (Damotharanet al., 2010). The observed DO was above 5 mg/l which is also reported earlier in the Arabian Sea (Raghunathan, et al., 2004) and in Gulf of Kachchh (Desa, et al., 2005).

Biochemical Oxygen Demand (BOD) depends on temperature, extent of biochemical activities and concentration of organic matter. The BOD values varied between 3.3 to 5.7mg/l, 3.6 to 5.4mg/l and 3.8 to 5.3mg/l was respectively at the three stations minimum, maximum mean values of 4.51±0.72(S1), 4.53±0.58(S2), and 4.63±0.47(S3)mg/l (Fig. 8). The maximumBOD was recorded at station 1 during March, summer season and the minimum was observed in station 1 during June, monsoon season.These BOD values range normally recorded for healthy costal water. The low value indicates low organic pollution in study area. Maximum value of BOD was observed in summer period due to the maximum biological affinity at elevated temperature and low in winter due to reduced flow of riverine water(Ghavzan, et. al. 2006). Anithaet al., 2013 has also made similar observations in Thengapattanam estuary and Tamil Selvanet al., 2016 has also made similar observations in Adayar estuary.

The total hardness values varied between 6.2 to 8.2g/l, 6.5to 8.3g/l and 6.4 to 8.3g/l was respectively at the three stations minimum, maximum mean values of 7.2±0.69(S1), 7.23±0.63(S2) and 7.18±0.68(S3)g/l (Fig. 9). The maximumtotal hardness was recorded at station2 and 3 during August, monsoon season and the minimum was observed in station 1 during January, winter season. Bicarbonates, carbonates, chlorides, nitrates, phosphates, and sulphates are present in the form of Na^{+}, K^{+}, Mg_2^{+}.and Ca_2^{+} are mainly responsible for the hardness of water (Ravaniahet al., 2010).

The calcium values varied between 0.29 to 0.45g/l, 0.3 to 0.43g/l and 0.31 to 0.45g/l was respectively at the three stations minimum, maximum mean values of 0.35±0.04(S1), 0.36±0.04(S2), and 0.37±0.04(S3)g/l(Fig. 10).The maximum calcium was recorded at station 1 and 3 during December, winter season and the minimum was observed in station 1 during July, monsoon season.The magnesium values varied between 1.06 to 1.6g/l, 1.09to 1.6g/l and 1.11 to 1.67g/l was respectively at the three stations minimum, maximum mean values of 1.37±0.17(S1), 1.43±0.15(S2), and 1.46±0.17(S3)g/l (Fig. 11).The maximummagnesium was recorded at station 3 during January, winter season and the minimum was observed in station 1 during June, monsoon season.

The results of correlation coefficient test showed relationship with the physicochemical parameter studied at Ratnagiri coast. In case of Undisignificant positive correlation was observed between pH and salinity (0.877) and TDS with total hardness (0.943), whereas significant negative correlation was observed pH with TDS (-0.894) and total hardness (-0.891), TDS with salinity (-0.909), salinity with DO (-0.924) and total hardness (-0.909) showed in table no. 1. At Alawa significant positive correlation was observed between pH and salinity (0.953), TDS with total hardness (0.939) and DO with total hardness (0.845). Whereas significant negative correlation was observed pH with TDS (-0.879) and total hardness (-0.905), TDS with salinity (-0.896), salinity with DO (-0.863) and total hardness (-0.966) showed in table no. 2.In case of Wayangani significant positive correlation was observed between pH and salinity (0.876), TDS with DO (0.889) and total hardness (0.930), DO with total hardness (0.877). The significant negative correlation was observed pH with TDS (-0.891), salinity (-0.801) and total hardness (-0.865). TDS with salinity (-0.917), salinity with DO (-0.914), BOD (-0.914) and total hardness (-0.966) showed in table no. 3.Dissolved oxygen showed an inverse relationship with salinity and temperature with high values at ebb tides and low values at flood tides (Chandranet al., 1984).The present study agrees with earlier reported by (Suranaet al., 2013).The relation between total dissolved solid and electric conductivity is a function of the type and nature of the dissolved cations and anions in the water (Clair, et al., 1994).

IV. CONCLUSION

Present study reports the spatial and temporal variations of the seawater quality from Undi, Alawa and Wayangani shores along the Ratnagiri coastline. All the stations showed similar trends in terms of seasonal changes. The physico-chemical parameters such as temperature, BOD and salinity were increased during summer season, whereas TDS, DO and total hardness were increased during

Monsoon season.The results suggested normal range of physical, chemical and biological characteristics of coasts are away from major anthropogenic activity. Thus the coastal environmental condition has favourable for growth and development of aquatic ecosystem. The study of physico-chemical parameter which is very helpful for Policy makers to take precautionary measures for save the coastal ecosystem.

V. ACKNOWLEDGEMENT

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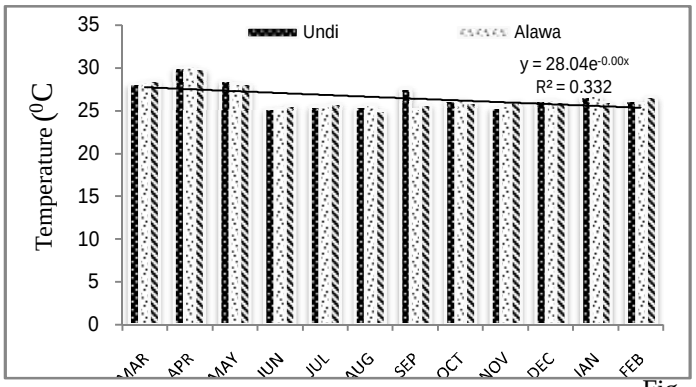

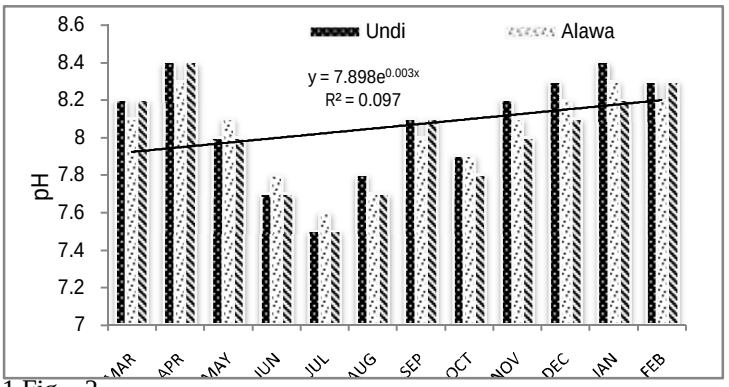

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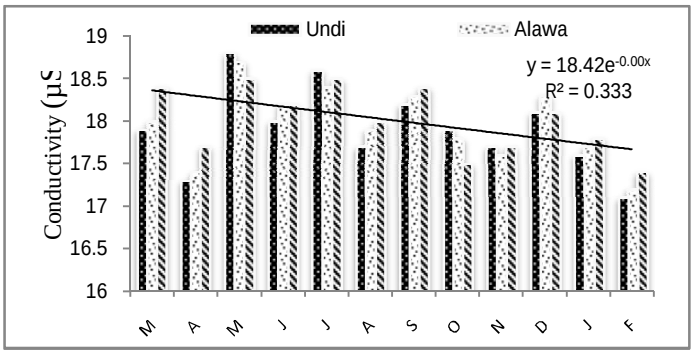

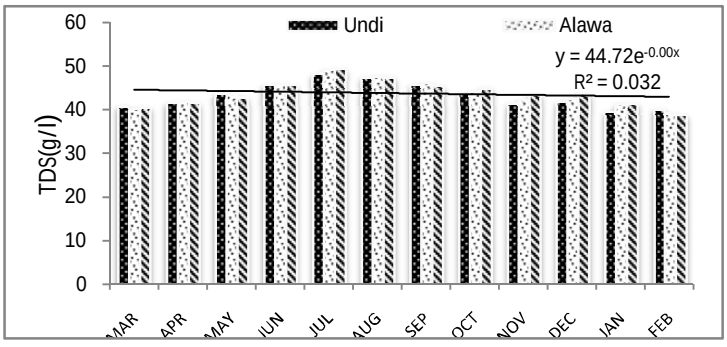

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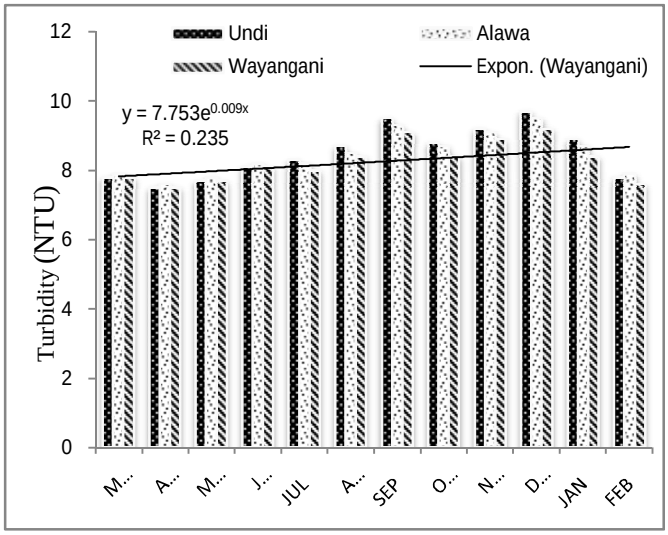


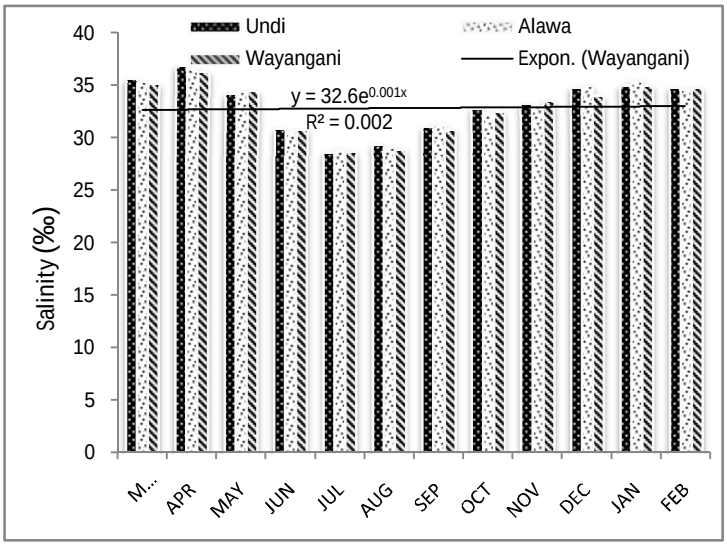
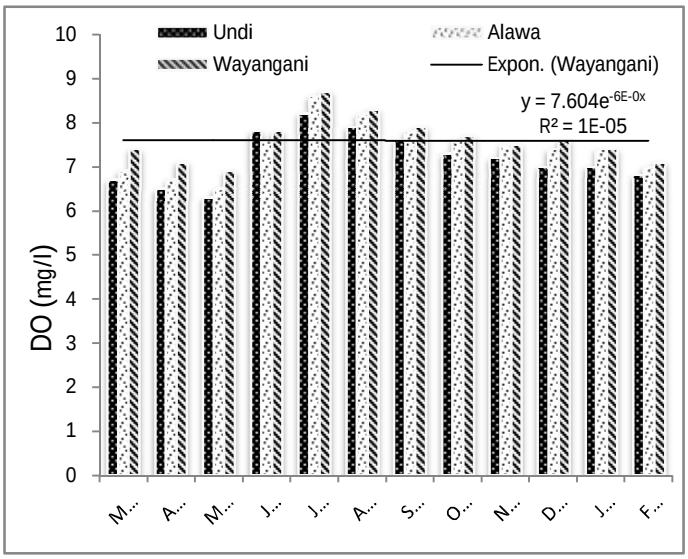


Fig – 5.Fig – 6.



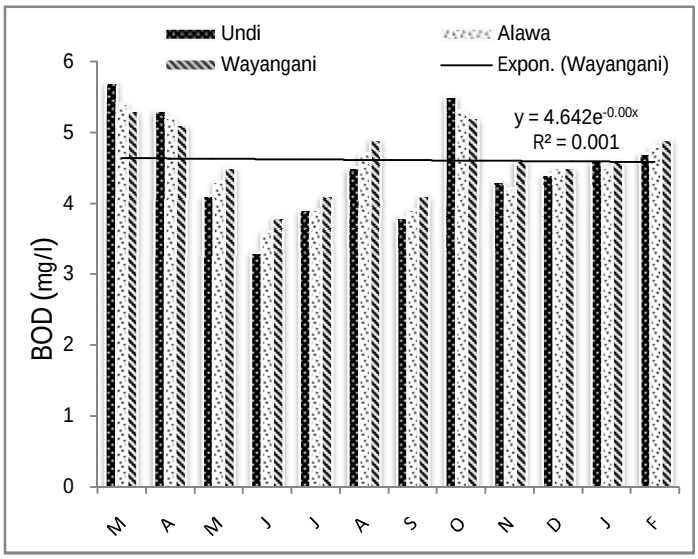
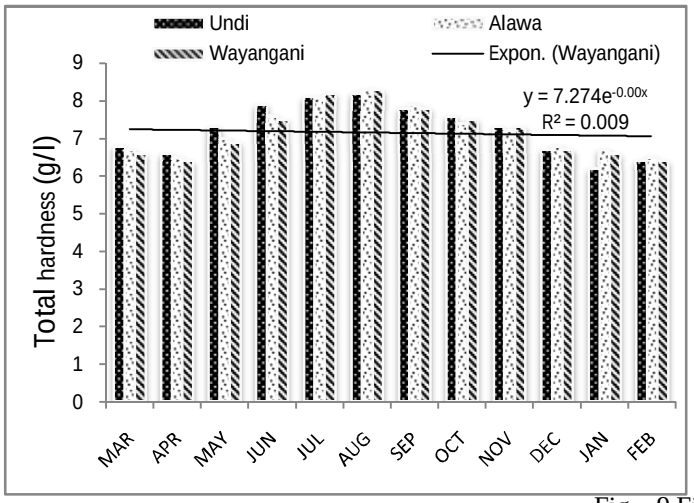


Fig – 7.Fig – 8.



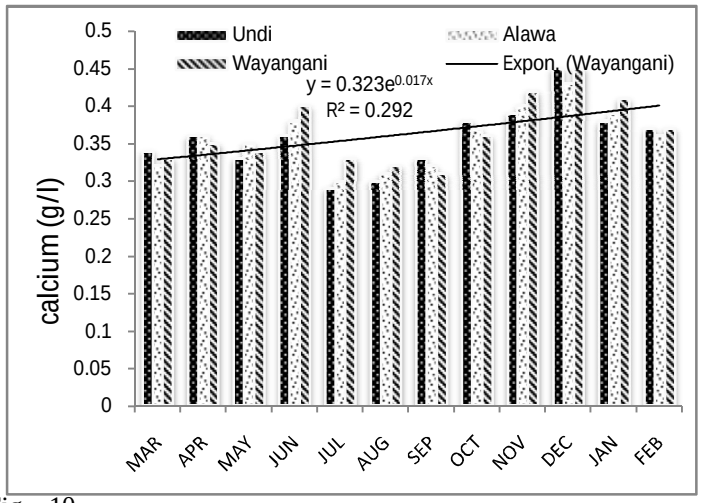


Fig – 9.Fig – 10.

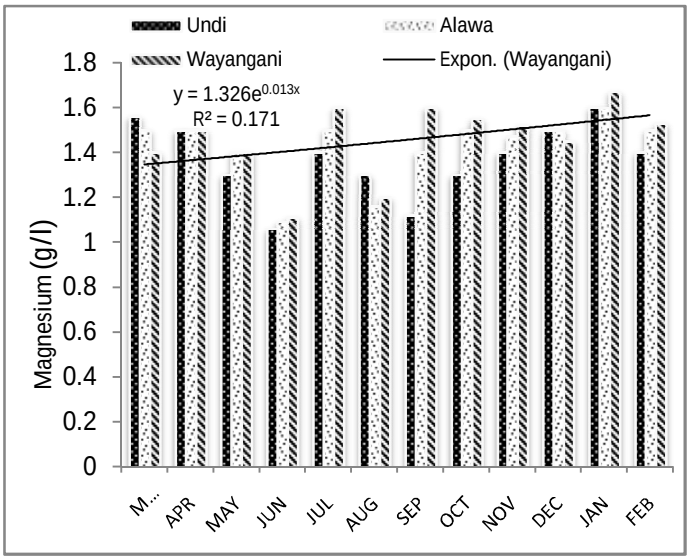


Fig – 11.

Table No 1: Pearson's correlation coefficient between physico-chemical parameters of Undi from March-2015 to Feb-2017.

	Temperature	pH	Conductivity	TDS	Turbidity	Salinity	DO	BOD	Total Hardness	Calcium	Magnesium
Temperature	1										
pH	0.487	1									
Conductivity	-0.018	-0.576**	1								
TDS	-0.318	-0.894**	0.563**	1							
Turbidity	-0.462*	0.067	0.125	0.086	1						
Salinity	0.627**	0.877**	-0.439	-0.909**	-0.274	1					
DO	-0.708**	-0.757**	0.219	0.778**	0.387	-0.924**	1				
BOD	0.436	0.469*	-0.459*	-0.530**	-0.253	0.606**	-0.513**	1			
Total Hardness	-0.410	-0.891**	0.526**	0.943**	0.158	-0.909**	0.773**	-0.485*	1		
Calcium	-0.083	0.614**	-0.323	-0.669**	0.415	0.587**	-0.398	0.177	-0.600**	1	
Magnesium	0.268	0.589**	-0.322	-0.649**	-0.093	0.626**	-0.486*	0.639**	-0.732**	0.306	1

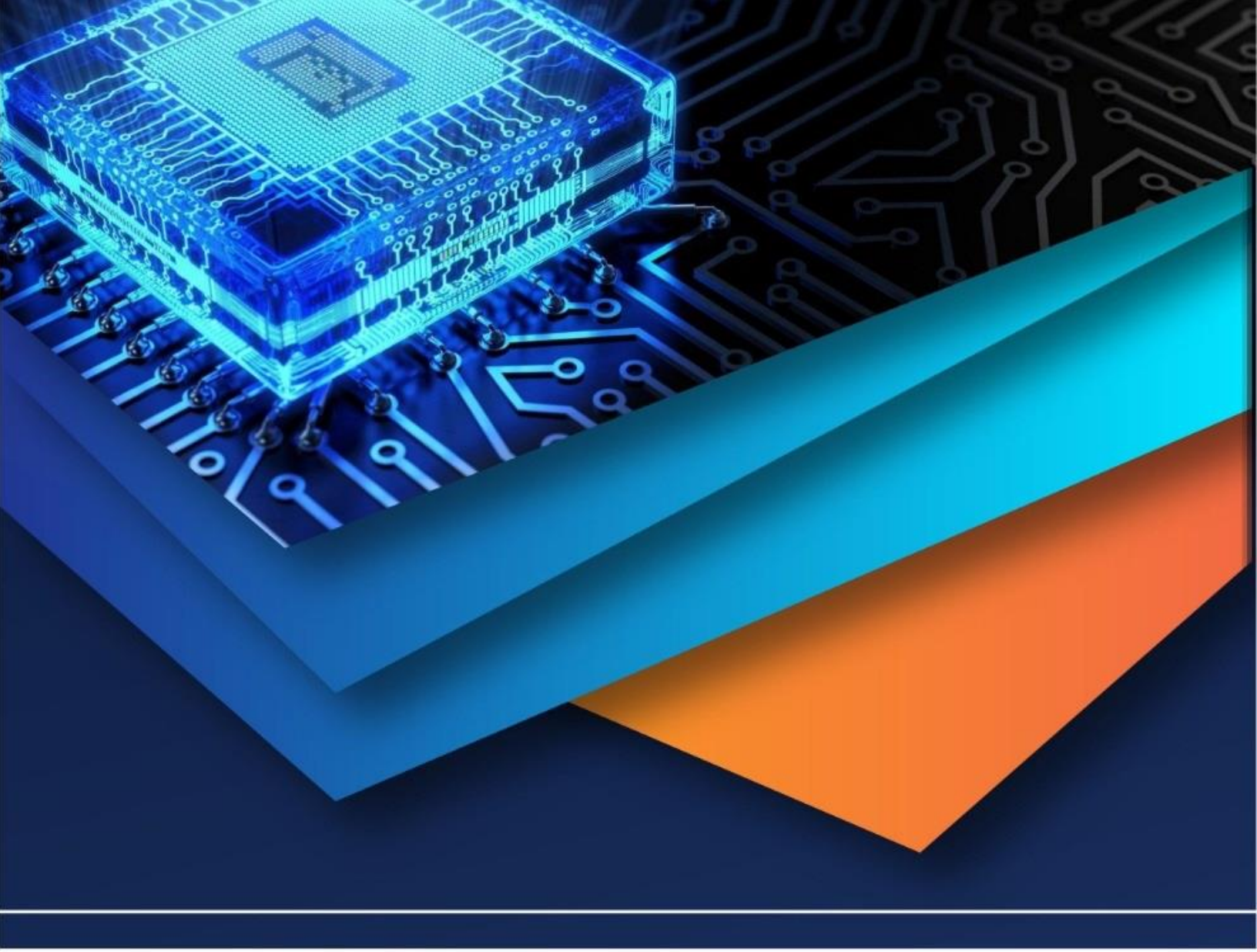
Table No 2: Pearson's correlation coefficient between physico-chemical parameters of Alawa from March-2015 to Feb-2017.

	Temperature	pH	Conductivity	TDS	Turbidity	Salinity	DO	BOD	Total Hardness	Calcium	Magnesium
Temperature	1										
pH	0.543**	1									
Conductivity	-0.151	-0.426	1								
TDS	-0.457*	-0.879**	0.570**	1							
Turbidity	-0.606**	-0.015	0.173	0.176	1						
Salinity	0.709**	0.953**	-0.368	-0.896**	-0.200	1					
DO	-0.732**	-0.790**	0.206	0.793**	0.439	-0.863**	1				
BOD	0.616**	0.395	-0.511**	-0.557**	-0.313	0.542**	-0.449	1			
Total Hardness	-0.622**	-0.905**	0.450	0.939**	0.281	-0.966**	0.845**	-0.509**	1		
Calcium	-0.014	0.566**	-0.214	-0.490*	0.412	0.501**	-0.334	-0.020	-0.535**	1	
Magnesium	0.342	0.584**	-0.276	-0.531**	0.068	0.614**	-0.276	0.427	-0.588**	0.204	1

Table No 3: Pearson's correlation coefficient between physico-chemical parameters of Wayangani from March-2015 to Feb-2017.

	Temperature	pH	Conductivity	TDS	Turbidity	Salinity	DO	BOD	Total Hardness	Calcium	Magnesium
Temperature	1										
pH	0.629**	1									
Conductivity	0.024	-0.356	1								
TDS	-0.578**	-0.891**	0.439	1							
Turbidity	-0.638**	-0.160	0.055	0.340	1						
Salinity	0.732**	0.876**	-0.371	-0.917**	-0.309	1					
DO	-0.665**	-0.801**	0.335	0.889**	0.350	-0.914**	1				
BOD	0.485*	0.460*	-0.505**	-0.524**	-0.325	-0.914**	-0.400	1			
Total Hardness	-0.666**	-0.865**	0.347	0.930**	0.341	-0.966**	0.877**	-0.427	1		
Calcium	-0.198	0.164	-0.374	-0.259	0.386	0.343	-0.257	-0.157	-0.406	1	
Magnesium	0.092	0.353	-0.222	-0.220	0.148	0.293	-0.103	0.142	-0.234	0.020	1

[**= significant 'r' value at 1% (P<0.1); *=significant 'r' value at 5% (P<0.05); (- indicate negative correlation)



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