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Research Paper

Seasonal variation in the physico-chemical analysis ofMangrove water, Kundapura, Karnataka, India.

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***Abstract**: Physico-chemical analysis of mangrove water was carried out for a period of two years from April-2010 to March-2012. The water samples were collected between 8.00 a.m. to 9.00 a.m. and usually from 10-15 cm depth from the water surface. During the study period, variations observed in different water quality parameters of mangrove stations respectively are as follows: Air temperature (25.20^{o}C to 28.45^{o}C), Water temperature (23.31^{o}C -27^{o}C), pH (6.86-7.56), Electrical conductivity (1.4dSm^{-1}-26.94dSm^{-1}), Dissolved oxygen (4.80mg/L-8.64mg/L), Biological oxygen demand(0.45mg/L-2.46mg/L),Free CO_2(0.96mg/L-1.81mg/L), Calcium (5.22mg/L-15.26mg/L), Magnesium (7.89mg/L-48.2mg/L), Potassium (1.02mg/L-10.15mg/L), Sodium (37.67mg/L-846.08mg/L), Bicarbonate (2.17mg/L-5.97mg/L),Chloride (9.99mg/L-271.41mg/L), Sodium absorption ratio (24.55mg/L-297.78mg/L). The carbonate content was absent in all the sites and in all the season except the site-1 in monsoon-2010 i.e.0.23mg/L. The residual sodium carbonate was observed during monsoon-2010 in site-2 and 4 i.e. 0.4 mg/L and 0.005 mg/L.Most of the parameters suggest low values throughout monsoon season and high values during pre-monsoon season; however dissolved oxygen is maximum for the duration of monsoon season and minimum throughout pre-monsoon.*
***Keywords:**Physico-chemical analysis, mangrove, monsoon, pre-monsoon, minimum and maximum.*

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I. INTRODUCTION

Mangrove ecosystem acts as a buffer between near shore and lagoonal or estuarine environments with regard to the influence of freshwater discharge and salinity regime [1]. They stabilize the shoreline and act as a bulwark against the encroachment by the sea [2]. When river water mixes with seawater, a large number of physical and chemical processes take place, which influence the water quality. The mangrove water is slightly alkaline and contains high amounts of pH, total hardness, calcium, magnesium, chloride, total inorganic and organic phosphate, ammonium, nitrite and nitrate [3].

Mangroves act as land builders and coastline stabilizers [4] &[5]. Among the marine ecosystems, mangroves constitute the second most important ecosystem in productivity and sustained tertiary yield after coral reefs. Productivity in mangrove waters depends on the extent of mangrove canopy cover that supplies carbon, nitrogen and phosphorous[6]. The environmental conditions such as topography, water movement and stratification, salinity, oxygen, temperature and nutrients characterizing particular water mass also determine the composition of its biota[7]. The stability of the mangrove is influenced by salinity, soil type and chemistry, nutrient content and dynamics, physiological tolerance, predation and competition at local level [8].

II. MATERIALS AND METHODS

Study area: The domain of study is located at Kundapura, 440 km from Bangalore and 37 km from Udupi, at 13°37'24" N latitude and 74°41'30" E longitude and maximum elevation of 18 meters above sea level. Four study sites (Table: 1) have been selected beside the backwaters of the Haladi River.

Table-1. Study sites

Study sites	Latitude	Longitude	Elevation
Site-1.Herikudru	13°38'28"N	74°42'01"E	28'
Site-2. Uppinakudru	13°39'21"N	74°41'59"E	25'
Site-3.Jaladi	13°39'41"N	74°42'16"E	16'

Site-4. Hemmadi	13°40'46"N	74°41'20"E	32'

Sample collection and analysis: Monthly water samples were collected from 4 different sampling sites for a period from April-2010 to March-2012. The water samples were collected between 8.00 a.m. to 9.00 a.m. using wide mouth sterile transparent plastic jar of five-liter capacity and usually from 10-15 cm depth from the water surface. The samples were analyzed in the laboratory by following standard methods of American Public Health Association[9]. The results of analysis were expressed as mg/L except temperature and conductivity measured as $^{\circ}$C and dSm^{-1} respectively.The temperature of air was recorded at the time of sampling using the thermometer. The temperature of water was recorded at the time of sampling using the mercury bulb thermometer by immersing the bulb of thermometer in water column. Water pH was recorded by pH meter. The conductivity of the samples was measured with the help of a digital conductivity meter. The amount of dissolved oxygen in water was estimated by the Winkler's iodometric method by titration assembly[9]. The dissolved oxygen was fixed on spot. In laboratory the biological oxygen demand of water was estimated by 5 days incubation method at 20°C in BOD incubator.The free carbon dioxide in water was estimated by the titrimetric method by titration assembly.The calcium of water was estimated by the EDTA titrimetric method by titration assembly.In the laboratory the chloride of water was estimated by the Argentometric method by titration assembly.In the laboratory the sodium and potassium of water was determined by using flame photometer. The magnesium of water was estimated by the EDTA titrimetric method by titration assembly.Carbonate and bicarbonate were estimated by titrimetric method.SAR is a parameter that evaluates the sodium hazard in relation to calcium and magnesium concentration. The SAR value was calculated with the analytical results of calcium, magnesium, and sodium from a discrete sample using the following equation:

$$SAR = \frac{Na^{+}}{\frac{\sqrt{Ca+Mg}}{2}}$$

III. RESULTS AND DISCUSSION

The air temperature varied from 25.20^{o}C (site-2)during monsoon and 28.45^{o}C (site-4)during pre-monsoon. Air temperature reaches its maximum during summer and minimum during monsoon.The surface water temperature varied from 23.31^{o}C during post monsoon (site-3) to 27^{o}C during pre-monsoon (site-4). There was a steady increase in temperature from March to May, and peaked during May. All the stations showed similar trend with similar seasonal changes. In the present study, summer peaks and monsoonal troughs in air and water temperature were noticed, as observed earlier by several workers in the west coast of India [10]; [11]; [12].

The pH values varied from 6.86 during monsoon (site-1) to 7.56 during pre-monsoon (site-3). pH in surface waters remained alkaline and slightly acidic throughout the study period in all the stations, fluctuations in pH values during different seasons of the year are due to removal of CO_2 by photosynthesis through bicarbonate degradation, dilution of seawater by freshwater inflow, reduction of salinity, temperature and decomposition of organic matter [13]; [14].

The electrical conductivity varied from 1.4 dSm^{-1} during monsoon (site-2) to 26.94 dSm^{-1} during pre-monsoon (site-4). The maximum and minimum values of electrical conductivity are due to freshwater influx and mix up with ebb and flow. The conductivity usually depends upon the dissolved nutrients and other dissolved ions [15]; [16].

The dissolved oxygen varied from 4.80 mg/L during pre-monsoon (site-3) to 8.64 mg/L during monsoon (site-2). In the present investigation, higher values of dissolved oxygen were recorded during monsoon season and lower values were found during summer. Higher dissolved oxygen concentration observed during the monsoon season might be due to the cumulative effect of higher wind velocity coupled with heavy rainfall and the resultant freshwater mixing[17]; [12]; [18].

The maximum value of B.O.D i.e.2.46 mg/L was observed in site-4 in post monsoon, whereas the minimum value of B.O.D i.e. 0.45 mg/L was found in the site-1 in monsoon. BOD is an indicator for the amount of the biodegradable organic substances. B.O.D depends on temperature, extent of biochemical activities, concentration of organic matter and such other related factors in monsoon period [19]. BOD value rises when there is more organic matter such as leaves; wood, waste water or urban storm water runoff took place at the river water[20].

The value of free CO_2 varied from 0.96 mg/L during monsoon in all the sites to 1.81 mg/L during pre-monsoon (site-1). This may depend upon alkalinity and hardness of the water body. High value of CO_2 could be related to the high rate of decomposition in the warmer months. Similar results were reported by [21].

The calcium content varied from 5.22 mg/L during monsoon (site-1) to 15.26 mg/L during pre-monsoon (site-1). Calcium values are indicative of intense of chemical weathering in the Indian sub-continent. Calcium concentration is the highest in estuaries due to the influx of riverine source. Similar results were reported by [22] &[23]. Magnesium values varied from 7.89 mg/L during monsoon (site-4) to 48.2 mg/L during pre-

monsoon(site-3). Similar results were reported by [3]. The potassium content varied from 1.02 mg/L during monsoon (site-4) to 10.15 mg/L during post monsoon (site-3). The highest concentration appeared in the winter and the lowest concentration was observed in the rainy season. Similar results were reported by [24].

Thesodium content varied from 37.67 mg/L during monsoon (Site-2) to 846.08 mg/L during pre-monsoon (site-4). Higher value of sodium (mg/L) during pre-monsoon season due to high salinity and low value during monsoon season due to rain and flow of river water [23]. Similar results were reported by [22].The bicarbonate content values varied from 2.17 mg/L during monsoon (site-3) to 5.97 mg/L during pre-monsoon (site-1). The high value in summer is due to the mixing of sea water and low value during rainy season is due to inflow of freshwater. The presence of high amount of bicarbonate indicates very hard water which is very hazardous for ecosystems [24]. The carbonate content was absent in all the sites and in all the season except the site-1 in the month of September-2010 i.e.0.23 mg/L.

The chloride values varied from 9.99 mg/L during monsoon (site-2) to 271.41 mg/L during pre-monsoon (site-4). Chloride contents tend to vary inversely to the rate of flow of water[25]. The chlorides, in high concentration, indicate the presence of organic matter[26]. The value of chloride was higher during pre-monsoon which might be due to high salinity, tidal flow and less freshwater mixing. Low value was during monsoon season due to rain and more mixing of freshwater from river[23]. Thesodium absorption ratio varied from 24.55 mg/L during monsoon (site-2) to 279.78 mg/L during pre-monsoon (site-3). The residual sodium carbonate was observed during the months of August-2010 in site-2 and 4 i.e. 0.4 mg/L and 0.005 mg/L and absent in all the months from September to July.

Table-2: Seasonal average values of the physico-chemical parameters of water: (April-2010 to March-2012)

Sites	Air temperature			Water temperature			pH		
	Monsoon	**Post monsoon**	**Pre monsoon**	**Monsoon**	**Post monsoon**	**Pre monsoon**	**Monsoon**	**Post monsoon**	**Pre monsoon**
1.	25.83	26.25	27.37	24.41	24.37	26.37	6.86	7.06	7.40
2.	25.20	26.81	27.75	24.45	24.68	25.62	7.12	7.05	7.48
3.	25.54	26	27.87	23.79	23.31	25.83	7.04	7.21	7.56
4.	26.16	26.93	28.45	24.81	25	27	6.97	7.23	7.51

Sites	**Electrical Conductivity**			**Dissolved Oxygen**			**Biological Oxygen Demand**		
	Monsoon	**Post monsoon**	**Pre monsoon**	**Monsoon**	**Post monsoon**	**Pre monsoon**	**Monsoon**	**Post monsoon**	**Pre monsoon**
1.	15.87	16.95	24.48	7.77	5.87	5.85	0.45	1.33	1.84
2.	1.4	17.55	14.98	8.64	6.78	5.95	0.58	2.29	2.25
3.	1.45	19.43	26.64	7.29	5.56	4.80	0.90	2.12	1.87
4.	2.285	24.07	26.94	8.01	5.98	5.32	1.012	2.46	1.65

Sites	**Free CO_2**			**Potassium**			**Calcium**		
	Monsoon	**Post monsoon**	**Pre monsoon**	**Monsoon**	**Post monsoon**	**Pre monsoon**	**Monsoon**	**Post monsoon**	**Pre monsoon**
1.	0.96	1.73	1.02	1.81	8.49	7.82	10.74	5.22	15.26
2.	0.96	1.66	1.63	1.25	5.25	5.21	7.94	11.7	11.46
3.	0.96	1.66	1.64	1.38	10.15	7.72	10.99	12.95	15.24
4.	0.96	1.73	1.32	1.02	7.34	9.16	10.53	13.96	14.55

Sites	**Magnesium**			**Sodium**			**Bicarbonate**		
	Monsoon	**Post monsoon**	**Pre monsoon**	**Monsoon**	**Post monsoon**	**Pre monsoon**	**Monsoon**	**Post monsoon**	**Pre monsoon**
1.	11.09	16.45	44.43	95.71	648.42	456.95	2.93	2.64	5.97
2.	11.44	8.77	28.52	37.67	681.98	188.76	2.84	2.81	3.74
3.	14.38	12.99	48.2	55.41	595.76	789.53	2.17	2.79	4.33
4.	7.89	20.21	46.90	91.74	449.78	846.08	2.60	3.425	4.71

Sites	**Carbonate**			**Chloride**			**Sodium absorption ratio**		
	Monsoon	**Post monsoon**	**Pre monsoon**	**Monsoon**	**Post monsoon**	**Pre monsoon**	**Monsoon**	**Post monsoon**	**Pre monsoon**
1.	0.23	0	0	28.82	195.13	227.98	44.93	213.75	103.5
2.	0	0	0	9.99	94.10	132.29	24.55	197.025	62.14
3.	0	0	0	10.28	143.68	238.43	58.08	279.78	237.23
4.	0	0	0	13.33	161.94	271.41	64.31	177.58	215.61

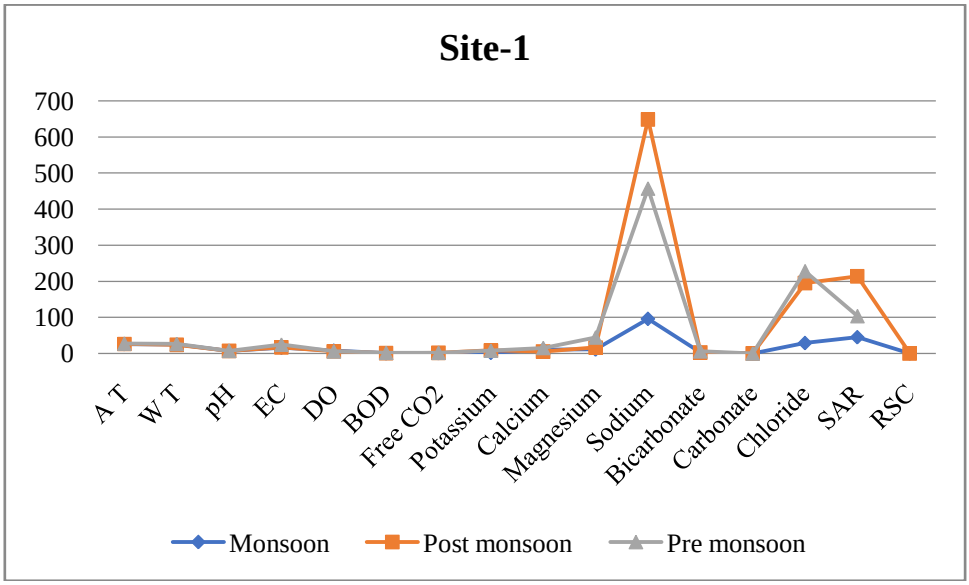

Fig-1, Site-1: Showing the seasonal average values of physico-chemical parameters of water: (April-2010 to March-2012)

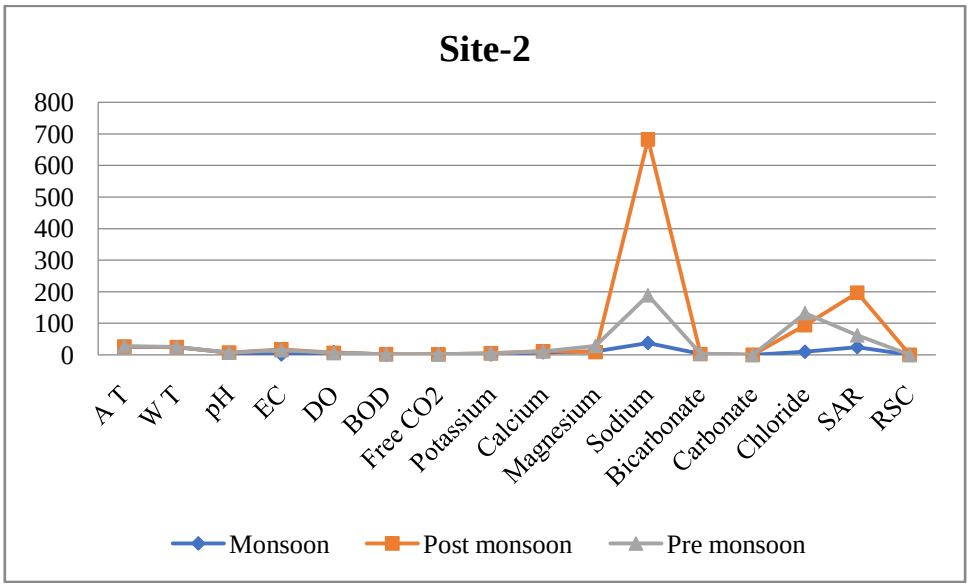

Fig-2, Site-2: Showing the seasonal average values of physico-chemical parameters of water: (April-2010 to March-2012)

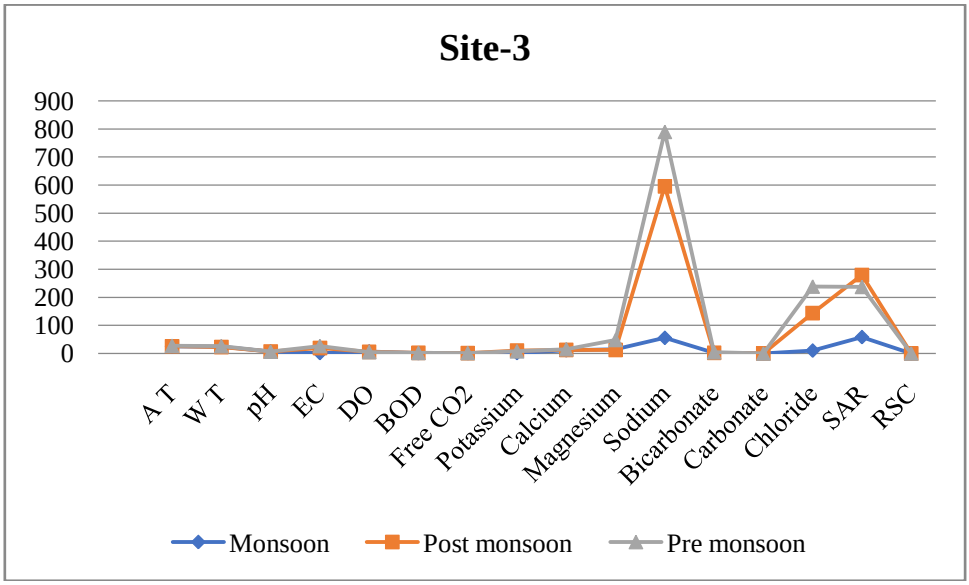

Fig-3, Site-3: Showing the seasonal average values of physico-chemical parameters of water: (April-2010 to March-2012)

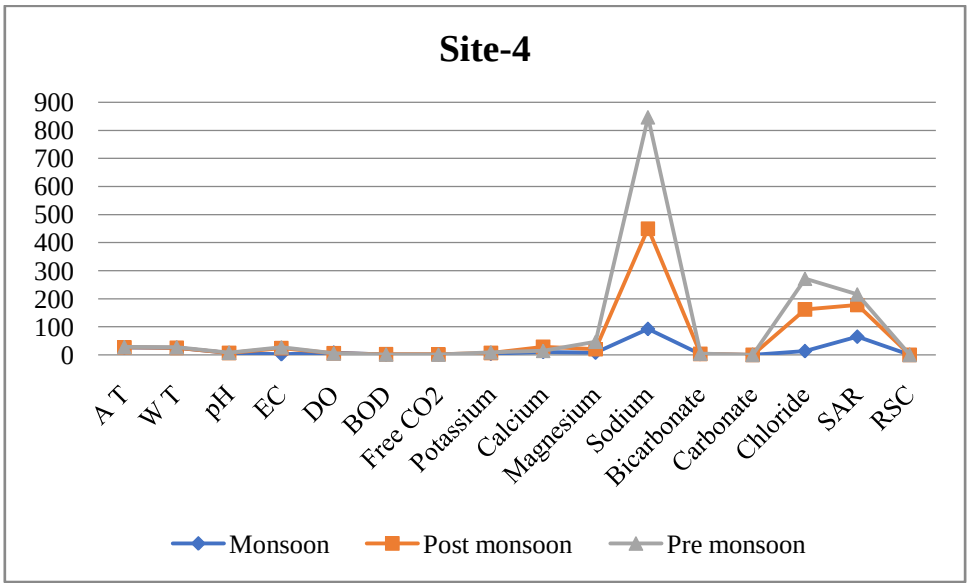

Fig-4, Site-4: Showing the seasonal average values of physico-chemical parameters of water: (April-2010 to March-2012)

IV. CONCLUSION

Physico-chemical parameters of the mangrove water showed fluctuations from season to season. Most of the parameters suggest low values throughout monsoon season and high values during pre-monsoon season; however dissolved oxygen is maximum for the duration of monsoon season and minimum throughout pre-monsoon. The excessive value in summer season is due to the combination of sea water and low value within the course of rainy season is due to inflow of freshwater. Higher dissolved oxygen concentration observed in the course of the monsoon season might be due to the cumulative effect of higher wind velocity coupled with heavy rainfall and the resultant freshwater mixing.

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