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Seasonal Variations of certain Physico-chemical Parameters in the Valapattanam River of Kannur district, Kerala

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***Abstract*-- Rivers are the primary source of water for drinking, irrigation and other domestic purposes. The present work deals with the analysis of seasonal variations of physico-chemical parameters and estimation of the salinity intrusion in the Valapattanam river of Kannur district. The objectives of the study were to analyse the physico-chemical parameters like temperature, pH, transparency, salinity, carbon dioxide, dissolved oxygen, Biological oxygen demand, ammonia, hardness, chemical oxygen demand and primary productivity with respect to the seasons following standard methods.The alteration of these water quality parameters may provide an early warning signal about the degradation of this precious ecosystems. The river water quality is degraded mainly due to discharge of wastes from residential area, sewage outlets, solid wastes, detergents and automobile oil waste. The result of the studies showed that of all the three sites, site2 and site 3 are the most polluted. In the present study it has been observed that salinity ranged from 48.006 to 1471.73 mg/l. Maximum salinity was recorded in site 2(1471.73mg/l) during the pre-monsoon period and minimum was recorded in site 3 (48.003 mg/l) during the post monsoon period. Saltwater intrusion occurs mainly due to human and natural activities. This study brings to light the need for proper management of saline water intrusion in the riverine region because of the hardship its negligence brings upon the public that rely on it for livelihood. Strict measures must be brought about in order to adequately manage and control saline water intrusion so as to protect the dependent population from untold hardship that may result in near future.**

Key words - Physico-chemical parameters, salinity, BOD, COD

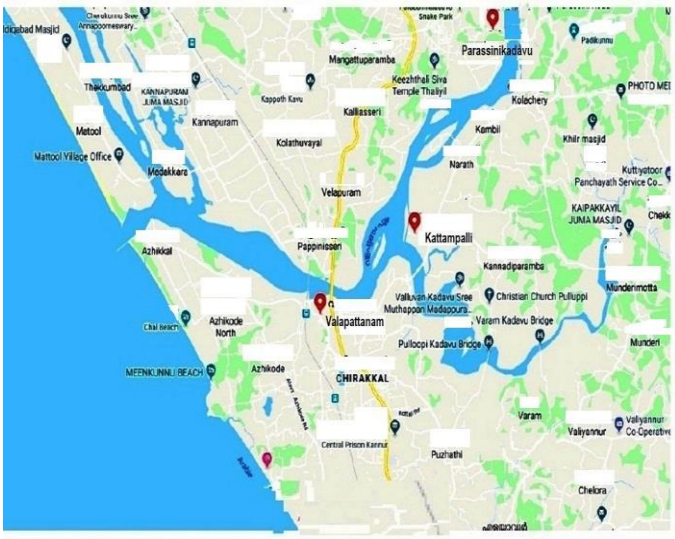
I. INTRODUCTION

Water is essential for the survival of all forms of life. Though 80% of earth's surface is covered by water, the fresh water supply has increasingly become a limiting factor because of varied reasons. The expansion of industrialization and exploding population are the major causes for such a situation. Acute short fall of heavy rains, poor water shed management, abundant use of water for house hold and agricultural purposes have led to the overexploitation of the surface water sources especially from the river bodies. Many perpetual rivers become short-lived and even dried up. The Valapattanam River is the largest river in the Kannur district, located in the South Indian state of Kerala. The Valapattanam River originates from the Brahmagiri hills in Bramhagiri Reserve Forest in Karnataka at an altitude of 900-1350m above sea level and drains into the Kannur district. Major tributaries of this river are the Sreekantapuram River, Bavali River, Veni River, and the Aralam River.

Rivers are very important in determining human progress by providing drinking water, making the earth as a comfort zone and serving as a medium for transportation. For centuries, humans have been enjoying the ecosystem services provided by rivers without having a knowledge how the river ecosystem functions and maintains its vitality (Naiman, 1992). Man has changed the nature of rivers by controlling their floods, by constructing large impoundments, by over exploiting their living and non-living resources and by using

rivers for disposal of wastes. Such tanning of rivers and exploitation of riverine resources have often led to serious decline and causing serious implications on human health and the environment (Carpenter *et al*., 1998). Global concern for the quality of river water in addition to quantity has been on the increase in recent years. Studies on riverine ecosystem indicate that the major Indian rivers are grossly polluted, especially beside the cities (Srivastava, 1992). Rivers in Kerala face the problem of pollution caused by municipal wastes which include liquid, solid, industrial effluents and agricultural runoffs.

The physico-chemical characteristics of river water have a direct impact on prevailing organisms as well as human beings using such water resources. The study of different water quality parameters helps in understanding the metabolic events of the aquatic system. Certain parameters such as Temperature, pH, Transparency, Turbidity, Hardness, Salinity, Ammonia, Carbon dioxide, Dissolved oxygen, Biological oxygen demand and Chemical oxygen demand are necessary for the proper understanding of flora and fauna and their abundance and distribution with time. The changes in these parameters provide valuable information on the quality of water, the sources of the variations and their impacts on the functions and biodiversity of the river. Organic and chemical contamination of surface and groundwater resources in the Valapattanam river in Kannur district coupled with dumping of waste and unscientific sewage disposal has raised concerns about health hazards for people living in the river basin areas. The contamination from wood industries and saline intrusion are aggravated by dumping of waste and abandoned crafts captured for illegal sand mining. The present study deals with the assessment of fluctuations in the physicochemical characteristic features and to measure the extend of salinity intrusion of three different sites in Valapattanam river that would form a reminder to conserve these precious ecosystems. This study brings to the need for proper management of saline water intrusion in the riverine region because of the hardships its negligence brings upon the public that rely on it for livelihood.



Map Showing the Study Sites in Valapattanam Region

II. MATERIALS AND METHODS

Water samples were collected during the year June 2019-June2020 from the study area using wide mouthed 1000ml polyethylene plastic bottles from three sampling points by direct immersion of bottles at water sampling points handled by rope. The containers must be capable of being tightly sealed either by stopper or cap. The collections were made once in a month at the time i.e., 7.00 to 8.30 am and from same sites throughout the period of study.Bottles were preserved using icebox and transported to the laboratory bottles and the physico-chemical parameters were analysed following standard methods of APHA (2005).

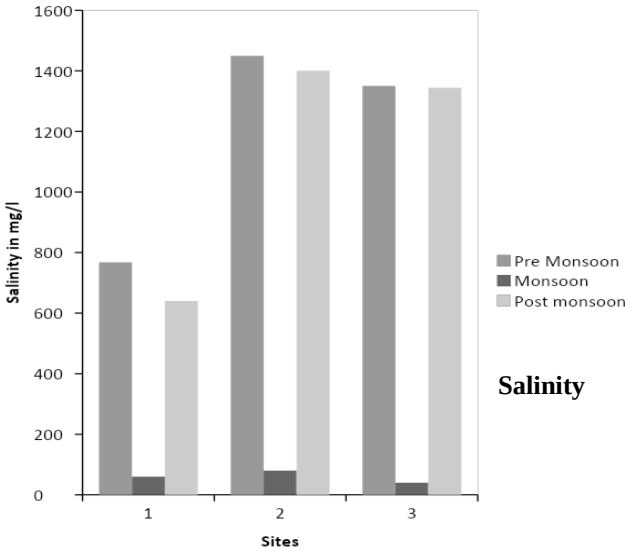


Fig. 1: Graph showing seasonal variations of salinity

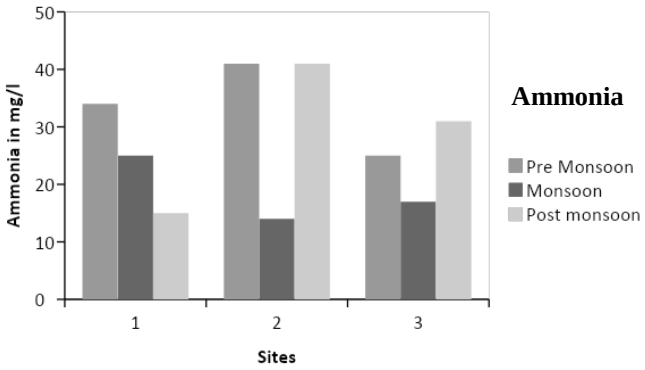


Fig. 2: Graph showing seasonal variations of Ammonia

Study Area

The Kerala state is blessed with 44 rivers and Valapattanam river,the largest river in Kannur district, located in the South Indian state of Kerala.Valapattanam river originates in the Western Ghats of Kodagu, the Brahmagiri Reserve forest in Karnataka at an altitude of 900-1350m above the sea level and drains into Kannur district. The river has a basin area of 1867 km^2 out of this 1321 km^2 in Kerala and 456

km^2 basin areas in Karnataka. Pazhassi Dam is the reservoir in Valapattanam River. The Valapattanam basin extends between latitudes 11º49'30" N and 12º13'50" North and longitudes 75º58'55" E and 75º17'22" East . The length of the river is 110.50 Km with a catchment area of 1907 sq km of which approximately 1321 Sq km of the area falls within the territory of Kerala State and the remaining in the Karnataka State. The river covers about 43.45% of Kannur district.The inhabitants are entirely dependent on this river for their livelihood. (Simpi *et al.*, 2011)The study was carried out in three different sites such as Parassinikadavu,Valapattanam, and Kattampally.

TABLE 1
Seasonal Variations of Physico-chemical Parameters in the Study Sites

Parameters	Seasons	Parassinikadavu SITE. 1	Valapattanam SITE. 2	Kattampally SITE. 3	MEAN ± SD
Temperature (0C)	Pre monsoon	30.7	31.1	30.8	30.87 ± 0.21
	Monsoon	28	29.4	29.2	28.87± 0.76
	Post monsoon	30.5	30.1	29.8	30.13± 0.35
pH	Pre monsoon	5	6	5	5.33± 0.58
	Monsoon	7	6	7	6.67± 0.58
	Post monsoon	6	7	6	6.33± 0.58
Transparency (cm)	Pre monsoon	66	90	60	72± 15.87
	Monsoon	82	100	80	87.33± 11.02
	Post monsoon	76	98	74	82.66± 13.32
Hardness (mg/l)	Pre monsoon	67.5	132.5	120	106.67± 34.49
	Monsoon	25	17.5	15	19.17± 5.20
	Post monsoon	37.5	32.5	25	31.67± 6.21
Salinity (mg/l)	Pre monsoon	67.87	1471.73	1375.75	1205.12± 381.69
	Monsoon	57.618	64.017	48.006	56.55± 8.06
	Post monsoon	671.89	1407.7	1343.76	1141.17± 407.62
Ammonia (mg/l)	Pre monsoon	34	42.5	25.5	34± 8.5
	Monsoon	25.5	5	17	15.83± 10.21
	Post monsoon	17	42.5	34	31.17± 12.98
CO2 (mg/l)	Pre monsoon	35.2	30.8	26.4	30.8± 4.4
	Monsoon	10.56	17.6	14.08	14.08± 3.52
	Post monsoon	17.6	22	15.84	18.48± 3.17
Dissolved oxygen (mg/l)	Pre monsoon	5.28	5.92	6.08	5.76± 1.42
	Monsoon	4.8	5.12	4.96	4.96± 0.16
	Post monsoon	6.4	6.72	5.76	6.21± 0.48
BOD(mg/l)	Pre monsoon	0.48	0.64	0.32	0.48± 0.16
	Monsoon	0.96	0.64	0.8	0.8± 0.16
	Post monsoon	0.32	0.48	0.96	0.59± 0.33
Gross Primary Productivity (mgC/m3/hr)	Pre monsoon	0.76	0.92	0.68	0.79± 0.12
	Monsoon	0.64	0.74	1.35	0.91± 0.38
	Post monsoon	1.56	1.24	1.25	1.35± 0.18
Net Primary Productivity(mgC/m3/hr)	Pre monsoon	0.46	0.14	0.06	0.22± 0.21
	Monsoon	0.24	0.09	0.07	0.13± 0.09
	Post monsoon	0.36	0.12	0.05	0.18± 0.16
COD(mg/l)	Pre monsoon	13.6	15.5	14.2	14.43± 0.97
	Monsoon	12.5	14.2	13	13.23± 0.87
	Post monsoon	13	16.5	15.1	14.87±1.7631

III. RESULTS AND DISCUSSION

The study of physico-chemical parameters of selected three sites in Valapattanam river of Kannur district, site 1 (Parassinikadavu), site 2 (Valapattanam), site 3 (Kattampally) of three seasons were analysed and compared. The physico-chemical parameters of each sites exhibited variations in each period.

Temperature

The temperature showed a minimum range of 28^0C and exhibited maximum range of 31.1^0C.All these sites showed an average temperature range from 28.87 ^{0}C -30.870C. In pre monsoon period, the temperature ranges from 30.7^0C to 31.1^0C.A high range of temperature was observed in site 2(31.1^0C) and a lowest temperature was observed in site 1 (30.7^0C). In monsoon period, the temperature ranges from 28^0C to 29.4^0C . A high range of temperature was observed in site 2(29.4^0C) and low range was exhibited in site 1 (28^0C). The temperature of water samples in the post monsoon period ranges from 29.8^0C to 30.1^0C. A higher temperature was shown in the site 1 (30.3^0C)and lower range was noticed in the site 3(29.8^0C). (Table 1 and Fig 1). The mean ± standard deviation ranges from 28.87 ± 0.76 to 30.87 ±0.21.

pH

From the study, in pre monsoon season the pH ranged from 5 to 6 . A higher level of pH was observed in site 2 (6) and lower pH was observed in site 1 and site 3 (5).In monsoon season the pH ranges from 6 to 7. A higher level of pH was observed in site 1 and 3(7) and lower pH in site 2 (6). In the post monsoon period site 1 and site 3 showed pH value 6 conferring that water is slightly acidic. The mean ± standard deviation rangers from 5.33 ± 0.58 to 6.67 ± 0.58.

Transparency

Transparency range showed variations in all the seasons .A higher transparency value was noticed about 100 cm in site 2 of monsoon season. The lower range was 60 cm in site 3 of pre monsoon season. In pre monsoon season the transparency of water ranges from 60to90c.m.Transparency of water in monsoon season ranges from80 to 100 cm.In post monsoon season the transparency value ranges from 74 to98 cm. A high range of transparency observed in site 2 in all seasons and a lower range was observed in site 3 in all seasons. (Table 1).The mean ± standard deviation ranges from 72 ± 15.87 to 87.33± 11.02.

Hardness

Hardness of the water samples in the pre monsoon season ranges from 67.5 to 132.5 mg/l. Highest range was observed in site 2 (132.5 mg/l) and lowest range was shown in site 1 (67.5 mg/l). In monsoon season, hardness ranges from 15 to 25 mg/l. In post monsoon season maximum hardness showed in site 1 (37.5 mg/l) and minimum hardness showed in site 3 (25mg/l). (Table 1 and Fig 4). The mean ± standard deviation was about 19.17± 5.20 to 106.67 ± 34.49.

Salinity

Salinity of water sample in the pre monsoon season ranges from 767.87 to 1471.73 mg/l. A highest range was obtained in site 2 (1471.73 mg/l) and lowest range was observed in site 1 (767.87mg/l). In monsoon season salinity ranges from 48.006 to 64.017 mg/l. Maximum range was observed in site 2 (64.017 mg/l) and minimum range was shown in site 3 (48.006 mg/l). Salinity of water sample in the post monsoon season ranges from 671.89 to 1407.7 mg/l. (Table 1 and Fig 2). The mean ± standard deviation ranges from 56.55 ± 8.06 to 1205.12 ±381.69.

Ammonia

Ammonia of water sample in the pre monsoon season ranges from25.5 to 42.5 mg/l. Maximum range was observed in site 2 (42.5 mg/l) and minimum range was observed in site 3 (25.5 mg/l).In monsoon season ammonia of water sample ranges from 5 to 25.5 mg/l. The maximum range was obtained in site 1 (25.5 mg/l) and minimum range was observed in site 2 (5 mg/l). Ammonia of water sample in the post monsoon season ranges from 17 to 42.5 mg/l. A highest range was observed in site 2 (42.5 mg/l) and lowest range was observed in site 1 (17 mg/l).(Table 1 and Fig 2). The mean ± standard deviation ranges from 15.83 ± 10.21 to 34 ± 8.5.

Carbon dioxide

Carbon dioxide in water sample in pre monsoon season ranges from 26.4 to 35.2 mg/l.The maximum range was observed in site 1 (35.2 mg/l) and minimum range was observed in site 3 (26.4 mg/l). In monsoon season, carbon dioxide of water samples ranges from 10.56 to 17.6 mg/l. The maximum range of carbon dioxide obtained in site 2 (17.6 m g/l) and minimum range was obtained in site 2(10.56 mg/l). Carbon dioxide of water sample in post monsoon season ranges from 15.84 to 22 mg/l. Maximum range was observed in site 2(22 mg/l) and minimum range was observed in site 3 (15.84 mg/l). (Table 1).The mean ± standard deviation ranges from 14.08 ± 3.52 to 30.8 ± 4.4.

Dissolved Oxygen

Dissolved oxygen of water sample in the pre monsoon season ranges from 5.28 to6.08 mg/l. The maximum range was obtained in site 3 (6.08 mg/l) and minimum range was obtained in site 1(5.28mg/l). Dissolved oxygen of water sample in monsoon season ranges from 5.76 to 6.72/l. Maximum range was observed in site 2 (6.72mg/l) and minimum range was observed in site 3(5.76mg/l). Dissolved oxygen of water samples in post monsoon season ranges from 5.76 to 6.72 mg/l. The maximum range was showed in site 2 (6.72 mg/l) and minimum range was showed in site 3 (5.76 mg/l). (Table 1 and Fig 9). The mean ± standard deviation ranges from 4.96 ± 0.16 to 6.21 ±0.48.

Biological Oxygen Demand

Biological Oxygen Demand of water sample in the pre monsoon season ranges from 0.32 to 0.64 mg/l.Highest range was observed in site 2 (0.64 mg/l) and minimum range was showed in site 3 (0.32 mg/l). In monsoon season Biological Oxygen Demand ranges from 0.64to 0.96 mg/l.Maximum range was observed in site 1 (0.96 mg/l) and minimum range was observed insite2(0.64mg/l). Biological Oxygen Demand of water sample in the post monsoon season ranges from 0.32 to 0.96 mg/l. A highest range was observed in site 3 (0.96 mg/l) and lowest range was observed in site 1 (0.32mg/l). (Table 1). The mean ± standard deviation was about 0.8 ± 0.16 to 0.59 ±0.33.

Chemical Oxygen Demand

Chemical Oxygen Demand of water sample in pre monsoon ranges from13.6 to 15.5mg/l. Maximum range was observed in site 2(15.5 mg/l)and minimum range was observed in site 1 (13.6 mg/l). In monsoon season Chemical Oxygen Demand ranges from 12.5 to 14.2 mg/l. The maximum range was observed in site2 (14.2mg/l) and minimum range was observed in site 1 (12.5 mg/l). Chemical Oxygen Demand of water sample in post monsoon season ranges from 13 to 16.5 mg/l. The maximum range was observed in site 2 (16.5 mg/l) and minimum range was observed in site 1 (13 mg/l).(Table 1 and Fig 11). The mean ± standard deviation ranges from 13.23 ± 0.87 to 14.87 ±1.76.

Primary Productivity

Gross primary productivity of water sample in pre monsoon ranges from 0.68 to 0.92 mgC/m^3 /hr. Maximum range was observed in site 2 (0.92 mgC/m^3 /hr). In monsoon season Gross primary productivity ranges from 0.64 to 1.35 mgC/m^3 /hr. The maximum range was observed in site 3 (1.35 mgC/m^3 /hr) and minimum range was observed in site 1 (0.64 mgC/m^3 /hr). Gross primary productivity water sample in post monsoon season ranges from 1.2 to 1.56 mgC/m^3 /hr. The mean ± standard deviation of GPP ranges from 0.79 ± 0.12 mgC/m^3 /hr to 1.35 ± 0.18 mgC/m^3 /hr. Net primary productivity of water sample in pre monsoon from 0.06 to 0.46 mgC/m^3 /hr. maximum range was `observed in site.1 (0.46 mgC/m^3 /hr) and minimum range was observed in site 3 (0.06 mgC/m^3 /hr). In monsoon season NPP ranges from 0.07 mgC/m^3 /hr to 0.24 mgC/m^3 /hr. Maximum range was observed in site.1(0.24 mgC/m^3 /hr) and minimum was observed in site 3 (0.07 mgC/m^3 /hr). In post monsoon season NPP ranges from 0.06 to 0.4 mgC/m^3 /hr. Maximum range was observed in site 1(0.46 mgC/m^3 /hr) and minimum range was observed in site 3 (0.06 mgc/m^3 /hr). The mean ± standard deviation ranges from 0.13 ± 0.09 mgC/m^3 /hr to 0.22 ± 0.21 mgC/m^3 /hr. (Table 1 and Fig 2&3)

When the quality or composition of water changes directly or indirectly as a result of human activities, it becomes unfit for usual purposes and then the water is said to be polluted (Bharucha,2005).The temperature difference might be either due to the geographical differences in the location or due to difference between the collection times (Madhuri and Minakshi,2008). Considering the three sites, high temperature was recorded in site 4 (30.8℃) during the pre-monsoon period. According to Desai (1995) water temperature varies depending on the season. This is reflected by lower water temperature at site 1 in monsoon due to cloudy weather and rainfall. Temperature variation is due to global warming and which result in the melting of polar ice caps and leads to sea level rise and causes salinity intrusion. The high value of pH 9.1 observed in station 4 during pre-monsoon period. The amount of calcium increases during premonsoon period due to rapid oxidation or decomposition of organic matter and pH become alkaline state (Billore, 1981). Site 1 and site 3 showed a low pH value of 5 during pre-monsoon season. Slight deviation towards acidity can be attributed to the anthropogenic activities like improper irrigation and weathering process (Sajitha *et al*., 2016).

Transparency of water is generally influenced by factors like wind action, suspended silt particles, plankton concentration and decomposition of organic matter at the bottom (Gorde and Jadhav, 2013). According to APHA (2005) the desirable limit for hardness is 300mg/l. Compared to the desirable limit, the values of the sample is found to be within the limit.Some of the main factors affecting salinity intrusion in the Valapattanam River are river topography, the sea level variation, increase in temperature, decrease in precipitation etc.(Arun Raj& Vasudeo,2015).Increased salt content water will not be used for the drinking or irrigation purpose (Chapman,1997). Ammonia in natural waters can be traced to percolating nitrates from sources such as decaying plant and animal material, agricultural fertilizers and domestic sewage (Adeyeye and Abulude, 2004). Drinking water contains more than 500mg/l ammonia can cause methamoglobinemia in infants(Ubaand Aghogho, 2001).

Carbon dioxide is the end product of organic carbon degradation in almost all aquatic environments and its variation is often a measure of net ecosystem metabolism (Hopkinson, 1985). Gurumayum *et al* (2002) also reported higher values of free CO_2 during monsoon months. According to Joshi *et al*.,(1995), the increase in carbon dioxide may be due to decay and decomposition of organic matter. According to Chaurasia and Pandey (2007), the quantity of dissolved oxygen in water is directly or indirectly depends on water temperature, partial pressure of air, etc. Rodgi and Nimbergi (1978) found that disposal of domestic sewage and other oxygen demanding wastes reduced the dissolved oxygen of the receiving water body.

The BOD and other microbial activities are generally increased by the introduction of sewage(Hynes, 1971).Higher values of BOD indicate the higher consumption of oxygen and higher microbial population load in the pond water (Sayeswara *et al.*, 2010). The oxygen utilisation by living plankton communities increases proportionally with increased chemical oxygen demand (Boyd,1973).COD is an indicator of organic pollution ,which is caused by the inflow of domestic ,livestock and industrial waste that contains elevated levels of organic pollutants (Ayati,2003). Agarwal and Thomas *et*

al.,(1980) stated that the weather conditions markedly affect productivity in aquatic system .This was also noted in present study as the highest gross and net production values were obtained on bright days. Decreased value of NPP and GPP during monsoon season might be due to the reason that high suspended solids in the flood water restricts light penetration into the water and results in less photosynthetic activities and productivity. The higher value of NPP and GPP during pre-monsoon may be due to penetration of high light intensity which facilitate higher rate of photosynthesis and ultimately the productivity of the riverine system (Datta *et al.*,1984;Singh 1995).

IV. Conclusion

The result of the studies shows that all the three sites exhibited seasonal variations in the physico-chemical parameters. The study indicates that of all the three sites, site2 and site 3 are the most polluted. High rate of salinity was noticed in the study area. One of the major environmental problems faced by the rivers of Kerala is due to the disposal of untreated municipal sewage. Regular monitoring and systematic assessment in the inlets and outlets of depth survey fields can save the vitality of biotic components. This study brings to the need for proper management of saline water intrusion in the riverine region because of the hardship its negligence brings upon the public that rely on it for livelihood. Groundwater remains the main source of quality and adequate water supply in the world over from which we get water for domestic, agricultural and industrial usage. One of the factors affecting the quality of water from this source is saline water intrusion, especially in riverine areas. This problem affects the potability of the water and the population that depends on it. Therefore, due to the above-mentioned problems, measures must be brought about in order to adequately manage and control saline water intrusion so as to protect the dependent population from untold hardship that may result in near future.

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VI. References

Adeyeye, E. I. and Abulude, F.O. (2004). Analytical assessments of some surface and groundwater resources in lle–lfe,Nigeria.*J.Chem.Soc.Nig*.,29: 98-103.

APHA.(2005).Standard method for the examination of water and wastewater. American Public Health Association.21st ed. Washington DC.948 pp.

Arun Raj.N and Vasudeo.A.D.(2015).Salinity Intrusion of Valapattanam River,Kerala.*International journal of Engineering Research and Technology*,4(11):710-713.

Ayati, B.,2003. Investigation of sanitary and industrial waste water effects on Anzali Reserved Wetland(Final report).MAB-UNESCO, Tarbiat Modares University, Iran,p 53.

Bharucha.E.(2005).Textbook of Environmental Studies;University Grants Commission,universities press (India) private limited 2005,p.122-124.

BilloreD.K.(1981),Ecological Studies of Pichhola lake, Ph.D.Thesis,Univ.of Udaipur.p 45-54.

Boyd,C.E.(1973).The chemical oxygen demand of waters and biological materials from ponds ,Trans.*Amer.Fish.Soc*.,3:606-611.

Carpenter.S.R., Caraco .N.F., Correll .,D.L., Howarth ,R.W., Sharpley ,A.Nand Smith.V.H.(1998).Non point pollution of surface waters with phosphorus and nitrogen .*Ecological applications*.8:559-568.

Chapman,D(1992).Water Quality Assessment (WQA). A guide to use of biota, sediments and water in environmental monitoring, 2nd ed, p 18-34.

Chaurasia Mahina and Panday.G.C.(2007).Study of Physico-chemical characteristics of some water ponds of Ayodhya., Faizabad. *IJEP*, 27 (11): 1019-1023.

Datta,N.C.,N.Mandal,and B.K.Bandyopadhyay.(1984).Seasonal variations of primary productivity in relation to some Physico-chemical property of a freshwater pond ,Calcutta.*Int.J.Acad.Ichthyol*,5:113-120.

Desai.P.V.(1995).Water quality of Dudhsagar river at Dudhsagar,Goa, India.*Poll Res*,14(4):337-382.

Gorde .S.Pand Jadhav .M.V.(2013). Assessment of Water Quality Parameters-A Review.*Journal of Engineering Research and Applications*,3(6): 2029-2035.

Gurumayum.S.D.,Daimari.P.,Goswami.B.S.J.,Sarkar. Chaudhary.M. (2002). *Journal of the Inland Fisheries Society of India*, 34(2):36-42.

Hopkinson.C.S.(1985).Shallow-water and pelagic metabolism: Evidence of heterotrophy in the near-shore Georgia Bight.*Marine Biology*,87:19.

Hynes.H.B.N.(1971).The Biology of polluted water, University toronto press, Canada.202 pp.

Joshi.M., Shishodia.S.K., Kumar.S.Nand Saikia.D.K. (1995). Ecosystem Studies in the upper region of Ganga River.*Environmental monitoring and assessment*,35:181-206.

Madhuri Pejaver and Minakshi Gurav.(2008).Study of Water Quality of Jail and Kalwa Lake, Thane, Maharashtra, *J. Aqua. Biol*, 23(2):44-50.

Manjusha Bohr., Prakash Kadave., Abhijit Bhor. (2013). Water Quality Assessment of the River Godavari, At Ramkund, Nasik, Maharashtra, India *International Journal of Engineering and Science*,2(2):64-68.

Naiman, R.J. (1992). New perspectives for watershed management. In:R.J.Naiman(ed),Watershed Management: BalancingSustainability and Environmental Change. *Springer-Verlag*,New York.pp.3-11.

Rodgi.S.S. and Nimbergi.P.M. (1978). *The Journal of the Karnataka University Science,* 23:92-115.

Sajitha.V., Smita Ashok and Vijayamma. (2016) .Study of physico-chemical parameters and pond water quality assessment by using water quality index at Athiyannoor panchayath, Kerala, India. *Emerging Life Science Research*,2(1):46-51.

Sayeswar.H.A., Ravikumar. H.S and Mahesh Anand Goudarb.(2010). Studies on physico-chemical parameters of pure pond water of Shivamogga, Karnataka ,India. *Int. J. Chem. Sci*,8(1):582-588.

Simpi,B;Hiremath,S,M;Murthy,KNS;Chandrashekarappa,K.N; Anil N Patel and Puttiah,E.T. Analysis of water quality using physico- chemical Parameters Hosahalli Tank in Shimoga District, Karnataka, India, *Global Journal of Science Frontier, Research*, 1(3),2011, 31-34.

Srivastava .C.P. (1992). Pollutants and nutrients status in raw sewage. *Indian Journal of Environment Protection*,18: 101-111.

Uba Aghogo and Aghogho.(2001). Rainwater quality from different root catchmentsinport–Harcourtdistrict.Institute public analyst Nigeria News,2:64-68.

Umamaheshwari .S and Anbu Saravanan .N. (2009). Water Quality of Cauvery River Basin in Tiruchchirapalli, India. *International Journal of Lakes and Rivers*, 2(1): 1-20.

Verma,S.R., Shukla,G.R. and Dalela,R.C.(1980).Studies on pollution of Hudson river in relation to fish and fisheries.Limnological(Bulletin),12(1):p 33-75.

VijayaKumar.K.M,Vijayakumara.(2013).Physicochemical Analysis Of Water quality of Kundapura Mangrove forest,Karnataka India., *International Journal of Engineering and Science*. 2:64-68.

Welch.P. S. (1952). Limnology, McGraw Hill Book Co. Inc., New York.2nded.1-538.

World Health Organisation(WHO)(1997).Guideline for drinking water quality.Health Criteria and other supporting information, 2nd ed,Geneva,2:p 231-270.