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Comparative Study of Seasonal Variation in Physicochemical Properties of Selected Wetlands of Mehsana Districts, North Gujarat.

KEYWORDS: Physicochemical parameter, Wetland, Seasonal variation

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ABSTRACT *The present work was assessing seasonal variation in physicochemical characteristics of some selected wetlands of mehsana districts during the period of March 2013-february 2014 for winter, summer and monsoon season. various parameter were measured like pH, calcium hardness, total hardness, phosphate (PO_4^-), chloride (Cl^-), potassium (K^+), sodium (Na^+), carbonate (CO_3^-) and bicarbonate (HCO_3^-), total alkalinity, Biological oxygen demand, (BOD),Dissolved Oxygen (DO). Data analysis reveals that pH and BOD were higher in summer, Total hardness, potassium, sodium, phosphate, carbonate were medium in summer, calcium hardness, chloride, bicarbonate, total alkalinity and DO were lower in summer. Calcium hardness, bicarbonate, total alkalinity were higher in monsoon season, chloride, DO and BOD were medium in monsoon whereas pH, total hardness, potassium, sodium, phosphate and carbonate were lower in monsoon. Total hardness, potassium, sodium, chloride, phosphate, carbonate and DO were higher in winter, pH, Calcium hardness, chloride; bicarbonate and total alkalinity were medium in winter whereas BOD was lower in winter season.*

Introduction
Water is one of the most important factors for all living organisms, imagine a form of life that can impossible without water. Approximately 71% of the earth surface covered by water in the form of oceans, glaciers, fresh water bodies, rivers, wells, lakes (Patel and Patel, 2012; Nirmala et al 2012). Out of which only 3% of water occupied by fresh water and less than 1% water is occupied by lakes and ground water.

Wetlands are one of the sources of water and transitional area between land and water. Wetland includes a differential habitat with permanent or temporary water bodies with variety of function and value likes diversity of organism included threatened and endangered species, nutrient recycling, purification of water and Ground water recharge. (Pramod, et al 2011; Sarkar and Upadhyay ,2013)

Quality of water in ponds, river may vary subject on geological morphology, vegetation and land use. Physicochemical properties were influence by season to season and also anthropogenic activities like agriculture, urbanization, domestic sewage etc. in the catchment area resulted in deterioration of water quality. (Bhat et al, 2009)

The present study is mainly focused on impact of seasonal changes in physicochemical characteristics like pH, Calcium hardness, Total hardness, Phosphate (PO_4^-), Chloride (Cl^-), Potassium (K^+), Sodium (Na^+), Carbonate (CO_3^-) and Bicarbonate (HCO_3^-), Total alkalinity, Biological Oxygen Demand (BOD), Dissolved Oxygen (DO).

MATERIALS AND METHODS
Area of study
Mehsana is an organizational district with 9 Tehsil namely mehsana, visnagar, vadnagar, unjha, kheralu, kadi, vijapur, satalasana, and becharaji. mehsana district were bounded by Banaskantha district in the north, Patan and Surendranagar districts in the west, Gandhinagar and Ahmedabad districts in south and Sabarkantha district in the east. It lies between 20°07' and 24°43' North latitude and 68°10' to 74°29' east longitude. Locations were selected based on the different activities carried out in the areas of every tehsil of Mehsana district for the analysis of physicochemical properties.

Climatic Conditions
District has very hot in summer with average temperature range from 30°c to 45°c and very cold in winter with average temperature range from 8°c to 18°c. Average rainfall in the district is 800-1200 mm. climate of mehsana district is dry or semi dry in nature.

Sample collection
For physicochemical analysis, water samples were collected from 9 taluka of Mehsana district. Water was collected in collection bottle during three successive seasons (winter, summer and Monsoon) of the year from March-2013 to Feb - 2014. Physicochemical parameter such as pH, Calcium hardness, Total hardness, Phosphate (PO_4^-), Chloride (Cl^-), Potassium (K^+), Sodium (Na^+), Carbonate (CO_3^-) and Bicarbonate (HCO_3^-), Total alkalinity, Biological Oxygen Demand (BOD), Dissolved Oxygen (DO) were analyzed in laboratory. For dissolved oxygen measurement a 500ml capacity BOD bottle was used for the collection of water samples and the oxygen was fixed by adding $MnSO_4$ and alkaline potassium iodide at the sampling site before being carried to the laboratory (Tanwar.S and Tyor.A, 2014).

Physicochemical analysis
Water sample were collected from A- panchot talav (mehsana taluka), B- unava mem talav (unjha taluka), C- bhandu pond (visnagar taluka), D- sundia pond (vadnagar taluka), E- suraj talav (kadi taluka), F- kheralu talav (kheralu taluka), G- Vijapur pond (vijapur taluka), H- Becharaji talav (becharaji taluka) and I- satlasana pond (satlasana taluka). pH was measured by digital pH meter, calcium hardness and total hardness by EDTA titration method, phosphate was determined by stannous chloride method, chloride by argentometric titration method, potassium and sodium by flame photometer, carbonate, bicarbonate and total alkalinity by titration method , DO by Winkler method and BOD by titrimetric method.

All physicochemical parameters of collected water samples were done from the methods reported in guidelines of central pollution control board, Govt. of India, New Delhi (CPCB New Delhi, 2000) and methods reported by Trivedi and Goel (1984).

Result and discussion
Wetlands contain uniform water solution which undergoes constant physicochemical changes due to transmission in the

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environment that widely affects the water quality composition. Difference in results is found between different lakes as well as within different sites of the lakes. However there could be always a possibility for difference in test result in different laboratories because of laboratory approach, sample preservation, quality of chemicals used and testing methods applied (Weldemarim 2013). Results of the physicochemical parameters obtained from this study are discussed bellow-

pH:
pH is a measurement of hydrogen ion concentration in water, which is either alkaline or acidic. (Harney et al 2013; Abir 2014). pH that responsible for the acidic or basic property, is a essential characteristic of any aquatic ecosystem since all the biochemical activities and retention of physico-chemical features of the water are greatly depend on pH of the surrounding water (Jalal and Sanal Kumar, 2013) . Most of the similar study suggested that water samples are slightly alkaline due to presence of carbonates and bicarbonates (Tank and Chippa, 2013; Gopalkrushna, 2011; Verma et al., 2012). The higher range of pH indicates higher productivity of water (Gopalkrushna, 2011) because availability of carbonates and bicarbonates in water enhance dissolve carbon dioxide level by dissociation and acts as a raw material for photosynthesis. Analytical study reveals that pH of every ponds were maximum in summer, medium in winter and minimum in monsoon season, which had mean value ranged from 7.38 to 8.08 during summer, 7.08 to 7.48 during winter and 6.63 to 6.93 during monsoon. Lowest mean value of pH - 6.63 was measured at study site F- kheralu talav (kheralu taluka) and highest mean value of pH 8.08 at study site B- mem talav (unava taluka), which was found very approximate to the high limit (6.5 to 8.5) prescribed by the BIS (Bureau of Indian Standard) (figure 1).

Calcium hardness:
As per APHA standard, Calcium hardness was ideally range from 0-20 soft, 20-40 moderate soft, 40 -80 moderate hard, 80- 120 hard and greater than 120 very hard. Calcium hardness of every pond was maximum in monsoon, medium in winter and minimum in summer. The mean value of calcium hardness ranged from 5.13 mg/l to 40.23 mg/l during summer, 16.4 mg/l to 86.25 mg/l during monsoon and 7.8 mg/l to 58.65 mg/l during winter. F-kheralu talav (kheralu taluka) possess 5.13 mg/l with lower concentration of calcium hardness whereas A- panchot talav (mehsana taluka) possess 86.25 mg/l with higher concentration of calcium hardness among the 9 taluka of selected lakes (figure 1). Organic substance and agricultural waste increase calcium hardness. (Tidame & Shinde 2012).

Total hardness:
Hardness is caused due to presence of cations like Ca^{+2}, Mg^{+2}, Fe^{+3} etc. This is the property of water to precipitate soap by formation of complex with calcium, magnesium present on water. As per APHA standard, total hardness was ideally range from 0-30 soft, 30-60 moderate soft, 60 -120 moderate hard, 120- 180 hard and greater than 180 very hard. Data indicated that, total hardness of every lakes were maximum in winter, medium in summer and minimum in monsoon season. The mean value varied from 56.5 mg/l to 167.25 mg/l during summer, 28.75 mg/l to 117.5 mg/l during monsoon and 84.25 mg/l to 221.7 mg/l during winter season. Maximum mean value of total hardness 221.7mg/l at A-panchot lake (mehsana taluka) and minimum mean value of total hardness 28.75 mg/l at I- Satlasana pond (satlasana taluka) (Figure 1).

Potassium (K^+):
In the analysis of potassium ion resulted maximum in winter, medium in summer and minimum in monsoon. The mean value of potassium found 1.48-7.15 mg/l during summer, 0.88-5.73 mg/l during monsoon and 2.13-8.78 mg/l during winter season. D-sundia pond (vadnagar taluka) was found 8.78 mg/l amount of potassium with highest mean value and I-satlasana pond (satlasana taluka) 0.88 mg/l with lowest mean value among the selected wetlands of mehsana district (Figure 1).

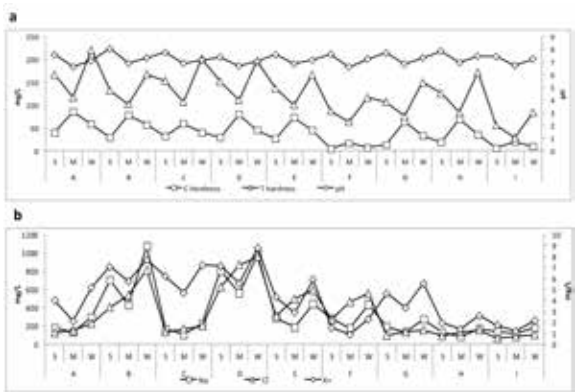

Figure 1: Physicochemical parameter analysis of water samples collected from different wetlands in Mehsana district. C hardness, T hardness and pH analysis is indicate in "a" and "b" content measurement of Na, Cl and K. A: A-panchot talav, B- unava mem talav, C- bhandu pond, D-sundia pond, E- suraj talav, F- kheralu talav, G- Vijapur pond, H- Becharaji talav and I- satlasana pond.

Sodium (Na^+):
During the period of study, it was observed the value of sodium was higher in winter, medium in summer and lower in monsoon. The mean value of sodium was from 127- 806 mg/l during summer, 79.3- 559.5 mg/l during monsoon and 169.5-1107 mg/l during winter season. Higher concentration of sodium was 1107 mg/l in D- sundia pond (vadnagar taluka) and lower concentration in becharaji talav (becharagi taluka) was 79 mg/l. Sodium concentration increase by human activities like discharges from water softness, human or animal waste disposal, etc. AS par WHO guideline, maximum acceptability of sodium was 50 mg/l (Figure 2).

Chloride (Cl^-):
Chloride is present abundantly in natural surface and ground water in varying level. Chlorides are mainly come from inorganic salts like NaCl, KCl and $CaCl_2$ etc. which are generally obtained from soil, natural layers of chloride salts, municipal and industrial sewage and animal wastes (Gopalkrushna, 2011). Chloride is generally not harmful to humans but higher level of chloride increase the corrosive property of water. Our result suggested that, value of chloride ion was greatest in winter, medium in monsoon and least in summer season. Chloride ion was range from 64.2 – 726.25 mg/l during summer, 82.25 – 1009.5 mg/l during monsoon and 100.5 – 1346.7 mg/l during winter season. D-sundia pond (vadnagar taluka) was found 1346.7 mg/l with higher concentration of chloride and I - satlasana pond (satlasana taluka) was found 64.2 mg/l with lower concentration among the studied area (Figure 2). The chloride content of studied water samples were over the permissible limit prescribed by BIS. Higher concentration of chloride ion in wetlands was indication of pollution by anthropogenic pressure. (Kumar et al, 2010; Nirmala et al, 2012). Permissible Range of chloride was 200- 300 mg/l as per BIS guideline.

Phosphate (PO_4^-):
Phosphate has a few sources in nature and also acts as a regulating factor for productivity of water body. Phosphate may occur in lake as result of domestic waste, detergent and agricultural run-off containing fertilizer (Gopalkrusna, 2011). During the period of the study, Phosphate concentration was higher in winter, medium in summer and lower in monsoon season. The mean value of phosphate was ranged from 0.60 – 1.7 mg/l during summer, 0.28 – 1.25 mg/l during monsoon and 1.03 – 2.03 mg/l during winter season. B- unava mem talav (unjha taluka) possess higher level of phosphate with

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the mean value 2.03 mg/l, whereas F- kheralu talav (kheralu taluka) possess lower level of phosphate (PO_4^-) with mean value 0.28 mg/l (Figure 2). Comparatively high amount of phosphate is recorded which is might be due to discharge of municipality sewage and dumping of domestic waste into the lakes (Benjamin et al, 1996) Higher concentration of phosphate is an indicator of pollution, which induce possibility of eutrophication (Singare.P et al, 2011). It was increase due to agriculture waste by local people inside the wetlands (Prasanna.M and Panda.C, 2010).

Carbonate (Co_3^-):
Present study concluded that carbonate was higher in winter, moderate in summer and lower in monsoon season. The mean value of Co_3- was range from 0.3 – 3 mg/l during summer, 0.08 – 1.3 mg/l during monsoon and 0.85 – 5.83 mg/l during winter season. B- unava Mem talav (unjha taluka) was found 5.83 mg/l with higher level of Co_3^- and A- panchot talav (mehsana taluka) was found 0.08 mg/l with lower level of Co_3^- (Figure 2)

Bicarbonate (HCo_3^-):
concentration of bicarbonate was higher in monsoon, medium in winter and lower in summer season. The value of Co3- varied from 97.25 – 269.5 mg/l during summer, 145.5 – 385.5 mg/l during monsoon and 123 – 288.5 mg/l during winter season. F-kheralu talav (kheralu taluka) possess 385.5 mg/l with higher amount of HCO_3^- and A- panchot talav (mehsana taluka) possess 97.25 mg/l with lower amount of HCO_3^- (Figure 2).

Total alkalinity:
Alkalinity is measuring the acid neutralizing capacity of water. Natural alkalinity to water sources is imparted mainly by salts of weak acids such as bicarbonates, carbonates, borates, silicates, phosphates and the salts of humic and fulvic acids (Budhlani et al 2014) Total alkalinity is the combined activity of the values of carbonates and bicarbonates in water (Nirmala et al 2012). Alkalinity was higher in monsoon, moderate in winter and lower in winter season. The observed values of total alkalinity varied from 98.45 – 270.75 mg/l during summer, 146.8 – 386.6 mg/l during monsoon and 124.7 – 289.88 mg/l during winter season. Maximum mean value of Total alkalinity was 386.6 mg/l at F-kheralu talav (kheralu taluka) and minimum mean value was 98.45 mg/l at Panchot talav (mehsana taluka) (Figure 2).

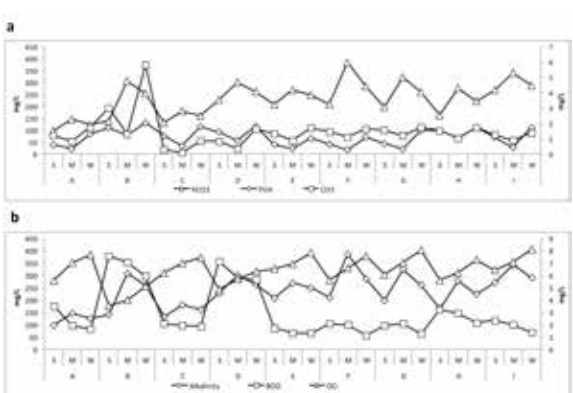

Figure 2: Physicochemical parameter analysis of water samples collected from different wetlands in Mehsana district. HCo_3, PO_4 and CO_3 analysis is indicate in "a" and "b" content measurement of Alkalinity, BOD and DO. A: A-panchot talav, B- unava mem talav, C- bhandu pond, D-sundia pond, E- suraj talav, F- kheralu talav, G- Vijapur pond, H- Becharaji talav and I- satlasana pond.

Biological Oxygen Demand (BOD):
Biological oxygen demand means consumption of oxygen by microorganism to oxidized organics in water under aerobic condition (Patil and Gorade, 2013). Biochemical oxygen demand (BOD) is an important parameter of water quality which measures the quantity of oxygen consumption by microorganisms during decomposition of organic matter. BOD is usually used for determining the oxygen demand of municipal or industrial discharge. High BOD indicates high scale contamination of organic matter in the water (Anhwange et al. 2012). As per APHA standard, BOD_5 was ranged from less than 3.0 mg/l non/slightly polluted, 3.0 – 4.9 mg/l lightly polluted, 2.0 – 4.5 mg/l moderated polluted and greater than 15 mg/l severely polluted. Data was reveals that BOD was comparatively high in summer, moderate in monsoon, and low in winter. But it's also influence by pollution under human activity. The mean value of BOD was recorded from 1.73 – 7.6 mg/l during summer, 1.33 – 7.08 mg/l during monsoon and 1.13 – 5.95 mg/l during winter. Higher level of BOD was 7.6 mg/l at B-unava mem talav (unjha taluka) and lower level of BOD was 1.13 mg/l at F-kheralu talav (kheralu taluka) (Figure 2).

Dissolved Oxygen (DO):
Dissolve oxygen indicates the health of the ecosystem and is refers to the volume of oxygen present in water body. It is an important water quality parameter to be measure because it prevail biological and physicochemical attributes of surrounding water. Oxygen enters into the water by aerial diffusion and as a photosynthetic byproduct of aquatic plants and algae. The DO depends upon the temperature, salinity and pressure of the water. The DO value indicates the degree of pollution in the water bodies (Gupalkrushna, 2011). The aquatic life distressed when DO levels drops to 4-2 mg/lit. (Francis and Floyd, 2003) and as DO level falls undesirable changes in odor, taste and color reduce the usefulness of water (Tank and chippa, 2013). Dissolved oxygen is an indicator of water quality, means that polluted water have low level of DO (Gupta et al, 2011; Patil and Gorade 2013). DO was varied from greater than 6.5 – non/slightly polluted, 4.6 – 6.5 mg/l – lightly polluted, 2.0 – 4.5 mg/l mostly polluted and less than 2.0- severely polluted as per BIS standard. DO was higher in winter, medium in monsoon and lower in summer. DO was ranged from 3.55 – 6.53 mg/l during summer, 4 – 7.1 mg/l during monsoon and 5.13 – 8.13 mg/l during winter. I- satalasana pond (satlasana taluka) possess 8.13 mg/l with high level of dissolved oxygen whereas B-unava mem talav (unjha taluka) possess 3.55 mg/l with low level of dissolved oxygen (Figure 2). DO level of studied water bodies are found within the prescribed range of BIS.

Water can only hold a limited supply of dissolve oxygen in a water body and is fluctuate with diurnal cycle of the aquatic ecosystem. The probable reasons for high BOD as well as normal DO in the studied lakes suggested that there is high nitrogenous oxygen demand (NOD) than carbonaceous biochemical oxygen demand (CBOD). NOD is the result of the breakdown of proteins into ammonia, which is readily converted to nitrate in the environment. The conversion of ammonia to nitrate requires more than four times the amount of oxygen as the conversion of an equal amount of hydrocarbons to carbon dioxide and water. Agricultural practice and sewage runoff in most of wetlands increase nutrients such as nitrate and phosphate in the water which endorses the growth of aquatic plants eventually, leads to an increase in plant decay and a greater move to and fro in the diurnal dissolved oxygen level, so normal DO despite high BOD is acceptable in the studied lakes where sewage runoff and agricultural run off as well as domestic waste contamination are the main problem.

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