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Study of monthly variations in selected physico-chemical parameters for evaluation of water quality of Manika Mann (Lake), Muzaffarpur, Bihar.

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ABSTRACT:
Manika Mann is a perennial source of water for the locals. To evaluate the water quality of the above Mann, selected physico-chemical parameters were studied in each month of the year that is from January to December. Here the temperature ranged between 10.5^{0}C to 31.8^{0}C, pH ranged between 6.68 to 8.36, Transparency 18.80 cm to 46.54 cm, Total Dissolved Solids 398 mg/l to 2165 mg/l, Conductivity 142.25 µs/cm to 246.24µs/cm. Dissolved Oxygen from 4.2 to 10.6 mg/l. Free Carbon Dioxide 4.50 mg/l to 7.26 mg/l, Alkalinity 139.62 mg/l to 166.35 mg/l, Hardness 78.54 mg/l to 154.54 mg/l, Carbonate 32.72 mg/l to 69.62 mg/l, and Bicarbonate 147.60 mg/l to 276.24 mg/l respectively. Therefore, on the basis of above findings it is essential that Mann water should be put under strict vigilance and constant monitoring, so that quality of water may be managed and cause of its deterioration be checked.

KEY WORDS: Manika Mann, Monthly Variations, Physico-Chemical Parameters, Water Quality, Deterioration, Dissolved Oxygen, and Conductivity.

INTRODUCTION:

Water on this planet is the primary need for the survival of all living organisms. We do not get any impurities in natural water, but due to change in the life styles, anthropogenic products became the main source of pollutants and purity of water degraded up to any extent. Water bodies like, ponds, lake or rivers etc. are being used by the people living near it. They use it for washing, cleaning, bathing, irrigation and other different purposes. Therefore, it is essential that they should know about the health and purity of water which they are utilizing. Pure water is essential for the cattle, and irrigation, washing of clothes etc. The data obtained by analyzing the different physico-chemical parameters will give a clear cut picture about the purity of water.

Physico-chemical parameters of different water bodies have been done by several investigators. Some of them are being mentioned here. Boyd (1981) reported that physico-chemical parameters of water are important to observe the functional relationship and productivity of fresh or marine ecosystems as they are regulated by the dynamics of their physical, chemical and biotic environment. The quality of a given water body where fish farming is done, is controlled by its physical, chemical and biological factors, all of which that is the interaction of the parameters with one another influences the productivity of the water body. (Tsegay and Zebib., 2016). Physico-chemical characteristics of different water bodies have been done by several workers. Some of them are being mentioned here such as Dwivedi and Pandey (2002); Srivastava *et al*; (2003); Murthi and Yajurvedi (2004); Narayan *et al*; (2005); Shah *et al*; (2006); Chaurasia and Pandey (2007); Ranjan et al; (2008) Aroye (2009); Mahananda *et al*; (2010); Arya *et al* (2011); Madhudule *et al*; (2012); Jena *et al*; (2013); Nag and Gupta (2014); Verma and Khan (2015); Bhayali *et al*; (2016); Balakrishnan *et al*; (2017); Ramnathan and Amsath (2018); Seetha and Chandran (2020); Farnaz and Rahamtullah (2021); Mehta and Kumari (2022). Manika mann is an old perennial water bodies, whose water is being used by the local for different agricultural and domestic uses. Even fish farming is being done in this. This study was carried out to determine some physico-chemical parameters and its monthly variations. So that, conclusion may be drawn regarding the water quality of this perennial water body.

MATERIALS & METHODS:

Manika mann is present in the village Manika of Mushahari Block. This is 8-9 kilometer East form the district town Muzaffarpur. The latitude of Muzaffarpur is 26.121473 and longitude 85.368752. The coordinate is 26.1197^0 N and 85.3910^{0}E.

Sample Collection and Analysis Methods:

Different parameters were studied monthly. The temperature was measured with the help of laboratory thermometer 100^{0}C. The pH was noted with the help of digital pH meter. Before use the glass electrode was calibrated with 4.0, 7.0 and 9.0 buffer solution. Similarly, the transparency was measured at the site with the help of Secchi disc and a wooden boat. This was measured when the light was falling perpendicular on the water surface and there was no air current. For other parameters samples water were collected in well cleaned and dried polythene bottles which had proper corks. For the analysis of dissolved oxygen sample water was collected with precautions so that there could not enter any air

bubbles. Then the dissolved oxygen was fixed soon for which 2 ml of Manganese chloride, 2 ml of alkaline iodide-azide solution. The precipitate was dissolved with few drops of concentrated sulphuric acid. In the laboratory the known volume of above fixed sample water was titrated with 0.02N Sodium thiosulfate using starch as an indicator. Conductivity of sample water was determined with conductivity meter and other parameters by following the APHA-2005.

RESULTS AND DISCUSSION:

Temperature:

Temperature of the Manika mann water ranged between 10.5^0C to 31.8^0C. Here lowest temperature was noted in the month of January, followed by December, while the highest temperature was noted in the month of June. Here from January to June there is gradual increase in the temperature while from June to December, there is gradual decrease. Water temperature is directly related with air temperature. In North Bihar, January is considered to be the coldest month; hence, the temperature was low. Similarly, June is considered as the warm month of the year so the air temperature was high. The month, in which the data were analysed, was neither too cold, not to warm. From the above data, it is clear that there was significant difference among the different months with respect to temperature. Water temperature is a vital factor that affects the biochemical reactions among the organisms. Jayalakshmi *et al*; (2011); Tsegay and Haftom (2016). The values obtained in this study were slightly higher than the recommended by WHO (2006) standard that is 25^0C. High water temperature enhances the growth of micro organisms, may increase the problems related to taste, odor, colour and corrosion (WHO, 2011). In wet temperature, the viscosity increases. This in turn diminishes the efficiency of settling of the solids that the water quality may contain, because of the resistance that the high viscosity offers to the down ward motion of the particles as they settle. (Jayalakshami *et al*; (2011)).

pH:

pH of the mann water ranged between 7.60 to 8.36 respectively. Here, during rainy season, due to dilution, the pH was lower where as during summer, due to high photosynthetic rate of the aquatic plants and consumption of Co_2 lower the pH and there was increase in alkalinity that was 8.36. pH also influences the metabolic activity of the aquatic organisms as has been reported by Kumar *et al*; (2014); Ranjan *et al*; (2017) and Farnaz and Rahamtullah (2021).

Transparency:

Transparency of Manika mann, was recorded highest in the month of May, which was 72.54 cm. similarly, higher transparency was noted in the month of November, 43.56 cm and in December 42.0 cm. Here the lowest transparency was noted in the month of August and September which may be due to presence of soil and sand particles brought during the raining season in the form of rain water runoff. During summer and winter the higher transparency may be due to gradual setting of suspended soil and sand particles. Similar reports have been given by Bhat *et al*; (1985); Kumar and Singh (2013); Rajan (2017); Mehta and Kumari (2022).

Total Dissolved Solids:

Total Dissolved Solids of Manika mann water was also calculated in different months of the year. The values of total dissolved solids ranged between 398 mg/l to 2165 mg/l respectively. Here the lowest value was noted it he month of January and highest in the month of May respectively. This may be due to the water volume. Here during summer, level of water in the ponds goes down in the bed only. Both banks and its surroundings become completely dry. Total dissolved solids denote mainly the different kinds of minerals present in water. The permissible value recommended for total dissolved solids in 500 mg/l, prescribed by IS 10500, and BIS, FAO (Sajitha and Vijayamma, 2016). From the data obtained here, it is clear that there are monthly variations in the amount of total dissolved solids in the pond water of Manika mann. Present findings are in agreement with the findings of Srivastava and Kanungo (2013) and Sajitha and Vijayamma (2016) respectively.

Electrical Conductivity:

Electrical conductivity of Manika mann water was also calculated in different months of working year. The means of the data obtained were tabulated in table-1. From the table, it may be noted that electrical conductivity ranged between 142.25µs/cm to 246.24µs/cm respectively. From the table, it is also clear that there were considerable variations in the values of electrical conductivity from January to December. Here higher value was observed in the month of April while lowest in the month of January. The electrical conductivity is the indicators of the presence of different charged particles present in the water. So dilution may affect the data. Electrical conductivity is the ability of an aqueous solution to conduct electric current. The values of electric conductivity help in the determination of purity of water (Acharya *et al*; 2008). Above findings are in agreement with the findings of Srivastava and Kanungo (2013) who also reported similar data.

Dissolved Oxygen:
Dissolved oxygen of Manika mann water also revealed monthly variations. Here the maximum value 10.6 mg/l was found in the month of January while the lowest value 4.2 mg/l in the month of June itself. As temperature influences the capability of oxygen to be dissolved in water, due to which its concentration was low in the month of June, because at higher temperature, the dissolving power is lowered, while at low temperature, it is high. Presence of dissolved oxygen is essential to maintain higher forms of biological life and to keep proper balance of various pollutions, thus making the water bodies healthy. (Sajitha and Vijayamma, 2006). Further, the chemical and biochemical process undergoing in water body are largely dependent up on the presence of oxygen. Therefore, the calculated values of dissolved oxygen help in the determination of the health of the water. In addition to temperature, another factor like algal bloom, Biochemical Oxygen Demand and Chemical Oxygen Demand also influence the concentrations of dissolved Oxygen in the water bodies. Above findings are supported by the findings of Tidame and Shinde, (2012); Singh (2014). Sajitha & Vijayamma (2016); Ramnathan and Amsath (2018); Chakrabarti (2019) respectively.

Free Carbon Dioxide:
Average value of free carbon dioxide ranged between 4.50 mg/l to 7.26 mg/l observed in the months of January and June respectively. Higher level of free carbon dioxide was observed from May to September which was 6.58 mg/l, 7.26 mg/l, 6.35 mg/l, 6.58 mg/l and 6.24 mg/l respectively. This value gradually decreased from 6.24 mg/l to 6.0 mg/l; 5.72 mg/l, 5.30 mg/l and finally 4.50 mg/l. From January to June, there was gradual increase in the concentrations of free Co_2. This may be due to active respiration along with rise of temperature, while low photosynthesis due to high temperature. Further, the decomposition of wastage may add in the amount of the free carbon dioxide. Similar, observations were found in the work of Tara *et al*; (2011); Jain and Senapathi (2016); Quadri and Shah (1984); Bhattacharya (2018).

Alkalinity:
Alkalinity of the Manika Mann was also evaluated. Here the values ranged between 139.62 mg/l to 166.35 mg/l from January to December. Here the higher value was observed in the month of October where as the lowest value in the month of April. It may be noted from the table, that from April to October the alkalinity values increased while from November to April the values decreased gradually. Alkalinity of water is the capacity to neutralize strong acids. In the present study monthly variations in alkalinity of Manika mann water was observed.
The ability to resist changes in pH is alkalinity which is due to presence of carbonates, bicarbonates, hydroxides and phosphates etc. (Bhatnagar and Pooja, 2013). Therefore, increase in concentrations of carbonate and bicarbonate also increases the alkalinity of water. Biswas *et al*; (2011); Khana *et al* (2011); Kumar *et al*; (2014); and Chakarbarty (2019) also reported similar variations in the alkalinity of different water bodies.

Hardness:
Total hardness is a measure of capacity of water and precipitates the soap (Teame and Zebib., 2016). In most fresh water, total hardness is imparted mainly by calcium and magnesium ions, which apart from Sulphate, chloride and nitrate are found in combination with carbonates and bicarbonates (Sangpal *et al*; 2011). In the present study the lowest hardness value 78.54 mg/l was noted in the month of February while the highest value 156.54 mg/l was observed in the month of September. Present findings are in agreement with the findings of Kiran (2010), Farnaz and Rahamtullah (2021).

Carbonate and Bicarbonate:
In the present study, lowest value of carbonate was 32.72 mg/l and the lowest value of bicarbonate was 168.25 mg/l respectively. Similarly, the highest value of carbonate was 69.62 mg/l while the maximum value was 276.24 mg/l for the bicarbonate. In this way carbonate alkalinity was low in different months of study while the concentration of bicarbonate was higher in all the months. This may be due to pH range which favour more Co_2 to be present as HCO_3 ion (Clarke, 1965), Singh (1985) have also reported high value of bicarbonate alkalinity in polluted water. As per WHO (2006) the highest desirable limit is 100 mg/l and maximum permissible limit is 500 mg/l. So in some cases, the desirable limits have been crossed which means the mann water is gradually becoming more polluted.

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CONFLICTS:
There are no conflicts regarding publication of this paper.

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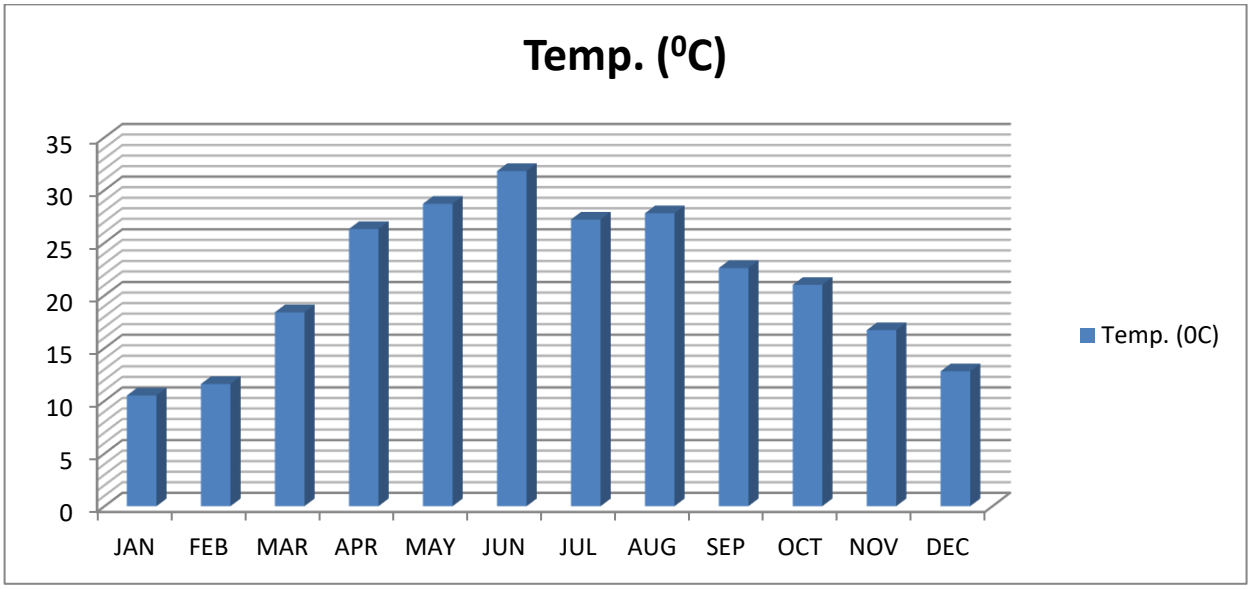
Table-1

Parameters	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Temp. (^{0}C)	10.5	11.6	18.4	26.3	28.7	31.8	27.2	27.8	22.6	21.0	16.7	12.8
pH	7.80	7.89	7.64	7.70	7.80	8.36	8.0	7.6	6.84	6.72	6.68	7.3
Transparency (cm)	22.78	29.45	32.60	72.36	46.54	30.18	24.45	19.60	18.80	19.74	43.56	42.0
Total Dissolved Solids (mg/l)	398	416	428	532	608	1854	2165	1080	488	502	1505	768
Conductivity (µs/cm)	142.25	148.36	234.56	246.24	216.72	192.48	198.75	182.64	181.24	162.18	156.38	158.15
Dissolved Oxygen (mg/l)	10.6	9.8	8.4	6.2	5.3	4.2	6.3	7.4	7.6	7.8	8.8	9.5
Free Co_2 (mg/l)	4.50	4.80	4.85	6.34	6.58	7.26	6.35	6.58	6.24	6.0	5.72	5.30
Alkalinity (mg/l)	141.28	143.46	146.75	139.62	145.62	140.18	156.36	158.25	154.70	166.3	165.0	154.25
Hardness (mg/l)	84.38	78.54	95.2	108.46	134.64	146.74	154.20	13.44	156.54	130.32	124.76	98.45
Carbonate (mg/l)	32.72	37.18	34.36	40.54	57.28	62.48	60.80	44.75	48.52	69.62	67.16	52.38
Bicarbonate (mg/l)	168.25	178.35	183.56	161.45	147.60	225.12	238.36	231.22	158.46	270.10	276.24	151.36

GRAPHS



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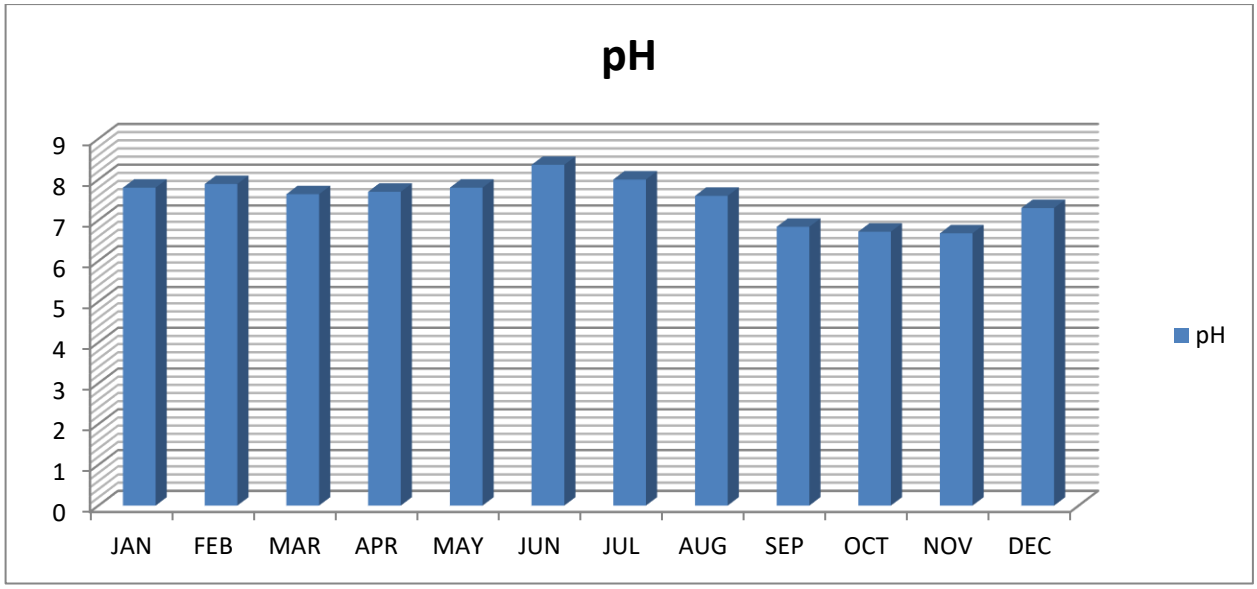

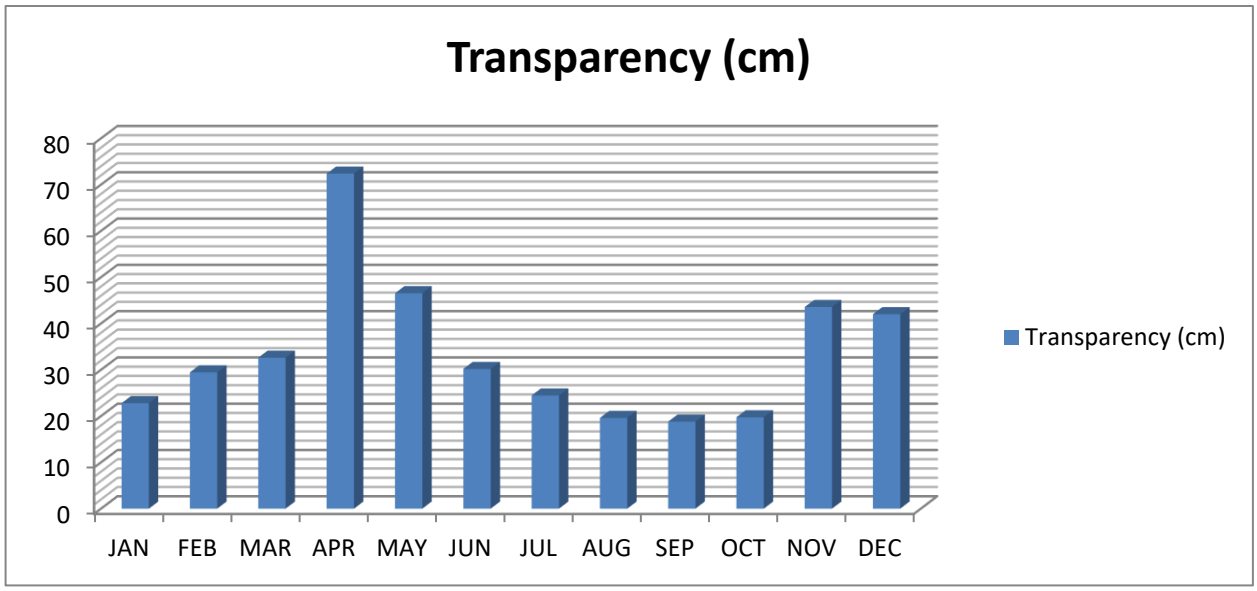

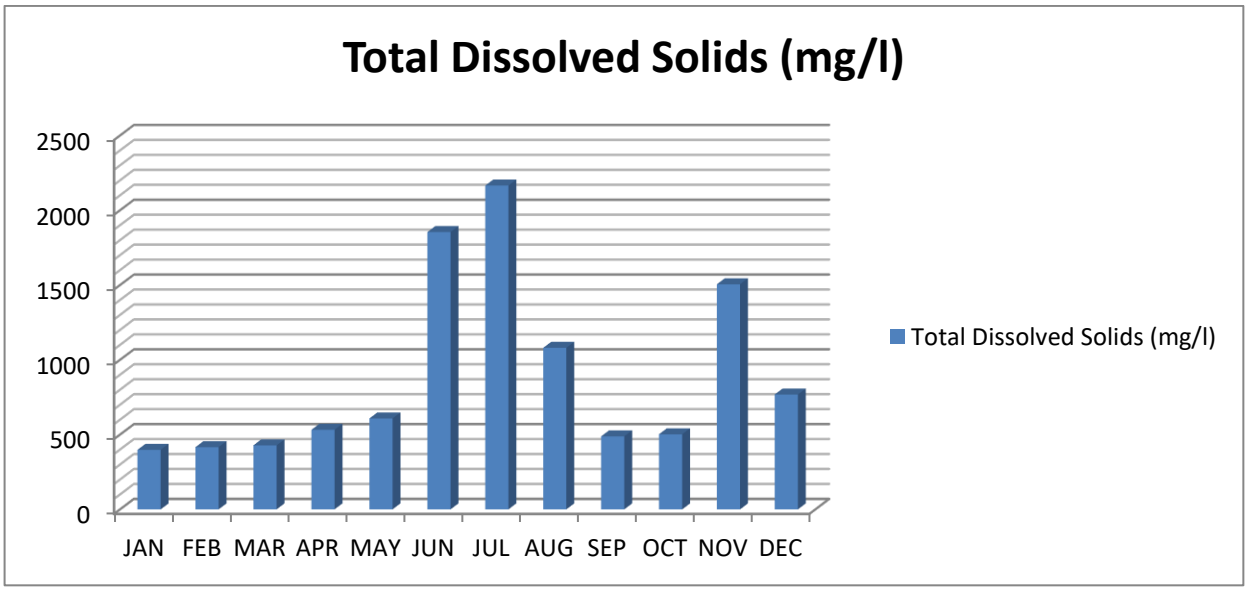

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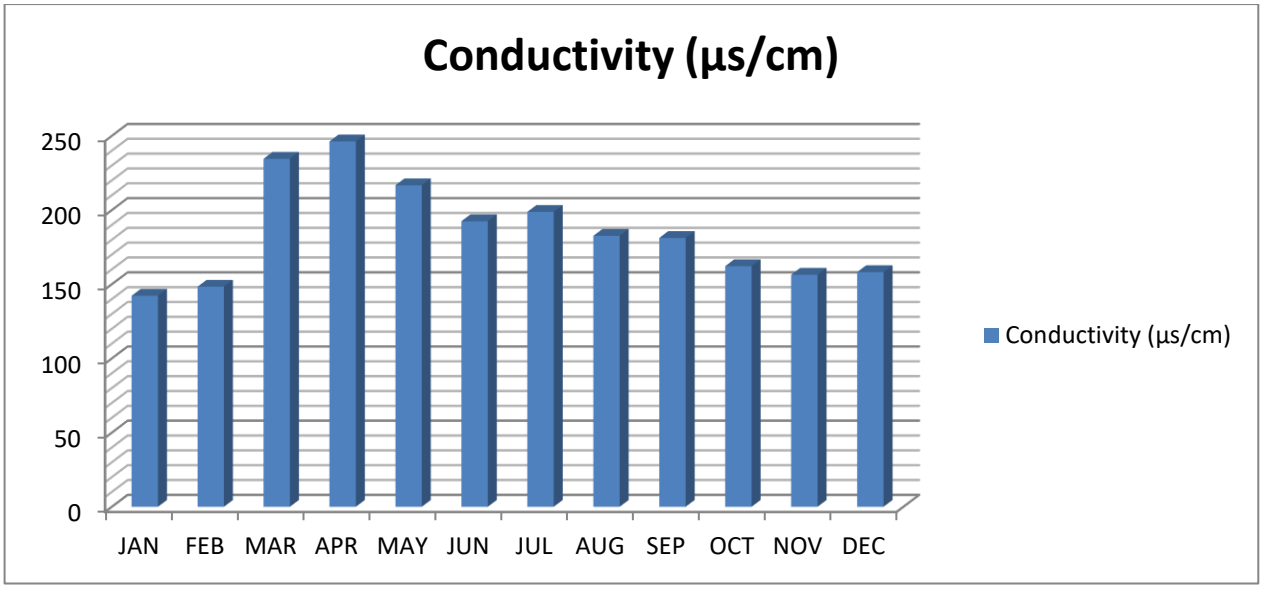

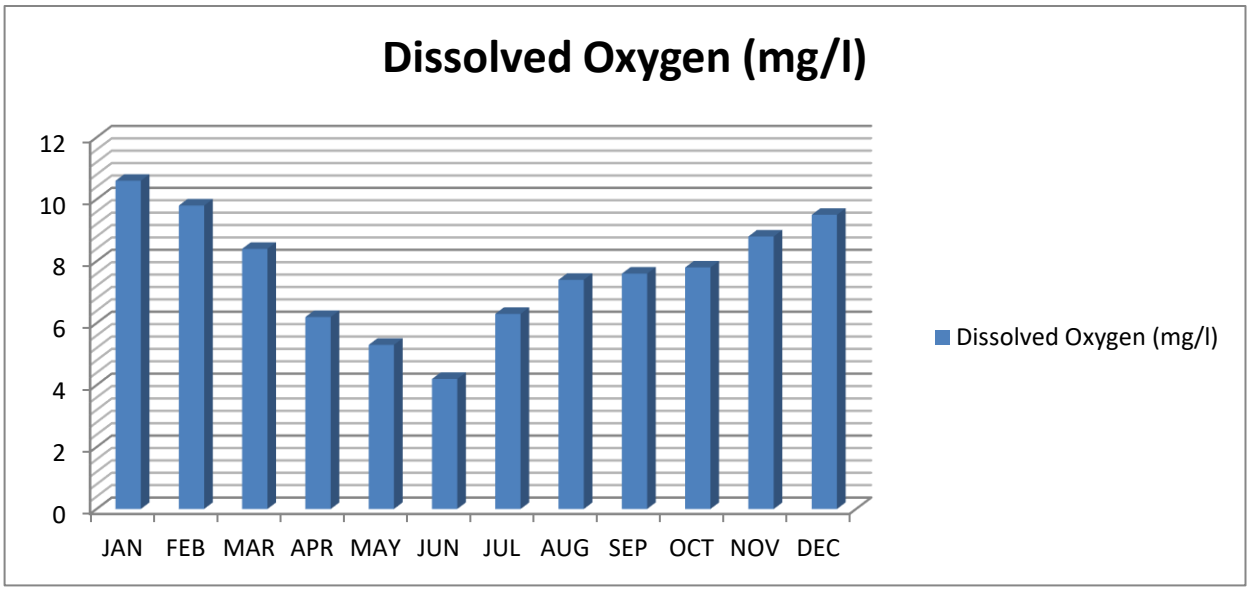

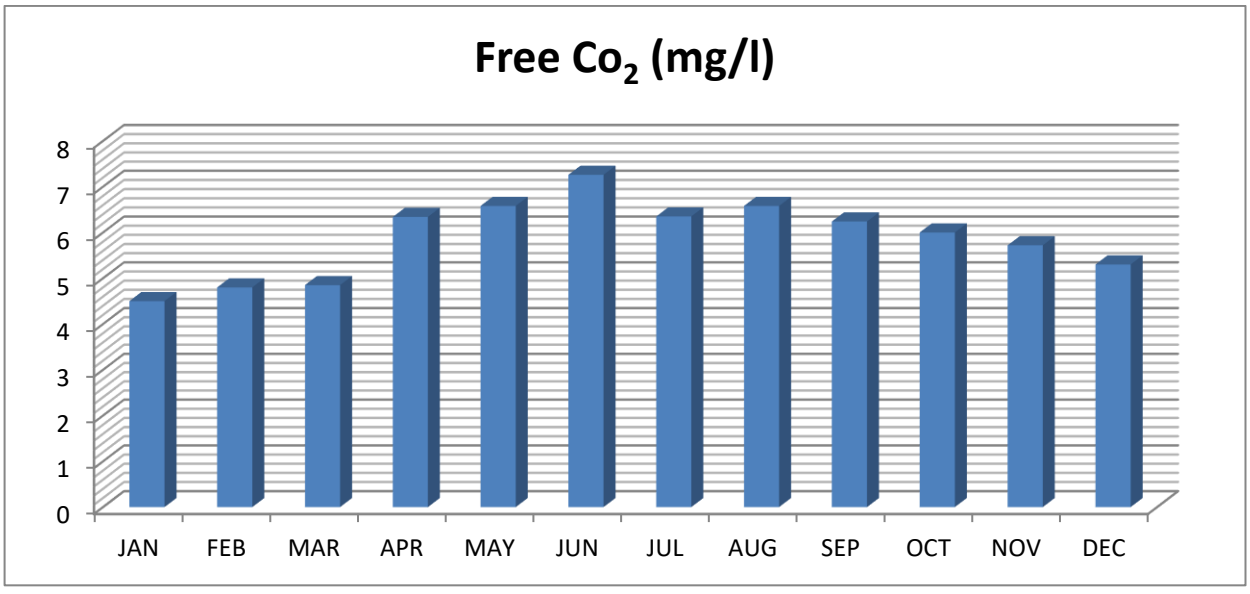

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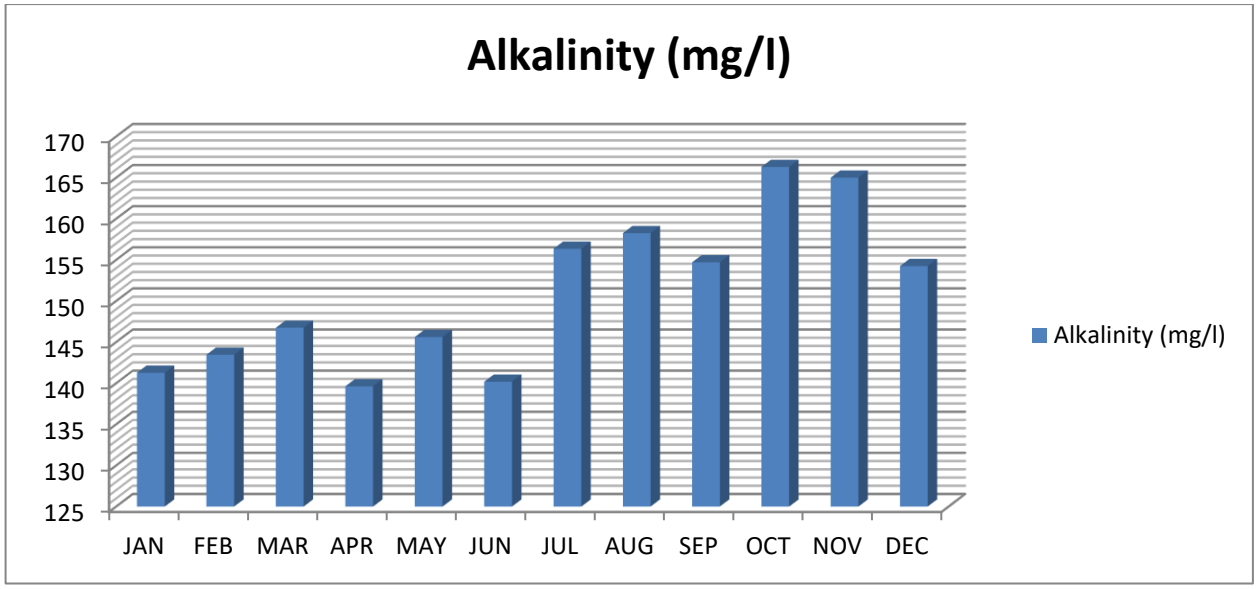

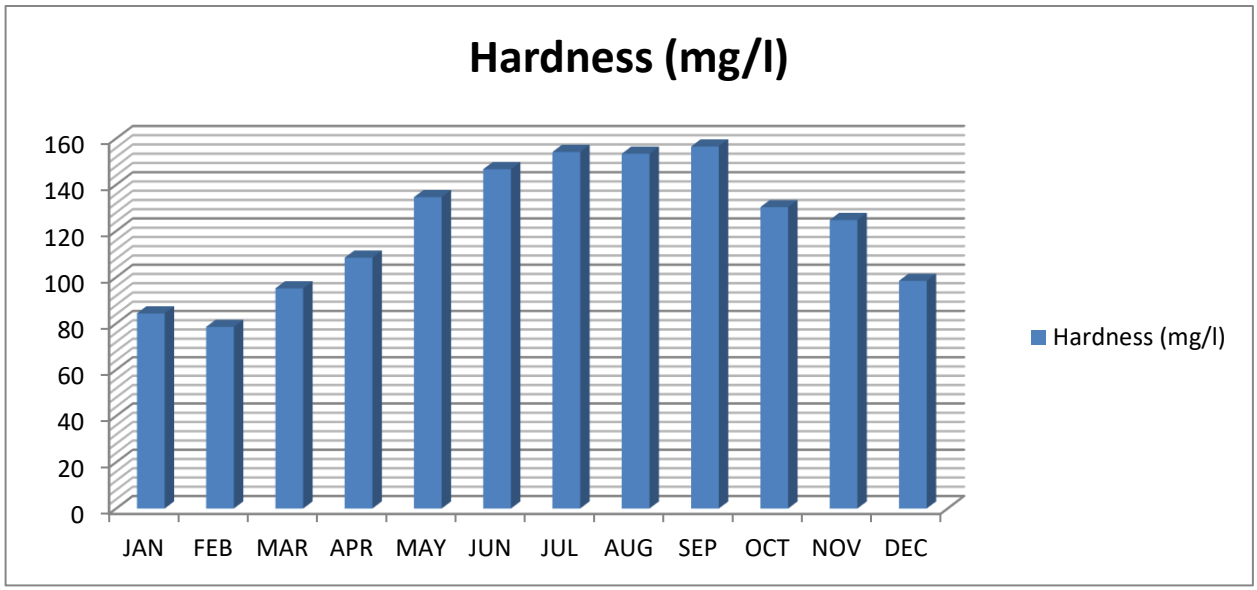

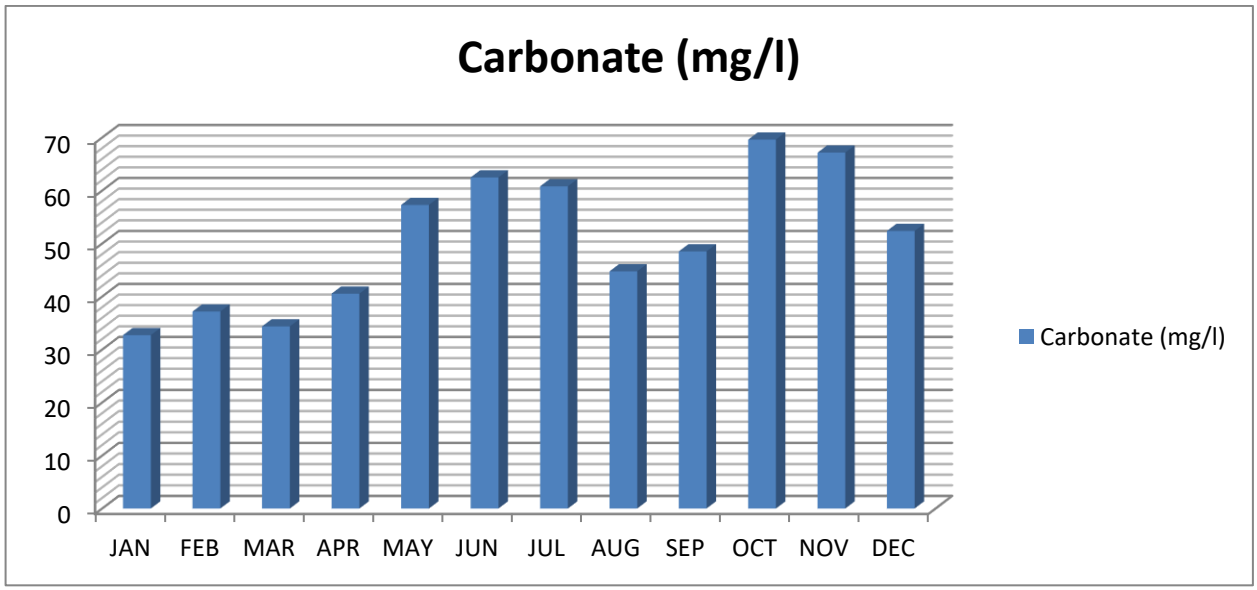

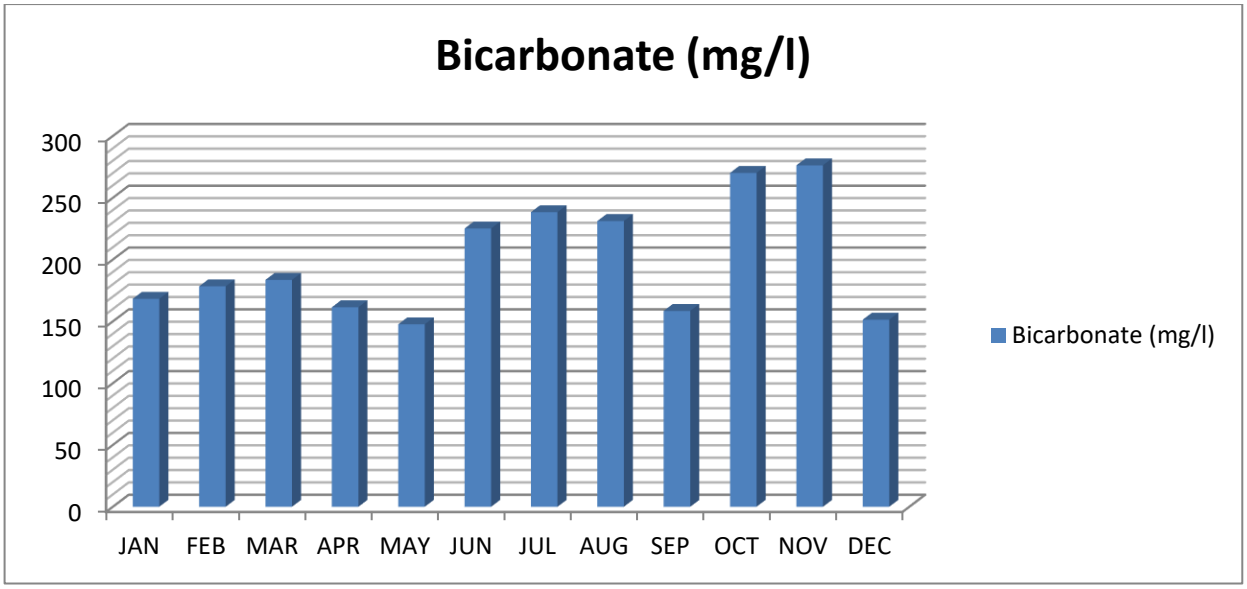

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