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A Comparative Study of Physiochemical Parameters in Vandranthangal Lake and Dharapadavedu Lake, in Vellore District, Tamilnadu

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Research Article

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ABSTRACT

A comparative study of the seasonal variation of two lakes was conducted from January 2019 to December 2019. The following parameters were analyzed in the current study: Colour, odour, turbidity, electrical conductivity, pH, alkalinity, total hardness, calcium, magnesium, ammonia, nitrite, nitrate, chloride, fluoride, sulphate, phosphate, BOD and COD. During the study period ammonia, fluoride and phosphate were found to be in higher concentration in Vandranthangal lake. According to the findings, Vandranthangal lake is significantly more polluted than the Dharapadavedu lake. The result revealed that the concentration of ammonia, fluoride and phosphate in Vandranthangal lake was higher than the standard limit. During entire study period observed a great seasonal variation in the values of physico chemical parameters.

INTRODUCTION

Water is a universal solvent and the most important and indispensable resource that nature has provided us with an abundance of substances, including organic and inorganic compounds. Only about 3% of the world's annual freshwater supply is fit for human consumption. Plankton is an essential part of the aquatic ecosystem. At various trophic levels, most aquatic bodies play a vital role in energy transfer.

Aquatic resources such as lakes, ponds, dams, rivers and other bodies of water contain about 1% of the total water on the planet, which is used by mankind for daily activities. Zooplankton is a key component of autotrophic and heterotrophic ecosystems. Many species, including humans, rely on these habitats, which cover just over 3% of the earth's surface.

Water quality is one of the most important considerations. It entails examining physicochemical, biological and microbiological parameters that reflect the biotic and abiotic status of affected living organisms in water bodies and is required for any management strategies to be implemented.

Due to climate and geological differences, the worldwide distribution of water bodies results in a wide range of temporary pond types. The implementation of any management strategy requires information about water quality. Freshwater is the most appropriate and affordable source for domestic and industrial needs, as well as a convenient waste disposal system. The increased demand for water as a result of population growth, agriculture and industrial and building construction has compelled environmentalists to investigate water's physical, chemical and biological properties [1].

MATERIALS AND METHODS

Vanderthangal lake

The Vanderthangal lake is surrounded by human habitat, which increases the human interference and chances of releasing untreated sewage water and effluent in this lake (Table 1). Thus the lake is prone to change its physico chemical day by day. It is located in Kilithampatari village Katpadi, Vellore. It is located within the geographical coordinates of 12.983229 latitudes and 79.129966 longitudes [2].

Table 1. Vanderthangal lake.

S. no	Parameter	January	February	March	April	May	June	July	August	September	October	November	December
1	Colour	Yellowish	Yellowish	Yellowish	Yellowish	Yellowish	Yellowish	Yellowish	Yellowish	Yellowish	Yellowish	Yellowish	Yellowish
2	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Turbidity	4	4	4	4	4	4	4	5	5	5	5	5
4	EC	1600	1620	1630	1675	1698	1680	1623	1750	1790	1800	1635	1615
5	pH	6.5	6.7	7	7.5	7.7	7.6	6.9	7.8	7.9	7.8	6.9	6.7
6	Alkalinity	315	320	380	389	394	385	355	385	375	382	320	327
7	Calcium	95	93	103	105	107	105	104	102	105	109	97	98
8	Magnesium	65	67	73	72	70	69	75	83	85	83	82	79
9	Ammonia	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.1
10	Nitrite	0.9	0.9	0.11	0.11	0.12	0.12	0.11	0.13	0.13	0.13	0.11	0.11
11	Nitrate	45	45	45	75	75	75	45	75	75	75	45	45
12	Chloride	345	365	360	375	373	369	342	398	397	367	321	325
13	Fluoride	1.5	1.5	1.5	2	2	2	2	2.1	2.2	2.1	1.5	1.5
14	Sulphate	253	245	261	254	278	265	246	275	285	284	285	279
15	Phosphate	0.12	0.12	0.13	0.14	0.15	0.13	0.14	0.12	0.11	0.13	0.12	0.11
16	BOD	54	57	60	62	65	67	65	67	62	65	60	59
17	COD	430	425	450	456	476	480	490	465	473	345	420	410

Dharapadavedu lake

The freshwater lake reservoir is situated near Katpadi, railway station. Its area is around 7 km and has a depth of 7-9 feet, this is a perennial lake and it is used by the people for many purposes. The bottom of the lake is sandy and surrounded by flora, it receives water from the catchment and supplies it for irrigation and washing clothes (Table 2). It is located within the geographical coordinates of 12.971824 latitudes and 79.133573 longitudes [3-7].

Table 2. Dharapadavedu lake.

S. NO	PARAMETER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SETEMBER	OCTOBER	NOVEMBER	DECEMBER
1	Colour	Greenish	Greenish	Darkgreen	Darkgreen	Darkgreen	Darkgreen	Darkgreen	Darkgreen	Darkgreen	Darkgreen	Greenish	Greenish
2	Odour	Unagreeable	Unagreeable	Unagreeable	Unagreeable	Unagreeable	Unagreeable	Unagreeable	Unagreeable	Unagreeable	Unagreeable	Unagreeable	Unagreeable
3	Turbidity	5	5	5	5	5	5	5	5	5	5	5	5
4	EC	1300	1320	1458	1475	1457	1460	1435	1397	1345	1276	1353	1295

5	pH	8.5	8.7	9	9.2	9.5	9.3	9	8.7	8.5	8	8.7	8.9
6	Alkalinty	325	315	395	420	452	457	453	440	375	390	355	340
7	Calcium	50	55	60	75	73	75	65	69	74	65	65	64
8	Magnesium	45	45	75	75	75	75	45	45	45	45	45	45
9	Ammonia	6	6.2	6.35	6.5	6.4	6.5	6.34	6	6	6.1	6.1	6.23
10	Nitrite	2.3	2.4	2.5	3.5	3.2	3.1	2.7	2.1	1.9	2.2	1.9	1.7
11	Nitrate	25	29	45	43	42	45	44	34	35	27	29	25
12	Chloride	235	230	355	350	355	345	332	325	279	290	275	270
13	Fluoride	2.5	2.7	3	3.1	3.1	3	3.2	3.2	2.9	2.7	2.9	2.7
14	Sulphate	123	125	155	160	135	145	143	160	134	125	129	130
15	Phosphate	0.23	0.21	0.25	0.25	0.25	0.23	0.21	0.21	0.24	0.23	0.2	0.2
16	BOD	39	37	38	43	42	44	45	43	44	35	30	29
17	COD	272	234	276	280	286	275	295	270	254	234	230	220

Water sample collection: Water samples were collected from the Vandranthangal and Dharapadavedu lakes with all the necessary precautions from January to December 2019.

Physicochemical parameter

Three random locations were chosen for each visit and each of these water samples was analyzed separately. All the samples were collected between 6 to 8 a.m. The samples were collected at a depth of five feet. Temperature, odour, color, turbidity, electrical conductivity, total dissolved solids, pH, alkalinity, calcium, total hardness, magnesium, nitrate, ammonia, nitrate, chloride, phosphate, fluoride, sulfate, BOD and COD were measured.

The pH, odour, conductivity and temperature of the water of two lakes were measured at their collection sites. pH was checked by using litmus paper. Transparency of water was measured using a black and white disc. A hand conductivity meter (EC tester) was used to measure the conductivity of the water. The temperature was measured by a mercury thermometer. Biological and chemical oxygen demand was measured by using Winkler's method. Water samples were collected in a clear plastic bottle and transported to the lab for analysis of the other physicochemical parameters [8-11].

RESULTS AND DISCUSSION

The current study focuses primarily on the variations in water quality of the lakes is presented in Table 1.

The importance of physicochemical parameters in assessing water quality was responsible for chemical and biological reactions in the body of water, as well as gas solubility.

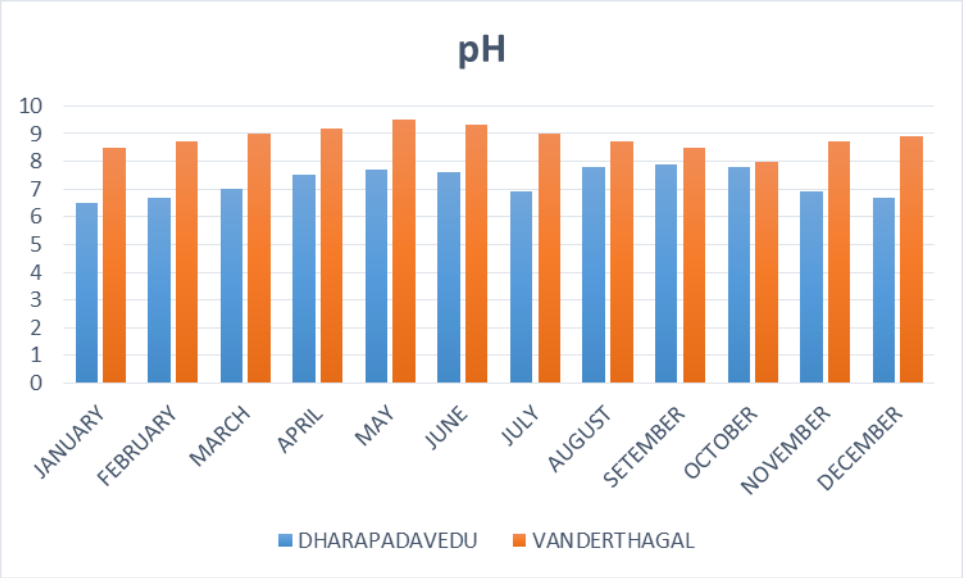
Temperature

Water temperature is one of the essential parameter since it influences the growth and distribution of flora and fauna. According to Kumar, et al., temperature is the intrinsic physical and chemical characteristics of the water. According to Murugesan, et al., an increase in water temperature causes an increase in chemical and biological reactions in the body as well as a decrease in gas solubility. The rate of reproduction, growth and immunity of all organisms is controlled by the temperature of the water. In the present study, there was no significant difference in the temperature of the water collected from the lakes. During the study period from January 2019 to December 2019, water temperatures were recorded at a minimum of 18°C and a maximum of 35°C [12].

pH

pH is an important parameter that helps to determine the acid-base balance of freshwater. The pH of water ranges from 6.5 to 8.5. The formation of vitamins and minerals in the human body is affected if the pH level is less than 6.5. When the value exceeds 8.5, the water becomes saltier (Figure 1). It causes eye irritation and skin problems if it is higher than pH 11 reported. The pH of Vandranthangal lake is 8.5 to 9.5, while the pH of Dharapadavedu is 6.5 to 7.9.

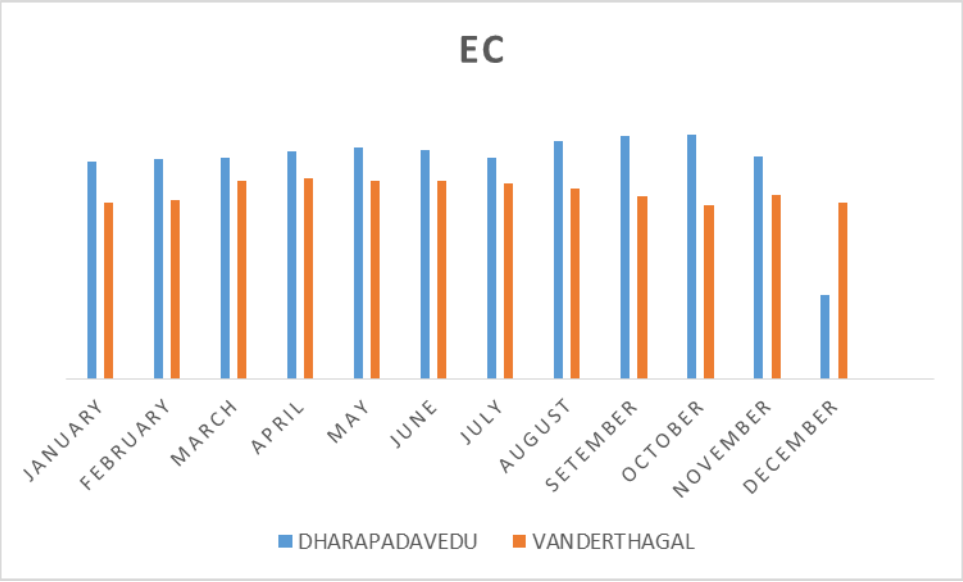
Figure 1. This Figure represents the pH level of Vandranthangal lake and Dharapadavedu lake for all months.



Electrical conductivity

Electrical conductivity indicates the amount of dissolved salts present in the water. Electrical conductivity values are most supportive of good fish fauna. The total concentration of ionized constituents in water is measured by electrical conductivity. The electrical conductivity of the two lakes varies (Figure 2). The Electrical conductivity value ranges from (615 to 1800 mho/cm) in Dharapadavedu lake, in Vandranthangal lake [13-15].

Figure 2. This Figure represents the electrical conductivity level of Vandranthangal lake and Dharapadavedu lake for all months.



Turbidity

The increased turbidity of water will harm aquatic life and degrade the quality of surface water due to light penetration. Heavy soil erosion and sewage derived suspended solids increase turbidity and have an impact on the river and aquatic

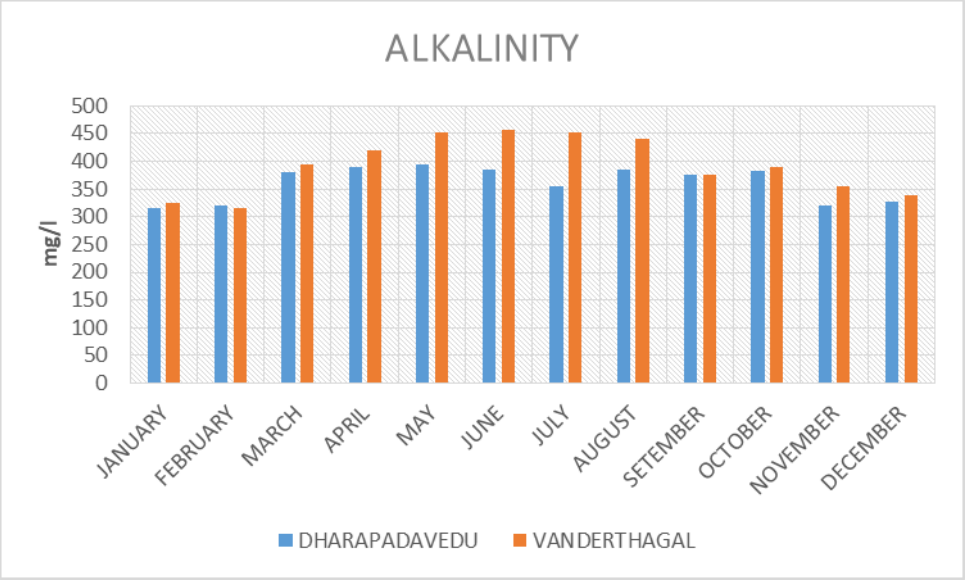
life. Turbidity levels above a certain threshold reduce the number of pathogens in the water. Turbidity in natural water bodies is primarily caused by suspended or dissolved sand, silt, clay, microorganisms, and organic materials. Turbidity influences the absorption of light scattering and the aesthetic appearance of water bodies. The current study found a high level of turbidity in the Dharapadavedu lake and Vandranthangal lake had a slightly lower turbidity value [16].

Alkalinity

Natural water bodies in the tropics usually shows a wide range of fluctuation in total alkalinity values depending upon the location, season, plankton population, and nature of bottom deposit. Alkalinity values provide guidelines for the proper doses of chemicals in water and waste water treatment processes, particularly in coagulation and operational control of anaerobic digestion. Alkalinity is a measure of buffering capacity of the water [17].

The capacity of water to neutralize a strong acid is known as alkalinity. The concentration of nutrients increased the alkalinity of water during the summer (Figure 3). The values of total alkalinity in Dharapadavedu were between 315-394 mg/l and in Vandranthangal 305–457 mg/l.

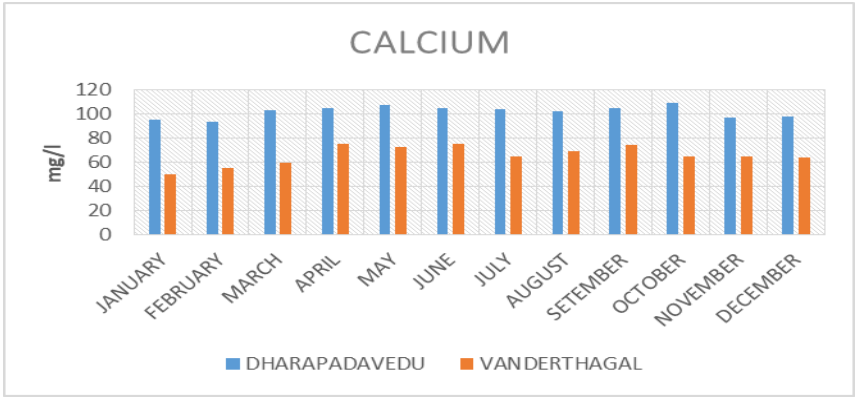
Figure 3. This Figure represents the alkalinity level of Vandranthangal lake and Dharapadavedu lake for all months.



Calcium

According to Jhingran AG in aquatic species, calcium is one of the most abundant ions and is essential for plant precipitation, shell and bone formation (Figure 4). Dharapadavedu Lake had the highest calcium concentration in the water (109 mg/l). Vandranthangal Lake had the lowest calcium concentration (50 mg/l). Calcium is abundantly found in freshwaters. Similar findings have also been reported by Ravichandran, S. and Ramanibai and Kant and Raina [18-21].

Figure 4. This Figure represents the calcium level of Vandranthangal lake and Dharapadavedu lake for all months.

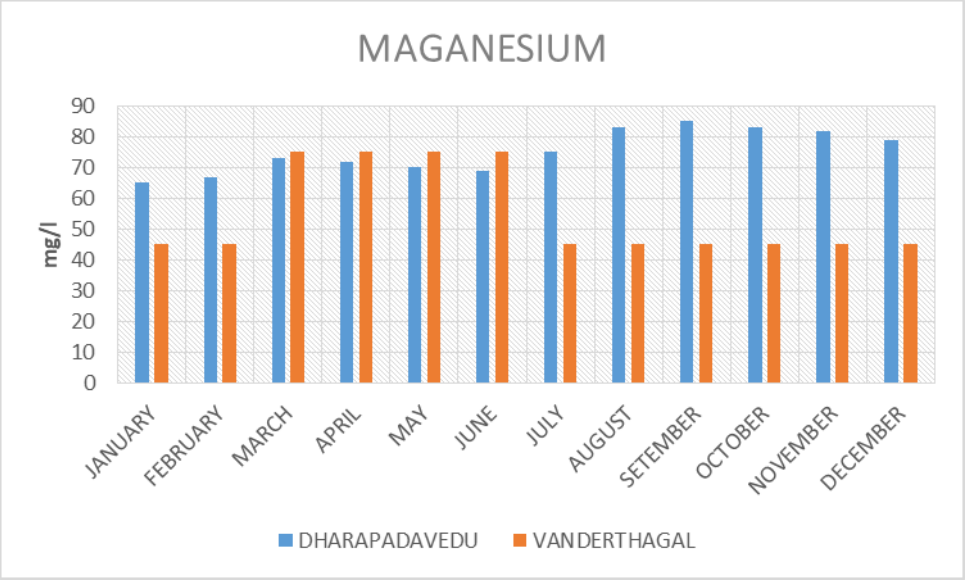


Magnesium

According to Kumar and Gupta, the decomposition process of plants and animals return magnesium to the ecosystem to be used again. Normal Drinking water with a magnesium content ranges from 450-500 mg/l per liter. The highest amount of 85 mg/l was recorded in Dharapadavedu and the lowest amount of 45 mg/l in Vandranthangal. The results

obtained are in accordance with the findings of Tripathy and Pandey, A Murugesan reported low values of magnesium during the winter and the highest during the monsoon (Figure 5).

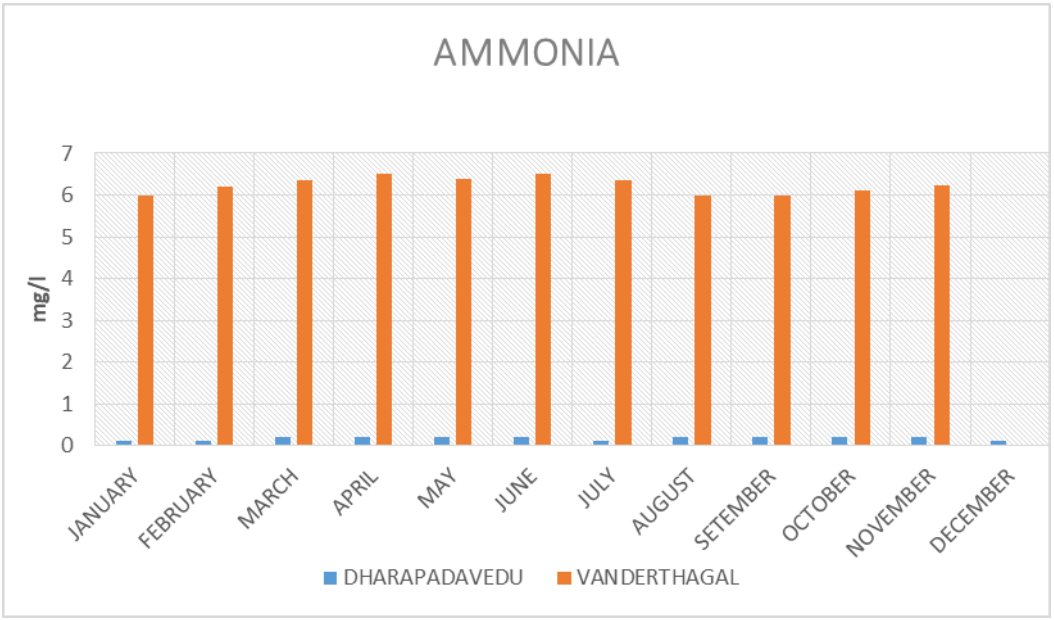
Figure 5. This Figure represents the magnesium level of Vandranthangal lake and Dharapadavedu lake for all months.



Ammonia

In the aquatic environment, ammonia is one of several types of nitrogen. Human health risks will not be created, but aquatic life will be severely harmed. Internal organ systems may be harmed by water containing more than 1 mg/l (ppm) ammonia. According to Sunder S. the findings, the highest concentration of ammonia was found in Vandranthangal (6.5 mg/l) and the lowest in Dharapadavedu (0.1 mg/l). Ammonia is a metabolic waste product released concentrations, ammonia can cause gill damage primarily thorough the gills of fish (Figure 6). The only safe ammonia level is zero. According to Boyd CE, has reported ammonia is more toxic at higher temperature and pH levels above 7.0 and less harmful at lower temperatures and pH levels below 7.0.

Figure 6. This Figure represents the ammonia level of Vandranthangal lake and Dharapadavedu lake for all months.

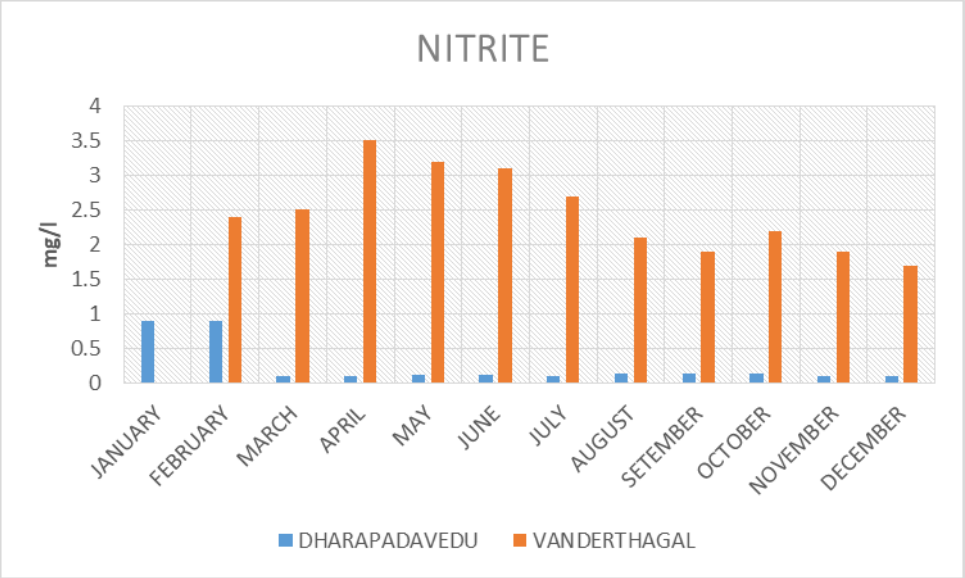


Nitrite

Nitrites are salts or ester anions of nitrous acid, which can naturally or artificially occur in water. Drinking water with levels of nitrite at or below 10 mg/l is considered safe for everyone. The maximum value of nitrite was noted in Vandranthangal Lake (3.5 mg/l) and the minimum amount of nitrite was recorded in Dharapadavedu lake (0.11 mg/l). It is found in fresh water bodies from 0.0 to 0.14 mg/l and can go up to 2.0 mg/l or higher in polluted waters. Nitrite anion

is generally present in natural waters. Prakash reported that in natural freshwater, a high concentration of nitrite is regarded as an indicator of pollution. Human and animal excreta and also industrial effluents bear huge quantities of nitrite along with nitrogenous compounds. As reported by Barg, values of NO_3-N are generally lower in unpolluted freshwater bodies than in polluted ones (Figure 7).

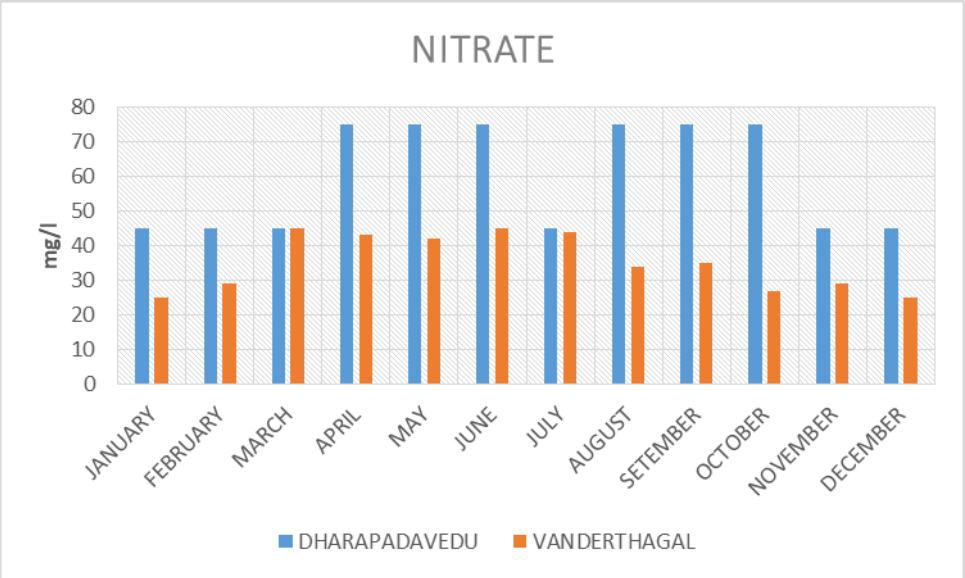
Figure 7. This Figure represents the nitrite level of Vandranthangal lake and Dharapadavedu lake for all months.



Nitrate

Different agricultural activities yield an increase in the nitrate concentration in the ground and surface water because of physical and biological activities. An increase in the amounts of nitrate-nitrogen in surface water causes different problems, such as the decreasing level of oxygen in the water, which has effects on aquatic life, plants and algae. Blue baby syndrome disease is caused in humans by a high concentration of nitrate. Nitrate is usually present in natural water. The sources of nitrate are from drainage, line stock feed and chemical fertilizer from cultivated land, domestic and industrial sources. It has been reported that values of NO_2-N are generally higher in unpolluted freshwater bodies than in polluted ones (Figure 8). The maximum amount of nitrate was recorded in Dharapadavedu lake (75 mg/l) and the minimum amount of nitrate in Vandranthangal lake (45 mg/l).

Figure 8. This Figure represents the nitrate level of Vandranthangal lake and Dharapadavedu lake for all months.

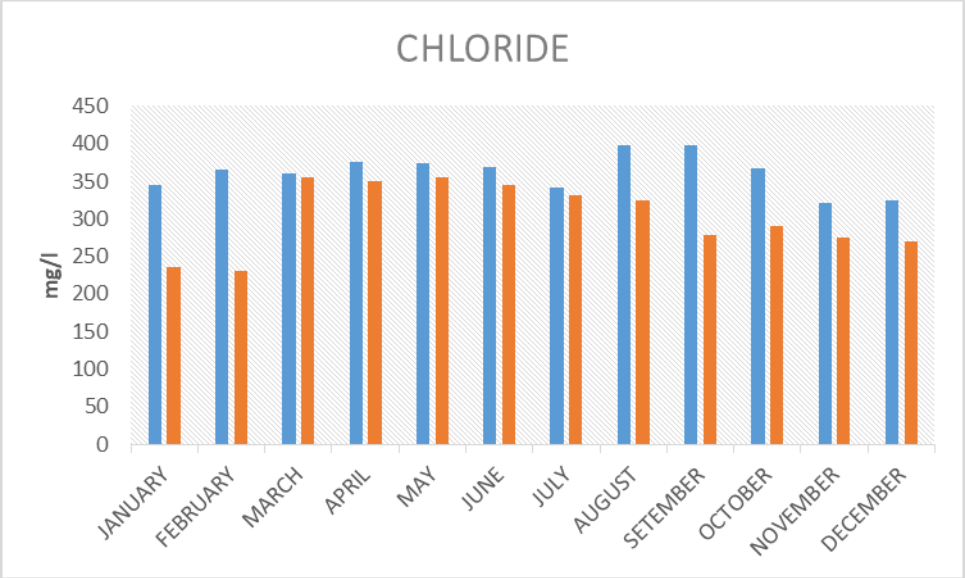


Chloride

The chloride anion is commonly found in natural water. According to Prakash, freshwater contains a high concentration of chloride, which is considered an indicator of pollution. Chlorides are one of the most important parameters in

problematic water, and they are also hazardous to aquatic life and irrigation water. Chloride is harmful to human life. In the current study, the highest chloride concentration (398 mg/l) was found in Dharapadavedu lake, while the lowest (230 mg/l) was found in Vandranthangal Lake. The low chloride indicates the absence of pollution as reported by A.Sreenivasan (Figure 9).

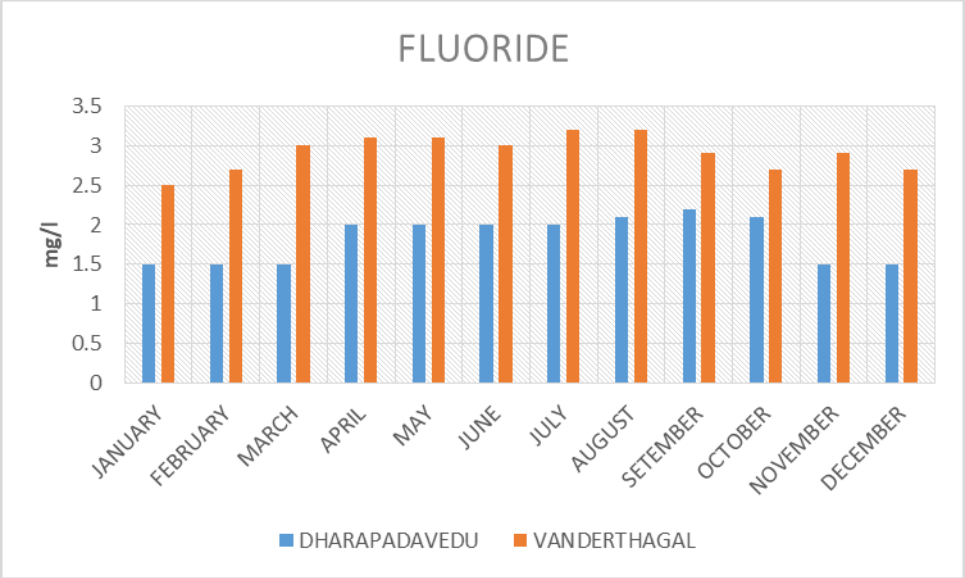
Figure 9. This Figure represents the chloride level of Vandranthangal lake and Dharapadavedu lake for all months.



Fluoride

Fluoride is a chemical compound that is sometimes added to drinking water and toothpaste because it is thought to be beneficial to people's teeth. According to WHO Fluoride levels in drinking water should be between 0.5 and 1.5 mg/l. Vandranthangal had the highest fluoride concentration (3.2 mg/l), while Dharapadavedu had the lowest (1.5 mg/l). The lowest value of fluoride occurs during the monsoon season and can be connected to the dilution of lake by rain water. According to Kedar, G.T. and G. P. Patil the concentration of fluoride can be related to the purity or impurity of water (Figure 10).

Figure 10. This Figure represents the fluoride level of Vandranthangal lake and Dharapadavedu lake for all months.

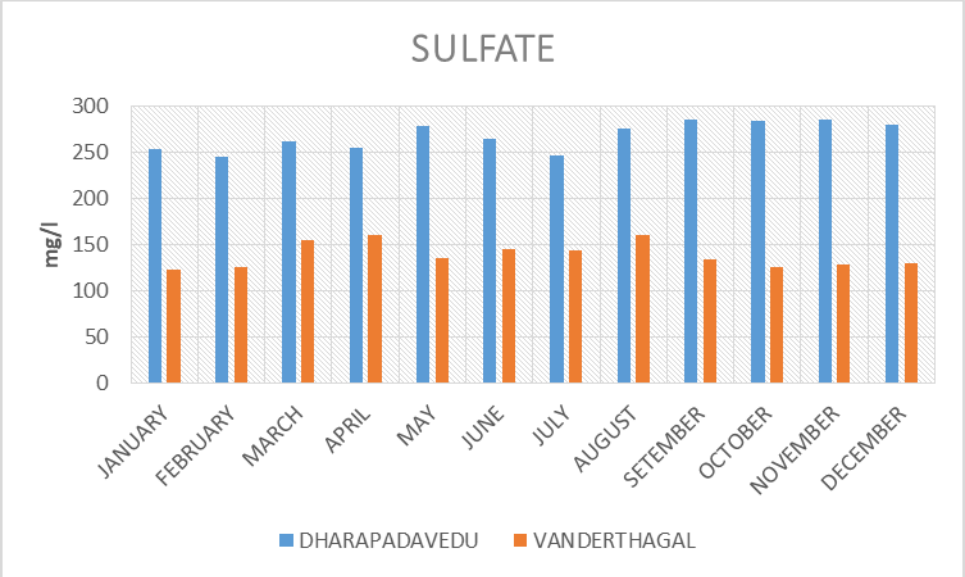


Sulfate

Sulfate dissolves naturally into groundwater in drinking water. Diarrhoea can be caused by high levels of sulphate in drinking water and it can also cause respiratory problems. The maximum amount of sulfate in the water of Dharapadavedu is (285 mg/l) and in Vandranthangal the maximum is about (160 mg/l). Freshwater sulphate concentrations typically range from 0 to 630 mg/l. The increase in sulphate is related to the decrease in water level

effecting concentration and the release of sulphate during decomposition, which increases with the rise in temperature (Figure 11).

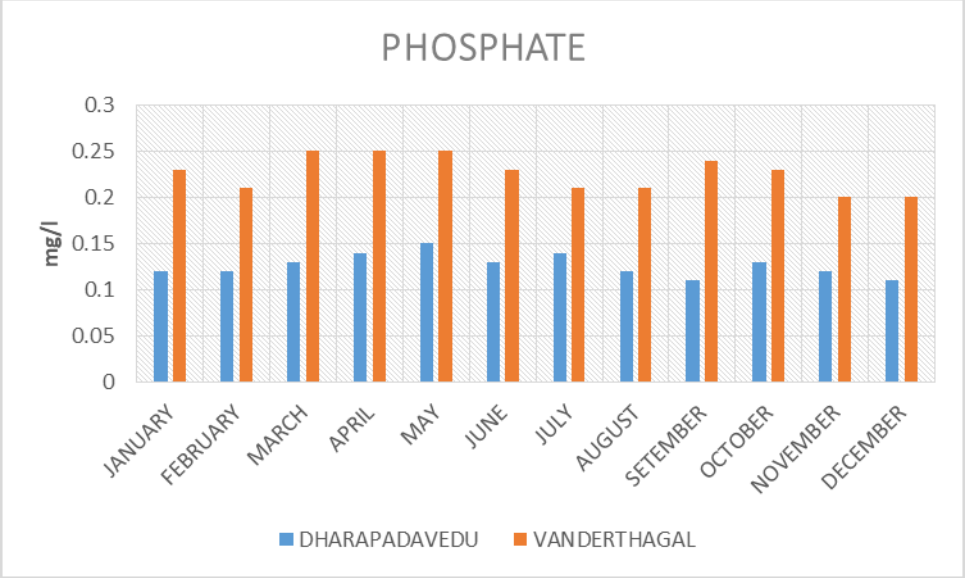
Figure 11. This Figure represents the Sulfate level of Vandranthangal lake and Dharapadavedu lake for all months.



Phosphate

Pollution is caused by the presence of phosphates in industrial and sewage waste, which promotes the growth of nuisance microbes. According to Nasar SAK, higher phosphate levels in water cause muscle damage, breathing problems and kidney failure. The limit for phosphate phosphorus is 0.1 mg L1 standard value. Because phosphorus is actively taken up by plants, it is rarely found in high concentration (Figure 12). This phosphate is primarily derived from domestic sewage and agricultural runoff. Vandranthangal had the highest phosphate content (0.25 mg/l). Dharapadavedu had the lowest phosphate concentration (0.11 mg/l).

Figure 12. This Figure represents the phosphate level of Vandranthangal lake and Dharapadavedu lake for all months.

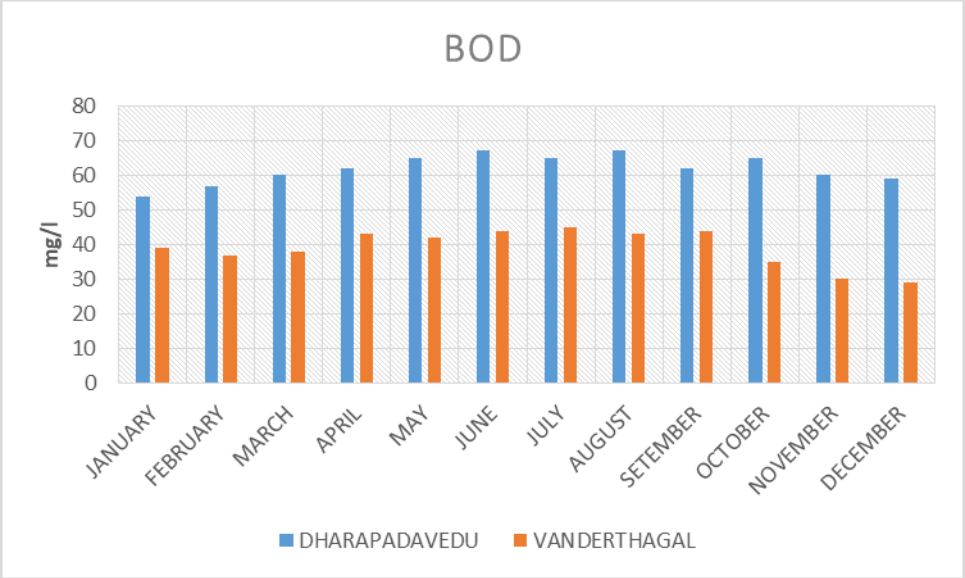


BOD

Biochemical Oxygen Demand (BOD) is an important parameter that indicates the magnitude of water pollution by oxidizable organic matter. The biochemical oxygen demand values are extremely useful in the process of assessing the water quality. According to Abida, the biodegradation of organic materials in water increases the biochemical oxygen demand. The amount of oxygen required by living organisms engaged in the utilization and eventual destruction or stabilization of organic water is referred to as BOD. BOD levels were found to be at their highest (67 mg/l) in Dharapadavedu and Vandranthangal had the lowest value (29 mg/l). The high biological oxygen demand values during

the summer indicate the higher growth of bacteria (Figure 13).

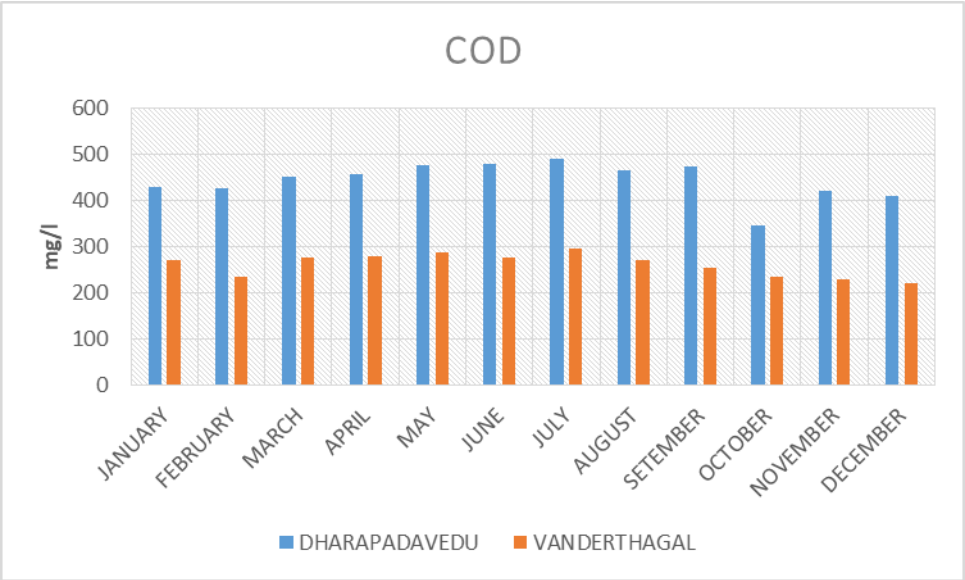
Figure 13. This Figure represents the BOD level of Vandranthangal lake and Dharapadavedu lake for all months.



COD

COD is commonly used to indirectly measure the organic and inorganic compounds in water. COD is the measure of oxygen required for chemical oxidation. Its values are generally higher than BOD values. The amount of organic matter found in water is determined by the COD measurement. As a result, COD can be used to detect organic pollution in surface water (Figure 14). The highest concentration of COD was found in Dharapadavedu water (490 mg/l) and the lowest concentration was found in Vandranthangal lake (220 mg/l).

Figure 14. This Figure represents the COD level of Vandranthangal lake and Dharapadavedu lake for all months.



CONCLUSION

The study assessed the water quality of two lakes in Dharapadavedu and Vandranthangal. Analysis of physicochemical parameters is essential to check the water before it's used for domestic, agricultural, industrial or other purposes. The result revealed that the concentration of ammonia, fluoride and phosphate in Vandranthangal Lake was higher than the standard limit.

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