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Assessment of Physicochemical Parameters of Water in Different Ecosystems of Yercaud Hills, Eastern Ghats, South India

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Abstract: Lakes have a more complex and fragile ecosystem and they easily accumulate pollutants. Biodiversity of lakes and pond ecosystems are currently threatened by a number of human disturbances. In order to determine the wealth and diversity of the forest it is essential to investigate the physico-chemical conditions in Yercaud region. The ground water and lake water were collected and temperature, pH, EC chlorides, sodium, potassium, phosphorous, magnesium were determined. The correlation coefficient was done by using SPSS statistical tools. The results support the water parameters are highly desirable and both the waters are suitable for irrigation and drinking purposes.

Key words: Human Disturbances % Physicochemical Parameters % Water % Yercaud % Correlation

INTRODUCTION

Yercaud is situated in Eastern Ghats of Tamilnadu and the total total area is about 383 km$^{2.}$ The main crops were raggi, maize, millet and horticultural crops like coffee, pepper, orange etc were highly distributed. Groundwater is used for domestic, agricultural and industrial purpose in most parts of the world. Rural population living in India depends on groundwater for domestic and agricultural purpose. And the people depend on the ground water for drinking and irrigating purposes. The lake is one of the main tourists spot and used for sailing activities. The lake also serves a habitat for many aquatic plants and animals. Hilton and Phillips [1] stressed the problems of boats activities on deterioration of water quality of recreational waterways and found that the effect of boats activities are more on turbidity in shallow waters. The area receives total overall rain fall about 1500mm to 2000mm. Lakes and wetlands have been recognized worldwide as extremely important biogeography zones These lentic water bodies are common and stable habitats of the biosphere [2,3].

The biodiversity and dynamics of different phytoplankton populations and their role in natural water cycle, are one of the least explored areas in aquatic biology. All the developmental activities have immediate effects on various water quality parameters; including hydrobiology groundwater is generally less susceptible to contamination and pollution when compared to surface water bodies. Also the natural impurities in rainwater, which replenishes groundwater systems, get removed while infiltrating through soil strata. Groundwater contamination can originate on the surface of ground, from the ground above or below water table. If a contaminant is spilled on the surface of the ground or injected into the ground above the water table, it may have to move through numerous layers of soil and underlying materials before it reaches the groundwater [4].

In spite of the fundamental importance of lakes, reservoirs and wetlands to humans as life-supporting systems and as systems providing recreation facilities for the people, these have severely been affected by a multitude of anthropogenic disturbances which have led to serious negative effects on the structure of these ecosystems worldwide [5]. As the supply of fresh water around the world continues to dwindle because of increased use and pollution, lakes of the world will undoubtedly be viewed as potential water reservoirs of convenience for human use [6].

The wetlands are one of the most productive ecosystems in the world and they include natural or artificial; permanent or temporary water [7]. Water plants are the basic components of a wetland ecosystem. They produce oxygen, provide protection for living organism in water and ensure the perpetual effects of sediment in the bottom and because they are the first of the food chain in water, they are indispensable for life in such mediums [8, 9]. The elements like nitrate, calcium, chlorides,

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magnesium and potassium are the essential driving forces for phytoplanktons. Hence the main hypothesis of this study is to determine the water suitability for the survival of plants and animals in the study area.

MATERIALS AND METHODS

Lake water is collected in 3 various sites in Yercaud Lake during different period of times. The groundwater samples from the sampling locations were taken after operating the motor pumps for about 10 to 15 min. River water is collected from three different sites and falls water is collected from kiliyur falls for different time periods. The selected sampling areas are extensively used for drinking, household and agricultural purposes were identified. Totally 48 samples were collected from 12 locations using spot sampling procedure. The samples were collected in the pre-cleaned polythene bottles with necessary precautions. The samples were put for examination in the laboratory to determine the physico-chemical parameters using standard methodology. These include temperature, pH, EC chlorides, sodium, potassium, phosphorous, magnesium. The correlation coefficient was done by using SPSS statistical tools.

RESULTS AND DISCUSSION

The variations in physicochemical properties of the lake, ground, river and falls water have been summarized in the Table 1. The correlation between the parameters is shown in Table 2, 3, 4 and 5.

Table 1: The physicochemical parameters of waters in the study area

	pH	EC	Ca	Mg	Na	K	Cl	P
Lake water	6.96±0.02	0.26±0.02	0.66±0.01	15.77±0.84	17.89±1.34	7.89±0.20	72.63±3.21	1.89±0.20
Ground water	6.82±0.05	0.08±0.00	14.43±0.75	10.53±0.92	14.32±0.86	3.67±0.34	58.55±0.39	0.50±0.17
River water	7.80±0.13	0.07±0.02	1.07±0.14	2.31±0.43	0.65±0.40	2.55±0.30	2.55±0.50	0.51±0.28
Falls water	6.49±0.52	0.56±0.46	0.46±0.34	1.72±0.85	0.92±0.22	0.12±0.03	0.61±0.17	0.53±0.61

Table 2: The correlation values of physicochemical parameters of lake water

		pH	Ec	Ca	Mg	Na	K	Cl	P
pH	Sig. (2- tailed)	1.000	-0.602	-0.454	0.445	0.981	0.520	0.207	-0.839
			0.588	0.700	0.706	0.125	0.967	0.867	0.367
Ec	Sig. (2- tailed)	-0.602	1.000	0.985	0.447	0.746	-0.766	0.656	0.940
		0.588		0.112	0.705	0.464	0.445	0.544	0.222
Calcium	Sig. (2- tailed)	-0.454	0.985	1.000	0.596	-0.619	-0.866	0.778	0.866
		0.700	0.112		0.593	0.575	0.333	0.433	0.333
Magnesium	Sig. (2- tailed)	0.445	0.447	0.596	1.000	0.262	-0.918	0.968	0.115
		0.706	0.705	0.593		0.831	0.260	0.161	0.927
Sodium	Sig. (2- tailed)	0.981	-0.746	-0.619	0.262	1.000	0.143	0.013	-0.929
		0.125	0.464	0.575	0.831		0.909	0.992	0.242
Potassium	Sig. (2- tailed)	-0.520	-0.766	-0.866	-0.918	0.143	1.000	-0.988	-0.500
		0.967	0.445	0.333	0.260	0.909		0.099	0.667
Chloride	Sig. (2- tailed)	0.207	0.656	0.778	0.968	0.013	-0.988	1.000	0.359
		0.867	0.544	0.433	0.161	0.992	0.099		0.766
Phosphorous	Sig. (2- tailed)	-0.839	0.940	0.866	0.115	-0.929	-0.500	0.359	1.000
		0.367	0.222	0.333	0.927	0.242	0.667	0.766	

Correlation is significant at the 0.05 level (2-tailed)

Table 3: The correlation values of physicochemical parameters of ground water

		pH	Ec	Ca	Mg	Na	K	Cl	P
pH	Sig. (2- tailed)	1.000	0.640	0.354	0.633	0.475	0.935	-0.987	0.127
			0.557	0.770	0.564	0.685	0.230	0.103	0.919
Ec	Sig. (2- tailed)	0.640	1.000	0.945	-0.189	-0.371	0.327	-0.756	-0.680
		0.557		0.212	0.879	0.758	0.788	0.454	0.524
Calcium	Sig. (2- tailed)	0.354	0.945	1.000	-0.500	-0.655	0.000	-0.500	-0.883
		0.770	0.212		0.667	0.546	1.000	0.667	0.311
Magnesium	Sig. (2- tailed)	0.633	-0.189	-0.500	1.000	0.982	0.866	-0.500	0.848
		0.564	0.879	0.667		0.121	0.333	0.667	0.355

Table 3: Continue

		pH	Ec	Ca	Mg	Na	K	Cl	P
Sodium	Sig. (2- tailed)	0.475	-0.371	-0.655	0.982	1.000	0.756	-0.327	0.933
		0.685	0.758	0.546	0.121		0.454	0.788	0.234
Potassium	Sig. (2- tailed)	0.935	0.327	0.000	0.866	0.756	1.000	-0.866	0.470
		0.230	0.788	1.000	0.333	0.454		0.333	0.689
Chloride	Sig. (2- tailed)	-0.987	-0.756	-0.500	-0.500	-0.327	-0.866	1.000	0.350
		0.103	0.454	0.667	0.667	0.788	0.333		0.978
Phosphorous	Sig. (2- tailed)	0.127	-0.680	-0.883	0.848	0.933	0.470	0.350	1.000
		0.919	0.524	0.311	0.355	0.234	0.689	0.978	

Correlation is significant at the 0.05 level (2-tailed)

Table 4: The correlation values of physicochemical parameters of river water

		pH	Ec	Ca	Mg	Na	K	Cl	P
pH	Sig. (2- tailed)	1	-0.355	0.23	-0.101	0.573	0.908	0.933	0.539
			0.769	0.852	0.935	0.612	0.274	0.235	0.638
Ec	Sig. (2- tailed)	-0.355	1	-0.828	-0.894	-0.97	0.68	-0.669	0.596
		0.769		0.379	0.296	0.157	0.957	0.534	0.593
Calcium	Sig. (2- tailed)	-0.23	-0.828	1	0.991	0.666	-0.616	0.137	-0.944
		0.852	0.379		0.083	0.536	0.578	0.913	0.214
Magnesium	Sig. (2- tailed)	-0.101	-0.894	0.991	1	0.758	-0.508	0.265	-0.893
		0.935	0.296	0.083		0.453	0.661	0.829	0.298
Sodium	Sig. (2- tailed)	0.573	-0.97	0.666	0.758	1	0.178	0.83	-0.382
		0.612	0.157	0.536	0.453		0.886	0.377	0.75
Potassium	Sig. (2- tailed)	0.908	0.068	-0.616	-0.508	0.178	1	0.696	0.842
		0.274	0.957	0.578	0.661	0.886		0.51	0.363
Chloride	Sig. (2- tailed)	0.933	-0.669	0.137	0.265	0.83	0.696	1	1.98
		0.235	0.534	0.913	0.829	0.377	0.51		0.873
Phosphorous	Sig. (2- tailed)	0.539	0.596	-0.944	-0.893	-0.382	0.842	0.198	1
		0.638	0.593	0.214	0.298	0.75	0.363	0.873	

Correlation is significant at the 0.05 level (2-tailed)

Table 5: The correlation values of physicochemical parameters of falls water

		pH	Ec	Ca	Mg	Na	K	Cl	P
pH	Sig. (2- tailed)	1.000	-0.154	0.350	0.455	0.920	-1.000	0.825	-0.997
			0.902	0.977	0.699	0.256	0.006	0.383	0.048
Ec	Sig. (2- tailed)	-0.154	1.000	-0.993	0.810	0.246	0.144	0.432	0.790
		0.902		0.760	0.399	0.842	0.908	0.716	0.950
Calcium	Sig. (2- tailed)	0.350	-0.993	1.000	-0.874	-0.359	-0.026	-0.536	0.400
		0.977	0.076		0.323	0.766	0.984	0.640	0.975
Magnesium	Sig. (2- tailed)	0.455	0.810	-0.874	1.000	0.768	-0.464	0.879	-0.521
		0.699	0.399	0.323		0.443	0.693	0.316	0.651
Sodium	Sig. (2- tailed)	0.920	0.246	-0.359	0.768	1.000	-0.924	0.980	-0.947
		0.256	0.842	0.766	0.443		0.250	0.126	0.208
Potassium	Sig. (2- tailed)	-1.000	0.144	-0.260	-0.464	-0.924	1.000	-0.830	0.998
		0.006	0.908	0.984	0.693	0.250		0.377	0.042
Chloride	Sig. (2- tailed)	0.825	0.432	-0.536	0.879	0.980	-0.830	1.000	-0.865
		0.383	0.716	0.640	0.316	0.126	0.377		0.335
Phosphorous	Sig. (2- tailed)	-0.997	0.790	0.400	-0.521	-0.947	0.998	-0.865	1.000
		0.448	0.950	0.975	0.651	0.208	0.042	0.335	

Correlation is significant at the 0.05 level (2- tailed)

pH: pH and Phosphate appeared to be the major environmental variables conditioning macro invertebrates. pH has direct and indirect effects on photosynthetic events and growth of water plant [10]. The pH values were 6.96±0.02, 6.82±0.05, 7.80±0.13, 6.49±0.52 in lake, ground, river and falls water respectively. Water is which allows the neutral nature and which may be due to the influence of temperature which reduces the solubility of carbon dioxide. The phytoplankton in lake water is the reason for high pH than groundwater. According to Fakoyode [11], such pH that is near to neutral is indicative of unpolluted water. The pH of the water was normal as is still fell within the recommended range of 6.5-7 support of aquatic life [12].

Calcium: The source of Ca in natural waters is basically leaching from Ca rich mineral rocks such as lime stone or mineralization of organic matter by the bacteria. Therefore, Ca in natural waters differs according to the difference in geographic regions or anthropogenic impact. The lake water could be classified as soft since its calcium did not exceed 120mg/l [13]. The Calcium values for lake, ground, river and falls were 0.66±0.01, 14.43±0.75, 1.07±0.14, 0.46±0.34. Calcium ions in the lake water determine the hardness of water and are suitable for phytoplankton and aquatic organisms. The general acceptable limit of Ca in waters is usually 75 mgL^{-1} whereas its maximum permissible limit is 200 mgL^{-1}[14].

Sodium and Magnesium: Magnesium is essential trace element for the growth of plants [15]. The Magnesium values for lake, ground, river and falls were 15.77±0.84, 10.53±0.92, 2.31±0.43, 1.72±0.85. The sodium values for lake, ground, river and falls were 17.89±1.34, 14.32±0.86, 0.65±0.40, 0.92±0.22 which is acceptable by aquatic life. Water containing more than 200 mg/l of sodium and magnesium should not be used for drinking by those and moderately restricted [16]. The general acceptable limit of Mg in water is usually 50 mgL^{-1} whereas its maximum permissible limit is 100 mgL^{-1} [14].

Potassium: The potassium values were 7.89±0.20, 3.67±0.34, 2.55±0.30, 0.12±0.03 in lake, ground and river and falls water respectively in the study area which comes under the desirable according to WHO standards.

Phosphorous: Bronmark and Hansson [5] found that biodiversity of lakes and pond ecosystems are currently threatened by a number of human disturbances. It is a major nutrient that triggers eutrophications and required by algae in small quantities [17]. Each P ion promotes the incorporation of seven molecules of N and 40 molecules of CO_2 in algae [16]. Phosphate occurs in natural water in low quality as many plants absorb and store phosphorous many times their actual immediate needs. The phosphorous values were 1.89±0.20, 0.50±0.17, 0.51±0.28, 0.53±0.61 in lake, ground, river and falls water.

Chloride: According to Chandrasekhar *et al.* [18] the presence of Cl concentration in a water source is used as an indicator of organic pollution by domestic sewage. Maximum permissible limit with regard to Cl content in natural freshwaters according to WHO [19] is 200 mgL^{-1} and the same according to ICMR [14] is 250 mgL^{-1}. According to versari *et al.* [20], chloride concentrations higher than 200mg/l are considered to be risk for human health and may cause unpleasant taste of water. The chlorine values were 72.63±3.21, 58.55±0.39, 2.55±0.50, 0.61±0.17 in lake, ground, river and falls waters.

Correlation Results: In lake water high positive correlation is observed between ph and sodium (0.981) and high negative correlation is observed between potassium and chlorine (-0.988). In ground water high positive correlation is observed between magnesium and sodium (0.982) and high degree of negative correlation observed between chloride and ph (-0.987).In river water high degree of positive correlation is observed between calcium and magnesium (0.991) and low degree of correlation is observed between sodium and Ec (-0.97) respectively. In falls water high positive correlation is observed between phosphorus and potassium (0.998) and high negative correlation is observed between ph and potassium (-1.00).

CONCLUSION

In order to ensure sustainable management and optimum exploitation of the aquatic resources, it is necessary to set safe limits for the pollution impact indicators. The goal of all types of monitoring programs is protection of the environment and its resources. The study investigated the physico chemical properties of lake water and groundwater in Yercaud region. The results showed both the ground water and lake water is suitable for drinking purposes and within the limit of WHO standards. Hence the water in the study areas highly supports aquatic life and proves its suitability for irrigational purposes. The results conclude that biodiversity is supported by water parameters in the study areas.

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