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STUDY ON PHYSICOCHEMICAL PARAMETERS OF LAKE MALOMBE, MALAWI

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ABSTRACT
In the present study assessment of some physicochemical parameters of the water body of Lake Malombe in Malawi were determined during July 2016 to June 2017 at monthly intervals with an objective to analysis the physicochemical characteristics like water temperature, transparency, total suspended solids, total dissolved solids, pH, dissolved oxygen, total alkalinity, hardness, BOD and minerals studies has been done during the investigation period. During the rainy season's total solids, total suspended solids, total dissolved solids and turbidity were maximum, which may be due to the gradual disturbances solids sedimentation and dust particles set down along with runoff rainwater. The values of pH, conductivity, hardness, calcium, dissolved oxygen and biological oxygen demands were higher during summer months. The present study enhances the quality of Lake Malombe.

KEYWORDS: Physicochemical characteristics, Alkalinity, pH, BOD and COD.

INTRODUCTION
Among all the natural resources, water is the most precious one and life is not possible without water. Although the fresh water in our planet is about 1500 million cubic km [1] but most of its useless for us, since it contains more quantity of salt. In recent years our planet has the total amount of estimated available fresh water is 84.4 million cubic km, rapid population growth increasing living standard, wide spheres of human activities and industrialization have resulted in greater demand of good quality of water, whereas resources of water pollution is also increasing steadily.[2]

The problems relating to water attract the attention to the regency for investigating causes and suggest remedies in a bid to prepare future plan of action for maintenance of portable waters and related development issues. Without fresh water of sufficient requirements, development will not be possible, since fresh water is available in limited resources as an essential for agriculture, industry and even human existence. The lakes are large or considerable body of water within land. The properties of water physiochemical parameters and the biological diversity plays a vital role for maintain the healthy aquatic ecosystem is reliant on.[3]

Nowadays, the ecology of reservoirs is under stressed condition due to fast pace of development, deforestation, cultural practices and agriculture. Day-by-day water quality of the fresh water resource is becoming deteriorated at the faster rate.[4] To determine the nutrient status of water should analyze the physical, chemical and microbiological characteristics. Physical and chemical characteristics differ along with its biological characteristics due to the presence of the dissolved and suspended materials in various proportions. The quality of the water gets affected due to the presence of dissolved oxygen or produce substances such as ammonia, nitrates, etc.

Malawi covers a geographical area of 118 484 km^2 and lies between latitudes 9nS and 17nS and between longitudes 33°E and 36°E. Nearly 23.6 percent or 28 000 km^2 of its area is taken up by Lake Malawi, the third largest freshwater lake on the Africa continent. The boundaries are shared with the United Republic of Tanzania to the north and northeast, the Republic of Mozambique to the southeast, south and southwest and the Republic of Zambia to the west. Malawi river systems follows the Shire, Songwe, Ruo, Bua, Linthipe, Lilongwe, Rukuru and lakes such as Lake Malawi, Lake Chilwa, Lake Chiuta and Lake Malombe. Lake Malombe and the Upper Shire River lies between the latitude 14°21' to 14°45'S and longitudes 35°10' to 35°20'E and part of the Great Rift Valley system. Lake Malombe has shallow water with an average depth of 4 meter, about maximum width of 15 kilometer and has 30 kilometer in length. The Upper Shire River ranges about 13 km long which flows from the southern tip of Lake Malawi before widening to form Lake Malombe. Approximately the lake surface area is 390.450 km^2 and is nourished by water from Lake Malawi through the Upper Shire River

and is further enriched by inflowing streams from highly populated catchment areas and sediment of nutrients recycling results in the lake shallowness.[5]

To understand the phenomena of water chemistry based on biologically, limnobiological and limnochemical components fully without the knowledge of the ecosystem is highly impossible. Physicochemical and microbiological characteristics may describe the quality of water.[3] The present study is aimed to provide detailed information on physicochemical parameters of the lake water at Mangochi (Lake Malombe) to indicate changes in the quality of waters at the beginning and lower end. The present study will be helpful in estimating the impact of the lake on various physicochemical and biological parameters of the water.

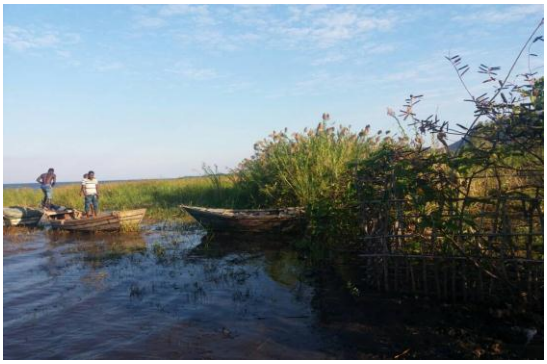
MATERIALS AND METHODS

1. Physicochemical Characteristics

For the present study water samples were collected from the Lake Malombe for the period of one year (July 2016 to June 2017) with the interval of 30 days, lake sampling spots were fixed at the time of 10 to 11 noon in order to maintain uniformity. The physical characteristics comprised with temperature, colour, conductivity, turbidity, total dissolved solids (TDS), total suspended solids (TSS) and total solids (TS). The chemical characteristics included alkalinity, hardness, pH, dissolved oxygen (DO), minerals (Ca, Mg, Fe, Na, Cl_2, So_4, Si, Po_4, No_3, organic carbon, K), Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD). The samples were pretreated in the field to setup the samples and immediately brought to the laboratory for an on spot physical and chemical analysis of various parameters following the standard methods.[6]

2. Study Area

Within Malawi, Mangochi District, Stephen village is in the latitude 14°21’ to 14°45’ South and longitude 35°10’ to 35°20’ East in the Southern Region located in the part of the Great Rift Valley system. The lake is 30 km in length and 15 km in width with a maximum depth of 7m. The Upper Shire River, about 13 kms long, flows from the southern tip of Lake Malawi before widening to form Lake Malombe. Around Lake Malombe chief socio-economic profession for the communities are fishing. In the year 1930s the lake was formed by the flood of a flood plain of the Upper Shire River, about 15 km from its source in Lake Malawi [7]. Lake Malombe is shallow, turbid and nutrient-rich, with defers in vegetated shores without the rocky outcrops so characteristic of Lake Malawi. An outlet of Lake Malombe streams into the Zambezi River. Much of the lake is navigable and fishing is heavy along its banks.



Lake Malombe, Mangochi.

3. Climate

Temperature ranges from 18°C to 24°C. October to April is the period of main rainfall season over Malawi. Normally the main rains start from November in the south and gradually spread towards north. Rainfall over Malawi includes the Inter-Tropical Convergence Zone (ITCZ), Congo air mass, Easterly Waves and Tropical Cyclones where rainfall varies substantially, seasonally and geographically.[8] The monsoon dominance the annual weather cycling Lake Malombe in December.

Visibility excellence due to clear skies and dry atmosphere, summer free monsoon extend from May to July. During the season, the lake begins to receive scattered rainfall, as moisture in the atmosphere builds up.

RESULTS AND DISCUSSION

Data of the seasonal variations in the physicochemical parameters of the Lake Malombe for a period of one year (July 2016 to June 2017) are presented in the Table I and Table II.

The water temperature was ranging from its tropical latitude; the water of this lake is generally warm, having a surface temperature that ranges from 18 to 27° C.

For biological metabolic activities temperature stays in a vital role. Water samples are collected in the Lake Malombe showed lower temperature in the monsoon season. In the summer season it was found to be higher in temperature.

The water was found brownish in colour during rainy season in the lake and it was found to colorless in most of the months; this may be due to the less rainfall.

The turbidity value was ranging from 19 N.T.U to 21 N.T.U in the lake. The maximum turbidity value was recorded in the month of January when compare to the month of April. The mean value of turbidity in Lake Malombe is 19.5 N.T.U.

The electrical conductivity value of the water was ranging from 190 to 320 µS cm^{-1}. The minimum electrical conductivity value of 190 µS was recorded in

the month of January and maximum electrical conductivity value of 320 µS in the month of April.

The pH value of lake was ranging from 7.4 to 7.6. The minimum pH value was recorded as 7.4 in the month of January. Maximum value of pH 7.6 was recorded in the month of May the mean value of pH is 7.5.

The dissolved oxygen value was ranging from 7.9 mg/l to 8.3 mg/l. The minimum dissolved oxygen value was recorded as 7.9mg/l in the month of January and the maximum value of dissolved oxygen 8.3 mg/l was recorded in the month of April. The mean value of dissolved oxygen is 8.1 mg/l. whereas the same reported that under natural condition the running water typically contains a relatively high concentration of dissolved oxygen tending towards saturation.[9,10,11] The study observed that a reverse condition.

The value of BOD and COD were increased with increase in the pollution load[12] stated out that the minimum dissolved oxygen content in water for maintaining fish life in healthy condition. The higher amount of carbonate and bicarbonate might be due to the combination of excess carbon dioxide with monocarbonate forming bicarbonate has also observed.[13]

The BOD value of lake was ranging from 1.0 mg/l to 1.6 mg/l. The minimum BOD value was recorded as 1.0 mg/l in the month of April and the maximum value of BOD 1.6 mg/l was recorded in the month of January. The mean value of BOD was 1.3 mg/l.

The value of calcium ranging from 36 mg/l to 53 mg/l and magnesium ranging from7.5 mg/l to 16.9 mg/l. Minimum amount was recorded at the month of July and maximum value was noted at the month of September. High concentration of calcium is due to its presence in rocks from where it has leached to water. The value of iron was ranging from 0.61 mg/l to 0.91 mg/l. and sodium ranging from 9 mg/l to 17 mg/l. The minimum amount was recorded at the month August of and maximum value was noted at the month of May. The international standards of iron recommended a permissible limit of 0.03 mg/l and excessive limit of 0.1 mg/l in drinking water.[14]

The value of chlorides ranging from 22 mg/l to 37 mg/l, minimum amount was recorded in the month of August and maximum value was noted at the month of September. Chloride is considered to be pollution indicating parameters and it's responsible for the salty taste of water chloride increases degree of entrophication [15]. The direct correlation between chloride concentration and pollution load.[16][17]

The value of sulphate ranging from 0.40 mg/l to 0.95 mg/l, minimum amount was recorded at the month of August and maximum value was noted at the month of May. Excess sulphate content indices cathartic effect on human health sulphate may have laxative effect if magnesium is present at an equivalent concentration.[18]

The value of silicate ranging from 0.80 mg/l to 1.10 mg/l, minimum amount was recorded at the month of August and maximum value was noted at the month of September. The value of phosphate ranging from 6.0 mg/l to 7.6 mg/l, minimum amount was recorded at the month of August and maximum value was noted at the month of May. Phosphate are nutrients their concentration above normal range is found to be cause entrophication.[19]

The value of nitrates ranging from 3.0 mg/l to 3.5 mg/l, minimum amount was recorded at the month October of and maximum value was noted at the month of March**.** Nitrogenous fertilizers, organic manures, human and animal wastes are the inorganic pollutants contributed by nitrate. The minimum amount of iron (0.61 mg/l) was recorded at the month of August and maximum value of 0.91 mg/l was recorded at month of May. For the growth of aquatic organisms essential micronutrients Fe and Mn are required. The value of potassium ranging from 2 mg/l to 6 mg/l the minimum amount was recorded at the month August of and maximum value was noted at the month of April. The value of organic carbon ranging from 0.62 mg/l to 0.9 mg/l, minimum amount was recorded at the month of October and maximum value was noted at the month of March.

Table I: Physicochemical characteristics of Lake Malombe for the period of (July 2016 to June 2017).

Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Temperature (C)	22.0	24.0	27.0	27.0	26.5	26.0	26.0	26.5	26.0	27.0	22.5	21.0
Colour	LB	C	C	C	B	B	B	C	C	C	LB	LB
Turbidity (N.T.U)	19.8	19.8	19.9	20.0	21.0	21.5	21.0	19.4	19.3	20.0	19.5	19.6
Electrical Cond (m Mho)	320	280	275	210	210	200	190	190	180	320	310	320
Suspended Solids (Mg/l)	2200	2240	2245	2276	2285	2340	2360	2370	2370	2000	1900	2000
Dissolved Solids (Mg/l)	1500	1400	1300	1450	1400	1300	1240	1240	1240	1500	1300	1500
Total Solids (Mg/l)	3700	3640	3545	3726	3685	3640	3600	3610	3610	3500	3200	3500
pH	7.4	7.5	7.4	7.4	7.4	7.4	7.4	7.5	7.5	7.4	7.6	7.4
DO (Mg/l)	8.1	8.1	8.1	8.0	8.0	7.9	7.9	7.9	7.9	8.3	8.3	8.1
BOD	1.0	1.2	1.4	1.5	1.5	1.6	1.6	1.5	1.6	1.0	1.6	1.0
Total Hardness (Mg/l)	45.8	36.0	29.2	26.3	26.3	24.0	26.2	27.3	23.6	45.2	56.8	43.9

*LB – Light brownish, B- Brownish, C- Colorless, DB – Dark brownish.

Table II: Variations in the nutrient content of Lake Malombe.

Month	Ca	Mg	Fe	Na	Cl	SO_4	Si	PO_4	NO_3	Organic Carbon	K
Jul-16	53	16.9	0.71	10	37	0.58	0.95	6.5	3.5	0.67	4
Aug-16	40	10.2	0.64	10	35	0.45	0.83	6.6	3.5	0.54	3
Sep-16	42	11.5	0.68	10	25	0.52	0.80	6.8	3.8	0.73	4
Oct-16	41	11.0	0.72	10	26	0.61	0.83	6.9	3.9	0.69	4
Nov-16	40	10.2	0.65	9	26	0.53	0.87	7.1	3.3	0.62	3
Dec-16	48	10.3	0.70	11	28	0.68	0.90	7.2	3.9	0.80	4
Jan-17	39	11.5	0.74	13	30	0.79	0.90	7.3	4.5	0.82	5
Feb-17	40	13.7	0.85	15	33	0.85	0.90	7.4	4.8	0.81	6
Mar-17	40	13.9	0.91	17	32	0.95	1.10	7.6	4.9	0.92	5
Apr-17	42	10.5	0.78	16	30	0.67	0.91	6.8	4.0	0.69	4
May-17	36	7.5	0.65	14	32	0.52	0.90	6.7	3.8	0.65	3
Jun-17	50	10.5	0.61	9	22	0.40	0.85	6.0	3.0	0.68S	2
Mean Values	42.58 (36-53)	11.48 (7.5-16.9)	0.72 (0.61-0.91)	144 (9-17)	29.67 (22-37)	0.63 (0.40-0.95)	0.82 (0.80-1.10)	6.91 (6.0-7.6)	3.91 (3.0-3.5)	0.72 (0.62-0.92)	3.92 (2-6)

CONCLUSION

The present study enhances the quality of Lake Malombe. During the rainy season total solids, total suspended solids, total dissolved solids and turbidity were maximum, which may be due to the gradual disturbances of solid sedimentation and dust particles set down along with runoff rainwater. The values of pH, conductivity, hardness, calcium, dissolved oxygen and biological oxygen demands were higher during summer months.

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REFERENCES

1. Penman HL. Seasonal distribution of nitrate, nitrite, ammonia and lankton in effluent discharge area of Mangalore, West coast of India. Ind. J. Mar. Sci, 1970; 233(3): 99.
2. Murugesan AG, Sukumaran N. Impact of urbanization on the river Thamirabarani, the lifetime of Tirunelveli and at Thoothukudi districts. Proc, sem. Env. Prob, 1999; 1-6.
3. Sinha UK. Ganga pollution and health hazard, Inter-India Publications, New Delhi, 1986.
4. Mahananda HB, Mahananda MR, Mohanty BP. Studies on the Physico-chemical and Biological Parameters of a Fresh Water Pond Ecosystem as an Indicator of Water Pollution. Ecol. Env & Cons, 2005; 11(3-4): 537-541.
5. Francis MT. Bio-economics of common resource over exploitation: Case of lake Malombe chambo (oreochromis sp. cichlidae) fishery in Malawi. Aquaculture and Fisheries Science Dept. Bunda College of Agriculture, Lilongwe, 2002; 1-22.
6. APHA. Standard Methods for the Examination of Water and Waste Water.18th ed. American Puplic Health Association, Washington, DC, 1992.
7. FAO. Fisheries Management in South-east of Lake Malawi, the Upper Shire River and Lake Malombe with particular reference to *chambo* (*Oreochromis spp*.), CIFA Technical Paper. No: 21. Rome, FAO, 1993.
8. Prospects for the 2016/2017 rainfall season in Malawi. Ministry of Natural Resources, Energy and Environment. Department of Climate Change and Meteorological Services, Malawi.
9. Reid GK, Wood RD. Ecology of inland waters and estuaries. *D. Van. Nostrand Co.,* New York, 1976.
10. Ellis MM. Detection and measurement of stream pollution. *Bull. U.S. Bar. Fish .Washington*, 1937; 365-437.
11. Welch PS. Limnology. 2nd Ed. McGraw Hill Book Co., *New York Inc*, 1952; 538.
12. WHO. Guidelines for drinking water quality. World Health Organization, Geneva, 1983.
13. Sinha MPJ. Limnobiotic study on tropic status of a polluted freshwater reservoir of coal field area. Poll. Res, 1986; 5(1): 13-17.
14. Klein L. Aspects of river pollution. Butterworth Scientific publication London, 1957.
15. Chatterje C, Chinmoy A, Rtaziuddin M. Ecology of polluted water. Vol. II. Ed. Arvind kumar A.P.M. Publishing Corporation.5, Snsari Road, Darya Ganj, New Delhi-110002, 2002.
16. Chatterjee C, Raziuddin M. Determination of water quality Index (WQI) of a degraded river in Asanol Industrial area, P.O. Raniganj, District Burdwan, West Bengal. Nature Environment and pollution Technology, 2002; 1(2): 181-189.
17. Koshy M, Nayar V. Water quality aspects of river Pumpa. Poll. Res, 1999; 18(4): 501-510.
18. WHO. Sulfate in drinking water. WHO Guidelines for Drinking-water Quality. WHO/ SDE/ WSH/ 03.04/114, 2004.
19. Xiao-e Yang, Xiang Wu, Hu-lin Hao, and Zhen-li He. Mechanisms and assessment of water eutrophication. J Zhejiang Univ. Sci. B., 2008; 9(3): 197-209.