Study on the Water Quality of Kye-in Lake Near the Chatthin Wildlife Sanctuary (Sagaing Division), Myanmar

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Abstract: Physico-chemical investigations have been made to assess the quality of water from Kye-In Lake near the Chatthin Wildlife Sanctuary (Sagaing Division).The physico-chemical and biological parameters conducted on water samples such as physical and aggregate properties, inorganic, metallic and organics constituents, nutrients and biological organisms, were measured by using titrimetry, gravimetry, uv-visible spectrophotometry, atomic absorption spectrometry, inductively coupled plasma-mass spectrometry, and multiple tube method based on the most portable number technique. The new findings of this research work are the presence of heavy toxic metals, such as Cd (0.01-0.04 ppm), Cr (5.87-6.52 ppm), Pb (0.07-0.09 ppm), As (1.76-1.95 ppm) and Sn (0.02-0.04 ppm), together with high levels of microbiological organisms (*Coliform* =>1800 MPN/100 ml and *E.coli* = 18 MPN/100 ml). The resulting findings indicate that the water body of studied area may reach the threshold of pollution stress.
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Key words: inductively coupled plasma-mass spectrometry, heavy toxic metals

1. Introduction

Globally, the study of the quality of river water has been reported elsewhere by many workers(1).But very few studies have been reported on the lake of Myanmar. Thus, this prompted the initiation of this research work. In the present research work, physico-chemical and biological characteristics of water from Kye-In Lake near the Chatthin Wildlife Sanctuary are to be investigated. Determination of toxic chemical substances are also to be carried out.

2. Experimental

2.1 Description of the study area

The study area (Fig.1), Chatthin Wildlife Sanctuary was established in 1941 during the British administration period. It is 268 km2 (104 sq. miles) in size and is located within Kanbalu and Kawlin Townships in upper Sagaing Division. It lies between 95 24 E and 23 42 N. The Mandalay-Myitkyina railway line passes through the town of Chatthin, which is 2 miles from the east of the entrance of sanctuary boundary (2).The major drainage of the sanctuary is Kinsan Chaung, which flows north-west words across the centre of the sanctuary and joins and Daungyu Chaung at Kye_In, it then flows into the Mu River to the west. Seasonal streams that feed into Kye-In Lake are flooded during the rains and shrink to isolated pools during the dry season.

2.2 Sample Collection

The six different sites of water samples were collected from Kye-In Lake near the Chatthin Wildlife Sanctuary (Sagaing Division). Each site was located 4 km apart. Sample collection was made by choosing different depth profiles of 5 ft, 10 ft,15 ft. Samples were collected three times in January 2004, February 2004 and March 2004.

2.3 Materials and Methods of Analyses

Most of the methods used in the present investigations are from American Public Health Association and International Standard for Drinking Water. The chemicals used were obtained from “British Drug House Chemicals Ltd., Poole, England”, “Kanto Chemical Co. Ltd., Japan”, and “Hopkin and Williams Ltd., Oxoid, England” and, they are simply abbreviated as BDH, Kanto and Hopkins and Williams and Oxoid respectively. In the study of the water quality, the analyses and determinations were carried out according to the recommended standard procedure. The experimental works of water samples were carried out in two portions, viz, physico-chemical and biological procedures. The analytical data were tabulated and the comparative study with WHO was carried out (3)

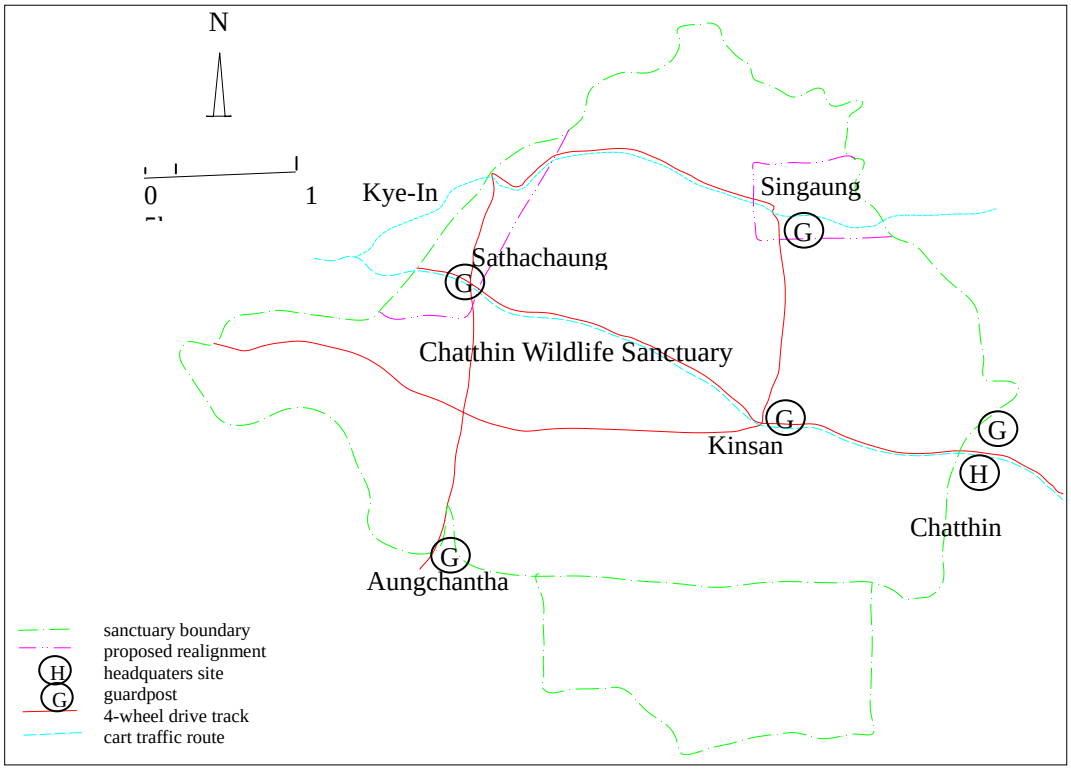

Fig 1. The map of study area, Chatthin Wildlife Sanctuary (Sagaing Division)

3. Results and Discussions

3.1 Physical and Aggregate Properties

The **pH** of water samples were found to be in the range of 6.2 to 7.3. The present pH values are in accordance with the range of 6.5 to 8.5 for drinking water (4). The pH of waters varies with the geological nature of the source and the presence of dissolved solids.

In this research, **hardness** of water varies from 120-285 ppm so that it may be regarded as hard water. The histogram revels the fact that the frequency distribution for sampling site. D was the highest and sampling site. A was the lowest. The amount of hardness increases in going from January, 2004 to March, 2004 due to increase in temperature which increases the solubility of salts. The total alkalinity of water samples were found to be in the range of 100-166 ppm. The largest population frequency distribution is at the sampling site-D and the total alkalinity for sampling site-A was the lowest. Also, in general, total alkalinity increased from January, 2004 to March, 2004. Most of the total alkalinity values are higher than the literature value of 150 ppm for good quality drinking water. The high values of hardness also correlate with high alkalinity values of the collected water samples.

The total dissolved solid (TDS) were found to be in the range of 101-410 ppm, allowed limit being 500 ppm for drinking water. The TDS of water samples generally increase in going from January, 2004 to March, 2004. This is probably due to fact that the rate of evaporation of surface water increases as the hot season approaches. Finally, all the samples showed a great increase of TDS in March, 2004. The TDS characteristic reflects the color of the muddy nature of water body. Hence, the observed high value of turbidity (>1000 NTU) in one way reflects the characteristic of the presence of high value of TDS. This findings suggest the presence of greater amounts of soluble organic matter (eg. Humic and fulvic acids). Dissolved oxygen is necessary for the life of fish and other aquatic organisms. The observed DO values were found to be in the range of 4.5 to 15.32 ppm. DO content was highest in Site-F since at that time, the temperature was low. The desirable DO concentration for maintaining the aquatic life population is about 5 ppm. The low DO value may adversely affects the survival of the most of the marine and biological community for self

purification process.

3.2. Inorganic Constituents

The inorganic constituents (Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, HCO^{3-}, SO_4^{2-}) can be considered as representing a group of water quality parameters. These ions primarily reflect the natural aesthetic qualities of the palatable waters. It was observed that a temporal trend of monovalent cations (Na^+, K^+) falloqed the reverse temporal trend of divalent cations (Ca^{2+}, Mg^{2+}). It is also observed that HCO^{3-} and Cl^- somewhat followed the same temporal pattern of the divalent cations, while SO_4^{2-} followed the same trend of the monovalent cations. The presence in the form of Ca^{2+}, Mg^{2+}, HCO^{3-} and Cl^- suggests that the water bodies (studied) are more under the category hardness, rather than the permanent hardness as once anticipated. The chloride content somewhat reflects the quality parameter "salinity". The increased concentration of SO_4^{2-} can arise from atmospheric precipitation, leaching of sulphate minerals, accidental industrial discharge and the alluvial soil conditions at the banks. The high content of Cl^- is due to the sewage pollution and soil condition at the banks. These make water unpalatable and therefore, unfit for human consumption such as drinking and irrigation.

3.3 .Metallic Constituents

Table 1and fig.2 presents the first high priority metals found in the water samples which can adversely affect the water quality. They are Al, Cd, Cu, Fe, Mn, Ni, Zn and As. The highly toxic metals are V, B, Ti, and Sn. Almost all the metallic constituents fall above the limits of the guidelines of the EPA standard. It is possible that the geographical terrain of the water body and catchment area must originally have contained these elements.

Table 1. Values of Metallic constituents in water samples of Kye-In Lake near the Chatthin Wildlife Sanctuary

No	Location	All data in ppm													
		Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn	As	V	B	Ti	Sn
1	**A**	4.52	0.02	5.91	1.23	0.32	0.94	0.51	0.08	4.81	1.94	2.91	1.81	2.23	0.03
2	**B**	4.71	0.03	5.87	1.03	0.36	0.95	0.52	0.09	4.79	1.84	2.87	1.94	2.34	0.02
3	**C**	4.83	0.04	6.12	1.25	0.29	0.94	0.49	0.07	4.23	1.95	2.95	1.98	1.95	0.03
4	**D**	5.32	0.02	5.94	0.95	0.34	0.86	0.47	0.09	4.78	1.76	2.37	2.1	1.84	0.04
5	**E**	5.11	0.01	6.46	0.98	0.28	0.87	0.48	0.07	4.31	1.86	2.75	2.23	1.96	0.03
6	**F**	5.42	0.03	6.52	1.31	0.31	0.91	0.54	0.08	4.26	1.94	2.86	2.42	1.29	0.03
Standard EPA Values (2001)		**3.1**	**0.005**	**0.005**	**0.1**	**0.05-0.5**	**0.05**	**0.05**	**0.05**	**0.01-5**	**0.05**	**0.34**	**1**	**0.86**	**0.001**

A= Side of Daungyu Chaung (Left), B= Side of Daungyu Chaung (Middle),
C=Side of Daungyu Chaung (Right), D= Side of Satha Chaung (Left),
E= Side of Satha Chaung (Middle), F= Side of Satha Chaung (Right)

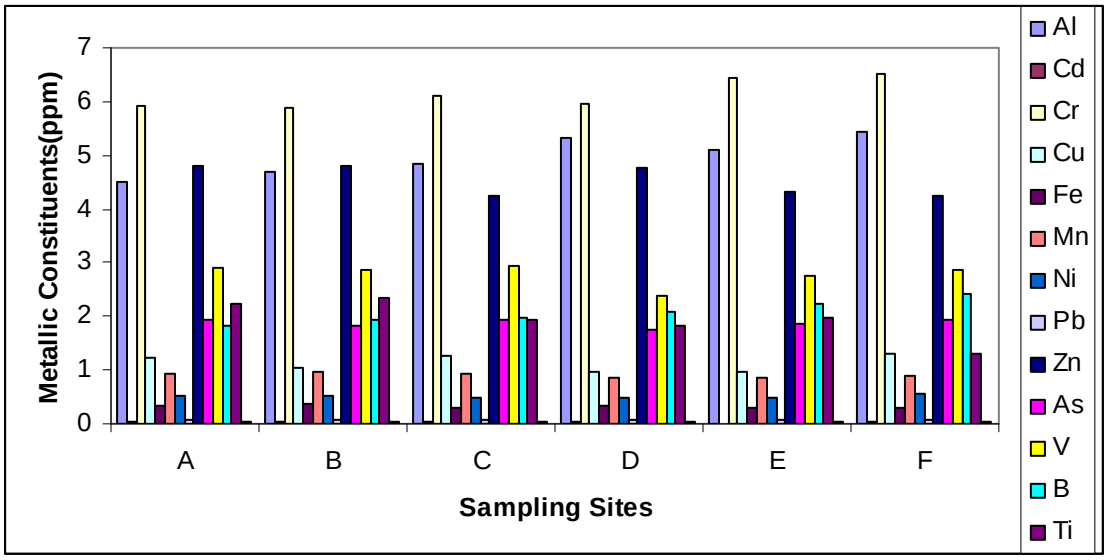

Fig. 2 Values of Metallic constituents in water samples of Kye-In Lake near the Chatthin Wildlife Sanctuary

3.4 Nutrients

In this research, the results of ammonia nitrogen were found to be in the range of 0.84 to 1.01 ppm. The frequency distribution for sampling site-F was the highest and sampling site-B was the lowest. The results of nitrate nitrogen was in the range of 0.29 to 3.21 ppm. All these water samples were within the allowable limit of drinking water (10 ppm). The WHO approaches has been adopted where the levels of nitrate most not exceed 1 ppm. The nitrite nitrogen concentrations in water sample were found to be in the range of 0.42 to 1.85 ppm. The lower concentration of phosphate may be explained by algal activity. In general, algal activity is at its highest, i.e., phytoplankton or algae absorb phosphate for its growth. In this research, the blooming of algae was observed and phosphate concentration was low.

3.5 Organic Constituents

The major parameters COD, BOD and DOC are commonly used too represent the organic matter contained in surface water. At all locations, COD are greater than BOD and DOC(Table 2 and Fig.3), in correspondence with the common trend: COD (6.0-7.5 ppm) > BOD (0.94-3.4 ppm) >DOC (0.71-2.86 ppm). The BOD of water was highest in March due to highest population of bacteria and phytoplankton of bacteria and phytoplankton in water. The sampling site-F showed the highest values of COD, which also had the highest value of nitrite nitrogen content.

Table. 2 Values of Organic Constituents in Water Samples of Kye-In Lake

		All data in ppm		
No	**Location**	**BOD**	**COD**	**DOC**
1	A	1.81	8	0.86
2	B	1.94	8.91	0.89
3	C	2.85	8.49	2.1
4	D	2.89	9.48	2.87
5	E	3.12	10.41	3.01
6	F	4.93	15	3.92
Standard EPA Values (2001)		***5***	***10***	***4.2***

3.6 Bacteriological Organisms

The data as regards to *Coliform*, *E.Coli*, and *Salmonella* were significantly greater than EPA standard values. The source of contamination may be due to the dense population and from the excretion of warm blooded animals near the studied areas. Contamination by sewage or by human or animal excrement is the greatest danger associated with water for drinking purpose (5). Thus, the water bodies from these areas may not be safe for purposes such as drinking recreation, health and irrigation on the basis of biological view point.

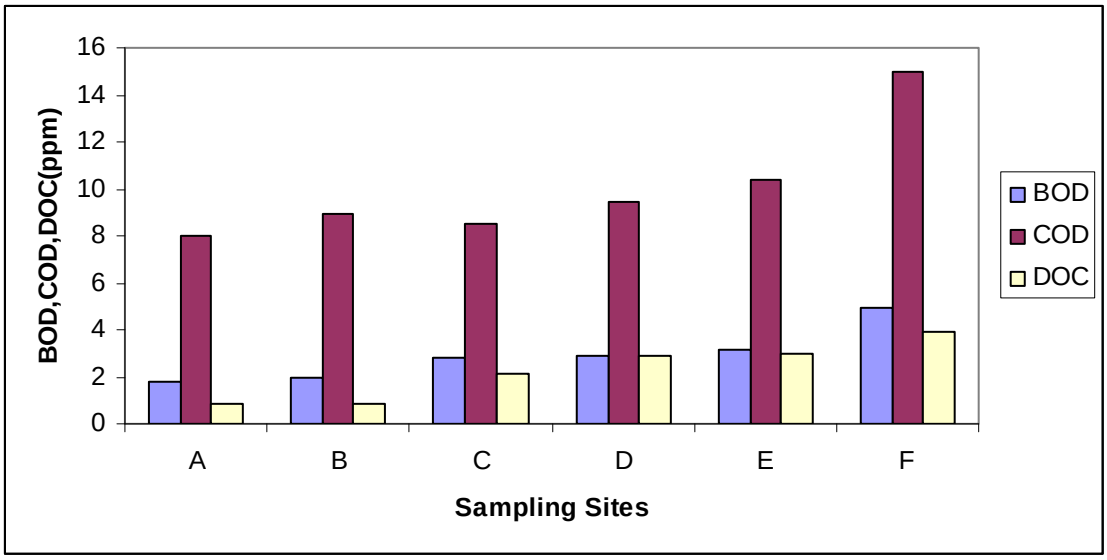

Fig. 3 Values of Organic Constituents in Water Samples of Kye-In Lake

4. Conclusion

From the overall assessments of the present work, a unique finding was the presence of heavy toxic metals, such as Cd (0.01-0.04 ppm). Cr (5.87-6.52 ppm), Pb (0.07-0.09 ppm), As (1.76-1.95 ppm) and Sn (0.02-0.04 ppm) were found to be above the EPA guidelines (5). The resulting findings indicate that the water bodies of the studied area are in the threshould of mild pollution. High concentration of nutrients may reflect the corresponding increase in algal activity. The increase in algal production can probably lead to eutrophication. Another significant feature which supports the nature of pollution is the presence of biological species *Coliform* (>1800 MPN/100 ml), *E.Coli* (18 MPN/100 ml) and *Samonella* in the water body of the Kye-In Lake. It was observed that the bacteria, *E.Coli* is isolated from all water samples. The water from the studied area should not be used for drinking and domestic purposes from the microbial viewpoint, so that the water from this regions may be used for multi-purpose by boiling to kill bacteria. The possible suggestion that the water body to be environmentally "clean and safe" is to prevent rather than control the indiscriminate discharge of effluents from the users of point sources.

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