

Water Quality Assessment of Paleik Lake, Sint-kaing Township, Mandalay Region, Myanmar

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Abstract

Currently population, urbanization and modernization are still going to increase for problems of sewage disposal and contamination of surface waters like lakes. Natural water is getting contaminated due to weathering of rocks, leaching of soils and mining processing, etc. Water samples were collected from Paleik Inn (lake), Sint-kaing Township, Mandalay Region, in summer 2017, 2018 and 2019 for this research work. Water quality of Paleik Inn (Lake) was assessed by various parameters such as BOD, COD, pH, total solid, total hardness, total alkalinity etc. Furthermore, the heavy metals contents, especially Pb, Cu and Cd were examined by Atomic Absorption Spectroscopy (AAS) at Department of Chemical Technology, Pyin Oo Lwin Township, Mandalay Region. In addition, bacteriological examination of water samples was carried out at Public Health Laboratory, Mandalay.

Keywords: Parameter, AAS, BOD, Water samples

1. Introduction

All water pollution affects organisms and plants that live in these water bodies and in almost all cases either to individual species and populations but also the natural biological communities. Natural chemical substances come in contact with water in its vapor or liquid phases, and because of the potential of these substances to dissolve, water lose its purity; at time it become contaminated. The contamination of water bodies such as lakes, rivers, oceans, or ground water is also caused by human activities [1]. Paleik Inn (Lake) is not only good in the supports for avifauna diversity but also attract more migratory birds as the presence of favorable conditions for bird inhabitant. Water quality of Paleik Inn (Lake) was threatened by agricultural residues including chemical fertilizer, farming of fishery and also includes industrial wastewater discharge. Thus, there is a need to assess water quality of Paleik Inn (Lake) protecting the ecosystem, natural environment and natural habitats of birds for future.

2. Materials and Methods

2.1. Study Area

Paleik Inn (Lake) is situated in Sint-kaing Township, Mandalay Region surrounded by Myit-nge River. It is

about 8.7 km away from Mandalay. It has 2.3 km long from east to west and 2.1 km width from south to north. The water body of Paleik Inn (Lake) is 96.22 hectares in rainy season and 16.35 hectares in hot season. It lines at latitude 21.50' 14.91"N and longitude 96.03' 12.00 " E.

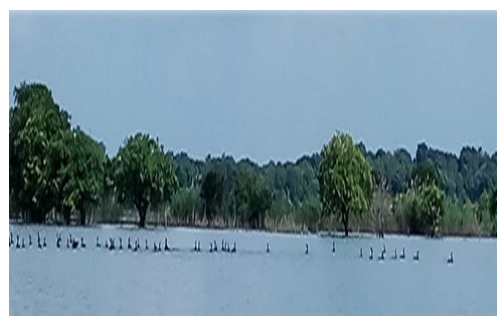


Figure 1. Paleik inn (lake)

2.2. Sampling

Water samples were collected and divided into four groups which were (i) open water area (sample 1), (ii) village area (sample 2) (iii) paddy_field area (sample 3) and (iv) stream (sample 4).

2.3. Analytical Methods

The collected water samples were sent to Water Resources Division, Department of Agricultural Research, Yezin, Pyinmana Township, Naypyidaw for analyzing pH, total hardness (TH), total alkalinity, electrical conductivity (EC), the concentrations of total dissolved solids (TDS) and total suspended solids (TSS) and also sent to Department of Chemical Technology, Pyin Oo Lwin Township, Mandalay region for measuring some heavy metal ions such as copper, calcium, magnesium and chromium ions.

3. Results and Discussion

The recommended water quality criteria set by World Health Organization (WHO), Indian Council of Medical Research (ICMR), Indian Standard Institution (ISI), Environmental Protection Agency (EPA), European Community (EC) and the physical and chemical characteristics of water samples of Paleik Inn (Lake) areas were shown in Tables (1) to (9), respectively.

According to Table (1), water from Paleik Inn (Lake) is slightly alkaline, and it is within the permissible level for drinking purposes according to WHO standard [8].

Table 1. Recommended water quality criteria[4, 6]

Quality Factor Desirable	Desirable Limit	Maximum Permissible limit	Organization/ Body	Remarks
pH	7.0-8.5	6.5-9.2	WHO, ISI, ICMR	
Total Hardness (TH), mgdm ⁻³	100	500 < 270	EPA, ICMR EPA	For drinking purposes
Total Alkalinity, mgdm ⁻³	200	600	WHO	
Total Dissolved Salts (TDS), mgdm ⁻³	500	1500 < 500	ICMR EPA	For drinking purposes
Total Suspended Solids	20			
Electrical Conductivity, umhos/cm	750	2500 0.4 – 0.85	WHO EPA	domestic For drinking purposes
Calcium ion, mgdm ⁻³	75	200	ICMR	
Magnesium ion, mgdm ⁻³	30	100	WHO	
Sodium ion, mgdm ⁻³	50	175	WHO	
		<100	EPA	For drinking purposes

According to Tables (2), (3) and (4), although the hardness values do not exceed the maximum permissible level [5], Carbonates and bicarbonates are the major contributors to the total alkalinity. The amounts of total alkalinity from all sampling points in Paleik Inn (Lake) do not exceed the highest acceptable limit and all samples are closed to lower limit. EPA (2012) has reported that the maximum contaminant level of EC is 0.4 -0.85 micro Siemens per centimeter. Mean values of all samples are under permissible level of 750 S/m. In this investigation, the TDS values varied from 130 mg/L to 292 mg/L throughout the Lake area although the mean values of TDS are within permissible level. As level of TSS increase, a water body begins to lose its ability to support a diversity of aquatic life. The amount of total suspended solids from all sampling points show the extremely higher level than the standard limits [2].

Table 2. Physical and chemical properties of water samples [6]

Quality Factor Desirable	Sample				Desirable Limit	Maximum Permissible limit
	(1)	(2)	(3)	(4)		
pH	7.1-7.5	7.3-8.0	7.1-7.9	7.1-7.9	7.0-8.5	6.5-9.2
Total Hardness (TH), mgdm ⁻³	130-180	140-200	180-220	130-200	100	500 <270
Total Alkalinity, mgdm ⁻³	240-325	260-390	260-390	260-390	200	600
Total Dissolved Salts (TDS), mgdm ⁻³	130-282	150-269	143-274	146-290	500	1500 <500
Electrical Conductivity, S/m	282-496	269-513	274-419	218-480	750	2500 [0.4-0.85 S/m]
Calcium ion, mgdm ⁻³	15-24	16-32	17-31	15-33	75	200
Magnesium ion, mgdm ⁻³	4-10	5-17	6-19	4-16	30	100
Sodium ion, mgdm ⁻³	24-40	20-40	23-40	25-40	50	175 <100
Lead(mg/L)	0.090	0.030	0.010	0.040		0.001
Cadmium (mg/L)	Nil	Nil	Nil	Nil		0.003
Copper (mg/L)	0.0230	0.0315	0.0322	0.0356		0.005

Table 3. Hardness classification expressed as mg/L of CaCO₃ [5]

Hardness Range (mg CaCO ₃ /L)	Description of Hardness
0-50	Soft
50 -100	Moderately Soft
100 - 150	Slightly Hard
150 - 200	Moderately Hard
200-300	Hard
>300	Very Hard

Table 4. Hardness level of water samples of Paleik inn (Lake) [5]

Sampling area	Hardness (mg CaCO ₃ /L)	Hardness level
Open lake area	100 – 200	Slightly Hard to Moderately Hard
Paddy field areas	130 – 226	Slightly Hard to Moderately Hard
Villages	133 - 200	Slightly Hard to Moderately Hard
Streams	140 - 198	Moderately Hard

Table 5. Clarity of water based on TSS level [3]

Total Suspended Solid (mg/L)	Description of Clearness
< 20	Clear
40-80	Cloudy
> 150	Dirty

According to Table (5), as level of TSS increase, water body begins to lose its ability to support a diversity of aquatic life. The amount of total suspended solids from all sampling points showed the extremely higher level than the standard limits.

Table 6. Clearness of Paleik inn (Lake) water based on total suspended solids (TSS) level [3]

Sampling area	Total suspended solids (ppm)		Clearness
	Mean (sD)	Min - Max	
Open lake area	311 (188)	162 - 860	Dirty
Paddy field areas	211 (70)	148 – 380	Dirty
Villages	416 (468)	214 -1056	Dirty
Streams	315 (55)	252 - 350	Dirty

According to Table (6), the amount of total suspended solids from all sampling points show the extremely higher level than the standard limits. Therefore, population of migratory birds are believed to be declining due to decrease water clarity levels

associated with suspended residues. Calcium concentration of higher than 32 mg/L can increase scaling problems lathering of soap impaired although it has no health effect. In this study, the concentration of Magnesium ranged from 4 to 19 mg/L. The solubility of magnesium in water is governed by the pH. According to WHO, the maximum admissible limit for sodium is 175 ppm, but for drinking purposes, the level should not exceed 100 mg/L. In this study, the concentration of sodium of all sampling points does not exceed the desirable limit for drinking. However, a maximum level of 20 ppm is recommended for people on low sodium diets (WHO, 1984). It was observed that lead (Pb) and copper (Cu) which could cause pollution to water were present as significant amount in water samples [8].

Table 7. Results of bacteriological examination of water samples [7]

Parameter	Open lake area	Paddy field areas	Villages	Streams
Coliform Count (MPN)	2/5	5/5	5/5	5/5
<i>E.coli</i>	Not-Isolated	Isolated	Isolated	Isolated
Remark	Satisfactory	Unsatisfactory	Unsatisfactory	Unsatisfactory

According to Table (7), bacteriological examination showed that the probable coliform counts are present in all sample areas. *Escherichia coli* can be isolated for other samples except open lake area. Therefore, all samples were found to be unsatisfactory for drinking purpose.

Table 8. Biochemical oxygen demand (BOD) levels of water [7]

BOD Level (in ppm)	Water Quality
1-2	Very Good There will not be much organic waste present in water supply.
3-5	Fair : Moderately Clean
6-9	Poor: Somewhat polluted
100 or greater	Very poor: Very polluted contains organic waste.

According to Table (8), the demand for oxygen will be high, due to all the bacteria. Therefore, BOD level

will be high. As the waste is consumed or dispersed through the water, BOD levels will begin to decline [6].

Table 9. BOD and DO levels of water samples [7]

Parameter	Open lake area	Paddy field areas	Villages	Streams
Biochemical Oxygen Demand (BOD) (mg/L)	4.6-8.8	6.8-12.0	4.5-5.8	4.6-9.6
Dissolved Oxygen (DO), (mg/L)	3.7-5.6	1.6-5.1	4.5-5.8	5.1-5.6

According to Table (9), BOD levels in paddy field area and streams were found to exceed the range 6-9. The other areas have fair BOD levels. So, Paleik Inn (Lake) is found to be polluted. It is necessary to preserve this lake.

4. Conclusions

It has been evident from research findings that the causes and sources of water pollution and its eutrophic state in Paleik Inn (Lake) region are due to anthropogenic activities. The major occupation in the study area is Farming. This is seen as the main source for the nutrient enrichment which leads to Lake Eutrophication. Domestic discharges into the river are probably responsible for the observed high concentration values of electrical conductivity, total hardness and total suspended solids. It is recommended that the activities to reduce erosion and sediment inputs should be implemented within Paleik Inn (Lake) catchment, especially in lands adjoining the lake. Promoting land management systems that increase surface runoff and may exacerbate surface erosion should be used with caution. According to on-going eutrophication and pollution status within the lake, it is important to immediately control inputs of chemicals and sediments from within-lake sources and adjacent wetlands. Since monitoring is very important for lake conservation like water quality monitoring which is used as the indicator of lake health and is important for the assessment of lake diagnosis, continuous monitoring on water quality is needed. Public awareness is essential in playing vital role in the preservation of Paleik Inn (Lake). Therefore, water from Paleik Inn (Lake) is not suitable for drinking purposes.

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