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# Evaluation of Water Pollution Status During Pre-monsoon Period of Fewa Lake, Pokhra, Nepal

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## Abstract

Water pollution has become a growing threat to human society and natural ecosystems in recent decades. Therefore, the study was carried out to assess the quality of water in Phewa Lake which is one of the largest lake systems in Nepal. The pollution status of lake water was examined by analyzing some important physicochemical and microbiological parameters such as ambient temperature water temperature, Turbidity, Total Dissolved Solid (TDS), Total Suspended Solid (TSS), Conductivity, Hydrogen- ion-concentration (pH), Dissolved Oxygen (DO), Total hardness (TH), Nitrate – Nitrogen ($NO_3$-N), Phosphate- phosphorus ($PO_4$-P), Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), total coliform and fecal coliform. The result showed that the values of turbidity (21.67 NTU), DO (5.2 mg/l), Phosphate- phosphorus (30 mg/L), total coliform (1733.33 MPN/100 ml) and fecal coliform (853.33 MPN/100 ml) were crossed the WHO guide line whereas others were under safe line. On the basis of pollution status found, the water of the lake was unfit for drinking purposes.

***Keywords:*** *Phewa Lake; Pollution; Water Quality; Physicochemical Parameters; Nepal*

## Introduction

Wetlands are one of the most threatened habitats because of their vulnerability and attractiveness for development [1]. Wetlands provide homes for a huge diversity of wildlife: birds, mammals, fish, frogs, insects and plants [2]. Surface waters include the lakes, ponds, reservoirs, rivers and streams and wetlands. The flow of water into and through these surface water bodies comes from rainfall, runoff from melting snow and ice and as base-flow from groundwater systems [3]. While surface waters volumetrically hold only a small volume (0.3 percent) of the earth's total freshwater resources, they represent about 80 percent of the annually renewable surface and groundwater [3].

The most important problem in protecting water resources is pollution [4]. Pollution parameters have been classified as physical, chemical and biological on the basis of analytical tests. Physical pollution can be determined by parameters such as PH, temperature, colour, turbidity, electrical conductivity, light permeability, suspended matter and dissolved matter [5]. Chemical pollution is determined by values which are derived from parameters such as total hardness, total alkalinity, phosphate content, and different heavy metal ions present in water [5]. Biological pollution may be determined by the presence of microorganisms such as faecal coliform bacteria (*E. Coli*), *Cryptosporidium parvum* and *Giardia lamblia*. The accurate determinations of trace element concentrations and other physical, chemical and biological parameters of ground and surface waters are important for controlling their pollution [5].

Worldwide deterioration of surface water quality has been attributed to both natural processes and anthropogenic activities, including hydrological features, climate change, precipitation, agricultural land use, and sewage discharge [6-9]. Information on water quality and pollution sources is important for the implementation of sustainable water-use management strategies [10-12]. Lake water contains dissolved gases Oxygen), organic, suspended and dissolved matters. The colour of lake is caused by dissolved or suspended matters; eutrophic lakes and reservoirs also have coloured water (green/brown) and low levels of dissolved oxygen in the deepest areas [13].

Nepal has many types of wetlands scattered in the Mountain and Terai regions. Its wetlands (approximately 743,500 ha) are particularly important for threatened species [14]. Because of its mountainous physiography, bigger wetlands are rather very few [15]. The main objective of the present work is to assess the quality and suitability of lake water for human consumption based on the examined parameters.

## Materials and Methods

### Site Description

Phewa Lake is situated in Pokhara Valley (28°1'N, 82°5'E, elevation 742 m from masl) in the western mid hill region of the country that has humid subtropical monsoon climatic condition (Figure 1). The temperature is moderate, with maximum temperature peaks at 25.5°C in July-August and falls to minimum of 13.2°C in January. It has a watershed area of approximately 110 km2 [16]. Lamichhane (2000) estimated 443 ha of water surface area with a maximum depth of 23 m [17]. The Phewa Lake is Nepal's second largest lakes, and the largest one in heart of Pokhara valley, a swiftly growing city and the second most visited tourist place in Nepal.

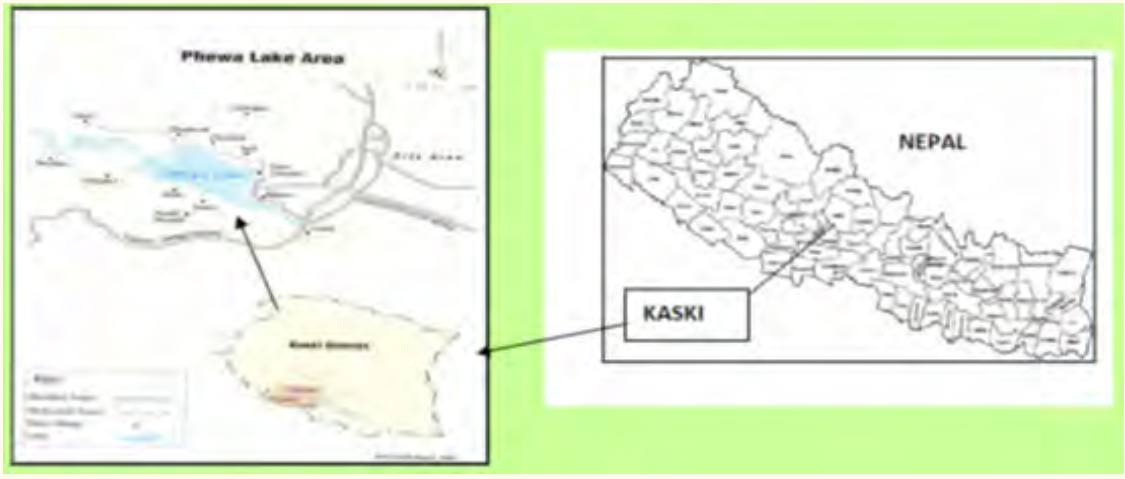


***Figure 1:*** *Map showing Phewa lake.*

## Methodology

The physicochemical and microbiological examinations of Lake Water were carried out during pre-monsoon period. Water samples were collected on May 22, 2017 from the three different representative sites from Talbarahi temple area of the lake and were brought to the laboratory in 2.5L plastic container for laboratory analysis. The parameters like temperature, pH, Dissolved oxygen, Free-carbon dioxide, Conductivity was determined on the spot while the rest of the parameters were determined in the laboratory. The overall analysis was done following the standard methods of APHA (2005) and Trivedy and Goel (1986).

## Result and Discussion

Regarding the water quality characteristics of Phewa Lake during pre-monsoon, some important physicochemical and microbiological

parameters were examined. All the results of the study have been shown in the table 1 whereas their graphic representations are shown in the figure 2 and figure 3.

| Sl. No. | Parameters | Units | Pre-monsoon (2017) | | | | WHO Guideline |
|---|---|---|---|---|---|---|---|
| | | | Site I | Site II | Site III | Mean | |
| 1 | Water depth | (ft.) | 1 | 5 | 10 | 4.5 | - |
| 2 | Ambient Temp. | (˚C) | 25.0 | 24.5 | 23.0 | 24.17 | - |
| 3 | Water Temp. | (˚C) | 27.0 | 25.5 | 23.5 | 23.5 | $25.33^0$C |
| 4 | Turbidity | (NTU) | 10.0 | 18.0 | 37.0 | 21.67 | 1.5 |
| 5 | TDS | (mg/L) | 167.2 | 227.3 | 220.0 | 204.83 | 1200 |
| 6 | TSS | (mg/L) | 3.7 | 7.8 | 6.9 | 6.13 | 25 |
| 7 | Conductivity | (µs) | 27.0 | 47.0 | 55.0 | 43.0 | 1000 |
| 8 | pH | | 8.2 | 7.8 | 7.6 | 7.87 | 6-5-8.5 |
| 9 | DO | (mg/L) | 8.5 | 5.6 | 1.5 | 5.2 | 5 |
| 10 | TH | (mg/L) | 78.5 | 84.7 | 78.3 | 80.5 | < 180 |
| 12 | $NO_3$ – N | (mg/L) | 0.165 | 0.150 | 0.245 | 0.187 | 50 |
| 13 | $PO_4$ – P | (mg/L) | 25.0 | 38.0 | 27.0 | 30.0 | 14 |
| 14 | COD | (mg/L) | 1.80 | 3.70 | 13.00 | 6.17 | 40 |
| 15 | BOD | (mg/L) | 2.45 | 1.15 | 3.6 | 2.4 | 5 |
| | Total Coliform | (MPN/100 ml) | 2500 | 1500 | 1200 | 1733.33 | Nil |
| 16 | Fecal Coliform | (MPN/l00 ml) | 950 | 760 | 850 | 853.33 | Nil |

***Table 1:*** *Physico-chemical and microbiological characteristics of water of Fewa Lake of Kaski District, Nepal (Pre-monsoon, 2017).*

*TDS: Total Dissolve Solid; TSS: Total Suspended Solid; DO: Dissolved Oxygen; TH : Total Hardness; $PO_4$–P : Phosphate – phosphorus; $NO_3$-N: Nitrate – nitrogen; BOD: Biological Oxygen Demand, COD: Chemical Oxygen Demand.*

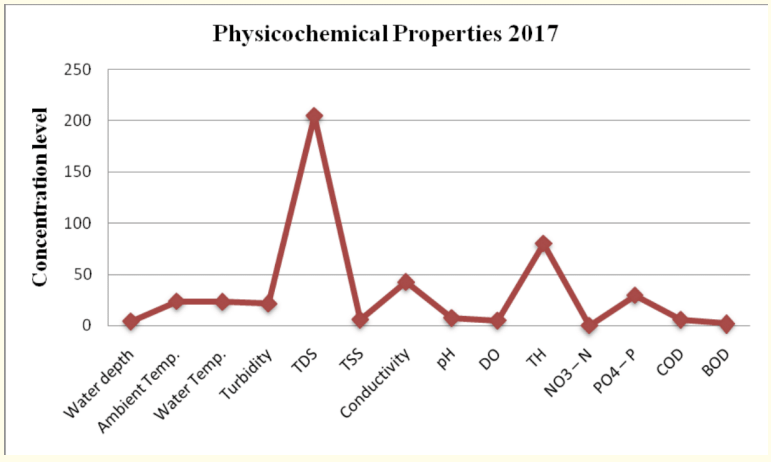


***Figure 2:*** *Physicochemical properties of water of Fewa Lake.*

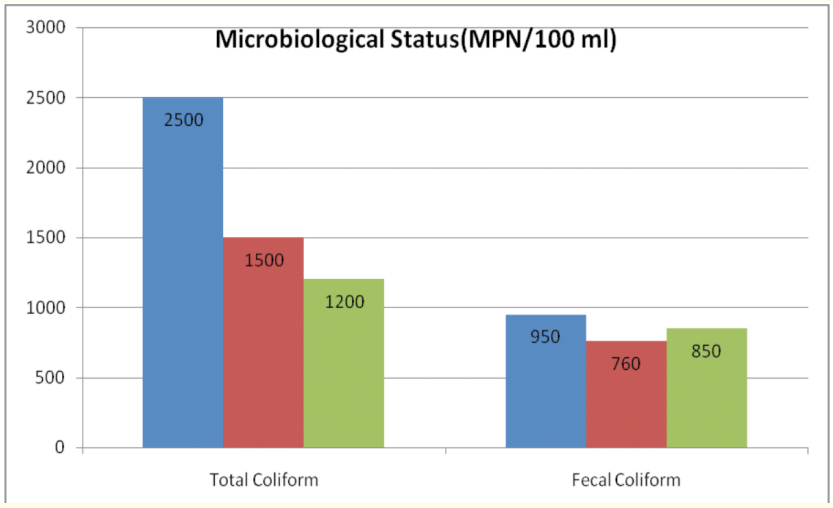


***Figure 3:*** *Microbial contaminations in the water of Fewa Lake.*

The average air temperature recorded was 24.170C whereas the average water temperature was 22.50C of the lake. The mean turbidity value of the lake water was 21.67 NTU, which crossed the permissible limit. The turbidity value depends upon the amount of total solids, plankton density, suspended materials and various human activities. The mean value of Total Dissolved Solid was 204.83 mg/L, whereas the mean value of Total Suspended Solids was 6.13 mg/L remaining under the WHO guideline.

E. Conductivity of water depends upon the concentration of ion and nutritional status of the water body. The mean value of E. Conductivity of the lake water was recorded 365.6 µs which is under the WHO guideline. Similarly, the mean pH value was recorded 7.87 which is under the permissible limit. The pH of waters depends upon the geological nature of the source and the presence of dissolved solids. The amount of dissolved oxygen in Fewa lake was recorded to be 5.2 mg/ but the WHO guideline value is 5 mg/L for drinking water. Total hardness was from 80.5 mg/L, 178 mg/L which is slightly under the WHO guide line.

Nitrate-Nitrogen content of the lake water was 0.187 mg/L, which is under the WHO permissible limit. Nitrogen content of water is of great significance for the algal growth. The concentration of PO4-P in the lake water was 30 mg/L which was crossed the WHO permissible limit. It is a pollution indicator, as its higher amount responsible for eutrophication in freshwater and it acts as growth limiting factor and is an important nutrient for microorganisms. Chemical Oxygen Demand is the amount of oxygen required for the oxidation of chemical wastes. The mean value of COD recorded was 6.17 mg/L which was under the tolerance limit. BOD value recorded from the lake was 2.4 mg/L which was under the tolerance limit.

The mean value of total coliform and fecal coliform recorded from the lake water were 1733.33 and 853.33 MPN/l00 ml respectively which was crossed the WHO guide line. Total coliform and fecal coliform were found in all the sites, which show that water is highly contaminated and not suitable for drinking purpose.

## Conclusion

On the basis of the present investigation, the lake water quality can be termed as not free from pollution. The present study disclosed the physicochemical and bacteriological contamination of Fewa lake of Kaski district, Nepal in pre-monsoon season. From the overall assessments of the present work, a unique finding was the presence of some pollutants, such as turbidity (21.67 NTU), DO (5.2 mg/l), Phosphate- phosphorus (30 mg/L), total coliform (1733.33 MPN/100 ml) and fecal coliform (853.33 MPN/100 ml) microbial were crossed the WHO guide line. Therefore, the lake water from the studied area should not be used for drinking and domestic purposes before proper treatment.

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