**Full Length Research Paper**

**Bacteriological and Physicochemical Characteristics of Kaptai Lake Water in Terms of Public Health Significance**

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**Abstract.** Kaptai Lake (KL), which is one of the largest artificial freshwater lakes of South-east Asia, is located in the Rangamati district of Bangladesh and also the major dwelling place of the indigenous ethnic minorities. The lake water is consumed for drinking and other domestic purposes by the population living within the lake without any intermediate purifying process. In the current study, the bacteriological, physicochemical and metal characteristics of the lake water have been measured to investigate the lake water quality regarding the health concerns in comparison with the limits set by WHO, USEPA and Bangladesh EQS. The heterotrophic plate count for the lake water samples were between ~75 and ~244 cfu mL⁻¹ and was in compliance with the USEPA limit of 500 cfu mL⁻¹. However, the coliform count was in the range of 4±0.6 to 140±17, and was above the standard limits set for drinking use. All the water samples also showed positive presence of *Enterococcus spp.*, *Salmonella spp.*, *Pseudomonas spp.* and *Vibrio spp.* The physicochemical analysis confirms that the water temperature (26–27 °C), pH (7.5–7.8), electrical conductivity (108–113 μS cm⁻¹), total dissolved solids (53–55 ppm), total hardness (42–43 ppm), total alkalinity (11–11.5 ppm), chloride (0.9–1.8 ppm) and dissolved oxygen (4.1–4.8 ppm) were within the limits of the guideline values. The concentrations (mg L⁻¹) of toxic metal-species, e.g., lead (0.025–5.128), cadmium (0.008–0.020) and nickel (0.199–0.288) were found to be higher than the recommended regulatory limits, while the contents of copper (0.099–0.301), manganese (0.179–0.291) and zinc (1.989–2.278) were within the acceptable range. The findings from our work indicate that the water of KL is unsuitable for drinking use in terms of bacteriological and metal characteristics and might pose a long-term health risk to its consumers.

**Keywords:** Kaptai Lake; Drinking water; Water quality; Coliform; Toxic metal

1. **INTRODUCTION**

The freshwater resources, consisting only 3% of the entire water reserve of the earth (Wilson and Carpenter, 1999), has been an important component of the biosphere as well as an essential element to ensure the sustenance of living beings (Jackson et al., 2001). The freshwater resources become inadequately renewable due to the exponential growth of human population, extensive urbanization, rapid industrialization and intensive agriculture practices (Fischer and Heilig, 1997; Douglas et al., 2002; Dale et al., 2005; Grimm et al., 2008). Water quality, which represents the physical, chemical and biological characteristics of water, tells whether water is polluted or not in terms of drinking, safety of human contact, and for the health of ecosystems (Schleiger, 2000). Water-borne diseases are responsible for emerging and recurring infectious diseases worldwide, whereas about 80% of the public health problems have been caused from contaminated water (Marshall et al., 2006; Jones et al., 2007; O’Reilly et al., 2007; Peace and Mazumder, 2007; Jayana et al., 2009).

Water contaminated with pathogenic bacteria is the potential carrier for transferring various infectious diseases to human (Sadeghi et al., 2007). Cholera, salmonellosis and shigellosis are the most common gastrointestinal diseases transmitted through water that is contaminated with feces of patients (Cabrall, 2010). Drinking water should be free from turbidity,
color, odor, as well as disease-causing organic and inorganic substances that may cause adverse physiological effects (Bhatt et al., 1999).

In Bangladesh, especially in the marginal locations, safe source of drinking water supply is limited and the population depends on the tubewell, pond, lakes, etc. Tube-well exploited the underground water and labeled as a safer source of drinking water until a large-scale geogenic arsenic-contamination is reported. On the other hand, the biggest obstacle of consuming surface water for the potable purpose is its possibility of exposure to pathogenic bacteria (Rahman et al., 2003; 2011a; 2011b; 2013).

Kaptai Lake (KL) located in the district of Rangamati and 68.5 km away from Chittagong metropolitan city, is the largest man-made reservoir in South-east Asia. The lake was created during the construction of a dam on the Karnaphuli River, which is flowing in the southeastern part of Bangladesh, for generating hydroelectricity (Fernando, 1980; Karmakar et al., 2011). As a consequence of the dam construction and creation of the lake, a large hilly area was submerged resulting in massive changes in the ecosystem (Newman, 1974). The indigenous population was also forced to move in more hilly places or the small islands formed within the lake. All the people living surrounding the lake becomes dependent on the lake water to meet the requirement of drinking, domestic or other purposes and the consumption is done without any intermediate processing (Ahmed et al., 2001; Chakma, 2008). The objective of our current work is to evaluate the quality of KL water in terms of drinking water standards. The water of KL has been studied before to assess the biodiversity of flora and fauna as well as the fish cultures (Chowdhury and Mazumder, 1981; Alam et al., 2006). However, to the best of our knowledge, the assessment of KL water regarding drinking standards correlating the health risks to the people due to water consumption for the potable purpose is not addressed before.

2. MATERIALS AND METHODS

2.1. Collection of Water Samples

The KL is situated in the southeastern part of Bangladesh, occupying an average surface area of 58300 ha with a water reserve of 525 × 106 m³ (Uddin et al., 2014). Water samples were collected from seven spots [Bashwar Tila (KL 1), Raikhon Mukh (KL 2), Rainchon Bazar (KL 3), Middle of Rainchon Bazar and Bridge Ghat (KL 4), Bridge Ghat (KL 5), Bikasher Tila (KL 6) and Bachnir Tila Jele para (KL 7)] and the spots were selected based on the water collection points of the inhabitants of the lake (Figure 1). The water samples were collected in March 2015 at the end of winter season. Samples for microbiological analysis were collected in sterile sampling bottles, placed in sampling buckets containing ice blocks to maintain a 2–8 °C temperature, transported to the laboratory within 3–6 h of collection and preserved at 4 °C until analysis. The samples for physicochemical and metal analyses were collected in clean high-density polyethylene screw-capped bottles.

Fig. 1: Map of Kaptai lake and the sampling locations (Source: Banglapedia: National Encyclopedia of Bangladesh)
2.2. Microbiological Analysis

To assess the microbiological characteristics of the KL water, tests for the heterotrophic plate count (HPC) and total coliform count (TCC) as well as the analysis to check the presence of some selected pathogenic bacteria were conducted. The HPC was done by the standard pour plate technique and the Most Probable Number (MPN) method was followed for TCC (Dubey and Maheshwari, 2011). The 0.1, 1, 10 mL water samples were inoculated into the lactose broth medium and double-strength medium was used for 10 mL sample. After incubation at 37 °C for 24 h, lactose broth containing Durham tubes were observed for any gas production. The tubes with the positive gas production were further tested to confirm the presence of coliform by streaking on eosin methylene blue (EMB) agar media. When bacterial growth was found on the EMB plate, the culture from EMB plate was inoculated into lactose broth media to assess the acid and gas production. Simultaneously, nutrient agar slants were also streaked on the growth-positive EMB agar plate for staining and biochemical study.

The presence of the four selected pathogenic bacteria (Enterococcus spp., Salmonella spp., Pseudomonas spp. and Vibrio spp.) in the water samples was checked by microscopic, cultural and biochemical analysis. After enrichment of the samples in peptone broth, selective media were used to enhance the growth of the target bacteria and to inhibit the growth of other bacteria. The enriched cultures were streaked on M-Enterococcus agar base for Enterococcus spp., bismuth-sulphite agar for Salmonella spp., cetrimide agar for Pseudomonas spp. and thiosulfate-citrate-bile salts-sucrose agar for Vibrio spp. The visible colonies from the plates were transferred to nutrient agar slants and further investigated for identification. The selected colonies were then subjected to microscopic observation, standard biochemical tests and identified according to the Bergey’s Manual of Determinative Bacteriology (Buchanan and Gibbons, 1974). All the experiments were performed in triplicates. The media used for microbiological analysis were purchased from Hi-Media (Mumbai, India).

2.3. Analysis of Physicochemical Parameters

The chemicals and reagents were of analytical grade as used throughout the study and the apparatuses were also within the limit of precise accuracy. The parameters studied to assess the physical and chemical characteristics were temperatures, total dissolved solids (TDS), pH, electrical conductivity (EC), total hardness (TH), total alkalinity (TA), chloride concentration (Cl⁻) and dissolved oxygen (DO). All the chemicals and reagents used for physico-chemical parameter analysis were from MERCK (Darmstadt, Germany). The analytical techniques used for sample analysis, under the standard protocols as described elsewhere (Clesci et al., 1998), are listed in Table 1.

<table>
<thead>
<tr>
<th>Parameters*</th>
<th>Method</th>
<th>Instrument Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA</td>
<td>Titration method</td>
<td>–</td>
</tr>
<tr>
<td>TH</td>
<td>EDTA Titrimetric Method</td>
<td>–</td>
</tr>
<tr>
<td>EC</td>
<td>Instrumental, Analyzed in situ</td>
<td>Combo meter, Model–HI 98129, HANNA, Mauritius.</td>
</tr>
<tr>
<td>TDS</td>
<td>Instrumental, Analyzed in situ</td>
<td>Combo meter, Model–HI 98129, HANNA, Mauritius.</td>
</tr>
<tr>
<td>Cl⁻</td>
<td>Argentometric titration method</td>
<td>–</td>
</tr>
<tr>
<td>pH</td>
<td>pH metry, Instrumental, Analyzed in situ</td>
<td>Combo meter, Model–HI 98129, HANNA, Mauritius.</td>
</tr>
</tbody>
</table>

*TA, Total Alkalinity; TH, Total Hardness; EC, Electrical conductivity; TDS, Total dissolved solids; Cl⁻, Chloride; DO, Dissolved oxygen.

<table>
<thead>
<tr>
<th>Sample</th>
<th>E. coli¹</th>
<th>Enterococcus spp.²</th>
<th>Salmonella spp.³</th>
<th>Pseudomonas spp.⁴</th>
<th>Vibrio spp.⁵</th>
</tr>
</thead>
<tbody>
<tr>
<td>KL 1</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>KL 2</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>KL 3</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>KL 4</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>KL 5</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>KL 6</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>KL 7</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

¹-⁵: + indicates presence of respective bacteria

Growth Media: ¹Eosin Methylene Blue, ²M-Enterococcus agar, ³Bismuth-sulphite agar, ⁴Cetrimide agar, ⁵Thiosulfate-citrate-bile salts-sucrose agar

2.4. Analysis for Metal Concentration

The water samples have also been analyzed for the contents of following potentially toxic metal species: copper (Cu), manganese (Mn), zinc (Zn), lead (Pb), cadmium (Cd) and nickel (Ni). The Agilent 200 series atomic absorption spectrophotometer (Agilent Technologies, Santa Clara, CA) was used to measure...
the metal contents. The instrument setting and operational conditions were determined in accordance with the specifications from the manufacturer.

3. RESULTS AND DISCUSSIONS

3.1. Microbiological Characteristics

The lake water samples were analyzed for HPC and MPN indexing to assess the microbiological characteristics that are the important indicators of water quality. All the samples have HPC count within 250 cfu mL\(^{-1}\) (Figure 2), whereas the standard limit of the viable count in drinking water is \(~500\) cfu mL\(^{-1}\) (US EPA, 2003). The HPC denotes the total amount of bacteria present in water as well as the microbial load in water (Aksu and Vural, 2004). A lower value of HPC in lake water was also observed in a study on Ahor lake, Ghana (Amfo-Out et al., 2011), which is being used for the recreational purposes. The HPC count of drinking water may vary from \(<1\) to \(>104\) cfu mL\(^{-1}\), which is known to be influenced by water pH, temperature, residual chlorine and incorporable organic matter contents (LeChevallier et al., 1980). However, a high number in HPC count in drinking water does not indicate a significant health risk (Allen et al., 2004).

![Fig. 2: Heterotrophic plate count (HPC) of Kaptai lake water sample in colony forming unit per mL (cfu mL\(^{-1}\))](image)

The TCC is used as indicators of potential contamination by pathogens, viruses or parasites in a water body. The TCC in the water samples using the standard MPN indexing method was found to vary in the range of \(~4\) to \(~140\) per 100 mL (Figure 3). According to WHO and Bangladesh EQS, the TCC should be 0 per 100 mL of drinking water. All the KL water samples were found to be coliform positive and, hence, is potentially dangerous for human consumption. Some of the inhabitants live in proximity use the KL as dumping sites for human and animal feces and thus contaminate the water. Naturally, \(10^3\)–\(10^4\) fold more thermo-tolerant coliform species contained in per gram of fresh feces of human and animal (Gleeson and Gray, 1997). Water contaminated with these feces can cause disease in infants, young children, elderly people or other severely immune-compromised people.

![Fig. 3: Coliform presence or the most probable number (MPN) index per 100 mL of Kaptai lake water sample](image)
To confirm the potential contamination by human pathogens, the presence of several bacterial pathogens, namely Enterococcus spp., Salmonella spp., Pseudomonas spp. and Vibrio spp., were determined using microscopic, cultural and biochemical tests (Tables 2 and 3). We found that all KL samples were contaminated with the mentioned pathogens. All those pathogens are responsible for gastrointestinal problems with the symptoms of diarrhea, nausea, vomiting, fever, abdominal pain, etc., and also the major etiological agents of many waterborne outbreaks (Craun et al., 2006). Human waste, wildlife excretes, fishing activities, people bathing with skin lesions, etc. are the possible sources of contamination of the isolated pathogens. It was documented that storm events and stream flow events are also responsible for contamination of lake water by these pathogens (Jamieson et al., 2005). However, the types and occurrence of disease in the dwellers near KL were not recorded. Our data indicates that the KL water is contaminated with pathogenic bacteria and therefore, the lake water is unsuitable for drinking and household use.

### 3.2. Physicochemical Characteristics

The values of pH, EC, TDS, TH, TA, Cl\(^{-}\) and DO of KL water are found within the permissible range of regulatory limits (Table 4). The water-TH, indicative of the capacity of water to react with soap, is due to the dissolved polyvalent metallic ions from sedimentary rocks, seepage and runoff from soils. The water having a TH value of greater than 500 ppm is considered as aesthetically unacceptable. There is no convincing evidence of adverse health effects in human due to water-TH, while different epidemiological studies suggested its positive impact against various diseases, e.g., cardiovascular disease (Masironi et al., 1979; Leoni et al., 1985; Smith and Crombie, 1987; Dzik, 1989). Hence, the lower value of water-TH in KL indicates the possibility of an adverse impact on the health of the consumers.

#### Table 3: Biochemical properties of the isolated microorganisms from Kaptai lake water

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Microscopic shape</td>
<td>Rods</td>
<td>Coccii</td>
<td>Rods</td>
<td>Rods</td>
<td>Rods</td>
</tr>
<tr>
<td>Gram staining</td>
<td>Negative</td>
<td>Positive</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
</tr>
<tr>
<td>Motility</td>
<td>Motile</td>
<td>Non motile</td>
<td>Motile</td>
<td>Motile</td>
<td>Motile</td>
</tr>
<tr>
<td>Catalase</td>
<td>Positive</td>
<td>Negative</td>
<td>Positive</td>
<td>Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>Oxidase</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
<td>Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>Methyl Red (MR)</td>
<td>Positive</td>
<td></td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
</tr>
<tr>
<td>Voges-Proskauer (VP)</td>
<td>Negative</td>
<td>Positive</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
</tr>
<tr>
<td>Indole</td>
<td>Positive</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td>Citrate</td>
<td>Negative</td>
<td>Negative</td>
<td>Positive</td>
<td>Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>Urease</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
</tr>
<tr>
<td>H(_2)S production</td>
<td>Negative</td>
<td>Negative</td>
<td>Positive</td>
<td>Negative</td>
<td>Negative</td>
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<tr>
<td>Glucose</td>
<td>Positive</td>
<td>Positive</td>
<td>Negative</td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td>Lactose</td>
<td>Positive</td>
<td>Positive</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
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<tr>
<td>Manitol</td>
<td>Positive</td>
<td>Positive</td>
<td>Positive</td>
<td>Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>Sucrose</td>
<td>Variable</td>
<td>Positive</td>
<td>Negative</td>
<td>Negative</td>
<td>Positive</td>
</tr>
</tbody>
</table>

*–** indicates that the test was not done, as MR is not referred for gram-positive bacteria

#### Table 4: Physicochemical parameters (mean±SD) of Kaptai lake water

<table>
<thead>
<tr>
<th>Sample code</th>
<th>Temp. °C</th>
<th>pH</th>
<th>EC μS cm(^{-1})</th>
<th>TDS ppm</th>
<th>TH ppm</th>
<th>TA ppm</th>
<th>Cl(^{-}) ppm</th>
<th>DO ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>KL 1</td>
<td>27±0.5</td>
<td>7.69±0.09</td>
<td>113±1.5</td>
<td>54.6±0.62</td>
<td>43±0.36</td>
<td>11.5±0.19</td>
<td>1.78±0.31</td>
<td>4.2±0.27</td>
</tr>
<tr>
<td>KL 2</td>
<td>26±0.5</td>
<td>7.75±0.10</td>
<td>112±2.4</td>
<td>53.5±0.59</td>
<td>43±0.46</td>
<td>11.0±0.23</td>
<td>0.90±0.16</td>
<td>4.3±0.24</td>
</tr>
<tr>
<td>KL 3</td>
<td>27±0.5</td>
<td>7.65±0.08</td>
<td>112±1.7</td>
<td>53.6±0.51</td>
<td>42±0.58</td>
<td>11.3±0.21</td>
<td>1.33±0.23</td>
<td>4.8±0.31</td>
</tr>
<tr>
<td>KL 4</td>
<td>27±0.5</td>
<td>7.74±0.10</td>
<td>108±1.3</td>
<td>53.3±0.71</td>
<td>42±0.45</td>
<td>11.3±0.25</td>
<td>1.33±0.19</td>
<td>4.8±0.29</td>
</tr>
<tr>
<td>KL 5</td>
<td>28±0.6</td>
<td>7.76±0.09</td>
<td>112±1.5</td>
<td>53.4±0.56</td>
<td>42±0.55</td>
<td>11.0±0.20</td>
<td>1.33±0.15</td>
<td>4.8±0.35</td>
</tr>
<tr>
<td>KL 6</td>
<td>27±0.5</td>
<td>7.75±0.07</td>
<td>110±2.1</td>
<td>52.5±0.53</td>
<td>42±0.41</td>
<td>11.5±0.27</td>
<td>1.33±0.12</td>
<td>4.1±0.26</td>
</tr>
<tr>
<td>KL 7</td>
<td>27±0.5</td>
<td>7.46±0.09</td>
<td>110±1.4</td>
<td>54.1±0.68</td>
<td>42±0.49</td>
<td>11.0±0.28</td>
<td>1.33±0.21</td>
<td>4.4±0.28</td>
</tr>
<tr>
<td>Standard value</td>
<td>20–30</td>
<td>6.5–8.5</td>
<td>700–3000</td>
<td>1000</td>
<td>200–500</td>
<td>&lt;20</td>
<td>150–600</td>
<td>6.0</td>
</tr>
</tbody>
</table>

**Ahmed and Rahman (2000)  
**TA, Total Alkalinity; TH, Total Hardness; EC, Electrical conductivity; TDS, Total dissolved solids; Cl\(^{-}\), Chloride; DO, Dissolved oxygen

The water-EC is a measure of the ionic activity and contents of dissolved ions in a water-body in a proportional perspective. The water-TDS is used to describe the contents of inorganic salts and soluble organic matter as originated from natural sources, sewage, urban and agricultural run-off, or industrial wastewater (WHO/UNEP and GEMS, 1989). A water-TDS value less than 900 ppm is fairly acceptable to the consumers regarding palatability of drinking-water (Bruvold and Ongert, 1969; WHO,
There is no health-based guideline value proposed for water-TDS, because it is more of an aesthetic rather than a health hazard (WHO, 2003a). Chlorides are widely distributed in natural water-bodies as salts of sodium, potassium, or calcium. A 45 mg daily intake of chloride is sufficient for children, while the recommended limit for an adult is 9 mg (Wesson et al., 1969). A detectable taste can be felt if the concentration of chloride exceeds 250 ppm, but it happens mostly due to associated cations. There are no available health specific guidelines for chloride in drinking water (WHO, 2003b).

The water-pH is an indicator of hydrogen ion concentration in the water and it is controlled by the carbon dioxide–bicarbonate–carbonate equilibrium system in the natural water. The water temperature causes a lowering in pH with an increase in the temperature. The recommended range for water-pH to be consumed for drinking is between 6.5 and 8.5 (WHO, 2007). The water-pH of KL is in the range of 7.46 to 7.75 and within the acceptable range. The water-TA is a measure of buffering capacity or ability to react with strong acids at a designated pH and can render unpalatable taste to water. However, the water-TA observed in KL samples are within the acceptable limit. The DO, which is an imperative regulator of chemical processes and biological activity within a water-body and inversely affected due to the water-temperature, might influence the odor, clarity and taste of water. The water-DO in KL is in between 4.1 and 4.8 and below the recommended guideline values.

### 3.3. Concentration of Metals

The assessment of metal concentrations in KL water indicates an acceptable presence of Cu, Mn and Zn, a moderately increased content of Cd and Ni, and an excessively higher Pb content (Table 5). The sources for Pb in lake waters is attributed to various causes, which includes agricultural discharge, spilling of leaded petrol, discharge from lead-acid battery, burning of fuels, military activities, etc. (Makokha et al., 2008; Wuana and Okieimen, 2011; Van der Kuijp et al., 2013). In KL, petrol boats are commonly used for fishing and transportation of local people living in the marginal areas and islands within the lake and can be a source of spilled leaded petrol. The people in islands also use the lead-acid battery as a primary source of power supply. Gasoline and coals used in nearby highways can be the source of Pb via leaching to lake water through soil discharge. Military activities are carried out intermittently either the inner or outer region of KL, which can contribute to Pb-intrusion in the lake water. A higher Pb-concentration can cause brain, nerve and kidney damage in children, digestive disturbances, blood disorders, and hypertension (Wuana and Okieimen, 2011). Damage in the kidney due to Cd, skin allergy and carcinogenicity due to Ni was reported in several studies (Fernando, 1980; WHO, 2004; Wuana and Okieimen, 2011).

### 4. CONCLUSION

The inhabitants of marginal areas and islands within the vicinity of KL consume the lake water for drinking without any intermediate purifying process. In our study, we have compared the water-quality of KL in terms of microbiological, physico-chemical and metal standards set for drinking purpose use of any water-body. The overall water-quality indicates the unsuitability of lake water for drinking use, and a prolonged consumption might cause significant health problems to the indigenous communities dependent on the lake water. Hence, the government should take necessary steps to increase awareness among the people and provide clean water for the community living in this area.

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