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Sunil Ram Vaidya
Department of Zoology, Patan Multiple Campus, Lalitpur, Nepal

Shyam Narayan Labh
Department of Zoology, Amrit Campus, Kathmandu, Nepal

Correspondence
Sunil Ram Vaidya
Department of Zoology, Patan Multiple Campus, Lalitpur, Nepal

Determination of Physico-Chemical Parameters and Water Quality Index (WQI) for drinking water available in Kathmandu Valley, Nepal: A review

Sunil Ram Vaidya and Shyam Narayan Labh

Abstract
Physico chemical parameter study is very important to get an exact idea about the quality of water and therefore we can compare results of different physico chemical parameter values with standard values. Water resources are equally important for natural ecosystem and human development. It is essential for agriculture, industry and human existence. Ground water, surface water (rivers, streams and ponds), atmospheric water (rain-water, snow and hail) and springs are the main source of water available to the people in general. The qualities of these water bodies vary widely depending on the location and environmental factors. The major source of ground water is precipitation that infiltrates the ground and moves through the soil and pore spaces of rocks. As ground water moves through soil, sediment and rocks, many impurities such as disease-causing micro-organisms are filtered out. Many water resources in developing countries are unhealthy because they contain harmful physical, chemical and biological agents. Nepal faces a plethora of problems related to drinking water quality and availability. Throughout Nepal, people are exposed to severe health threats resulting from water contamination by sewage, agriculture, and industry. Hence, to maintain a good health, water should be safe to drink and meet the local standards and international standards to taste, odour and appearance. The present review paper describes about the importance of different parameters of water quality.

Keywords: Physico-chemical parameter, pH, temperature, BOD, Nepal, Kathmandu, Water

1. Introduction
Nepal is a land-linked kingdom situated between China and India. The Kathmandu Valley is in the hill region of Nepal. The Kathmandu Valley is a roughly circular intermontane basin with a diameter of 25 km and an average altitude of 1,350 m (above sea level); the surrounding hills are approximately 2,800 m in elevation. The average annual rainfall is 1.3 m, 80% of which falls during the monsoon season between June and September. The bedrock underlying and surrounding the valley is composed of Paleozoic and Precambrian-age rocks known as the Kathmandu Complex [1]. Nepal faces a plethora of problems regarding both its drinking water quality and availability. In the Kathmandu Valley, the main urban center of Nepal, the chief concern is contamination from sewage lines, septic tanks, open pit toilets [2], and from surface water that has been polluted by direct disposal of sewage waste [3, 4]. Surface water in Kathmandu Valley is also polluted with direct disposal of industrial waste, possibly leading to contamination of the shallow aquifer [3, 4]. Approximately 50% of the water supply in the Kathmandu Valley is derived from groundwater sources [5, 6]. People of Kathmandu Valley use a variety of other groundwater sources including dug wells, tube wells and dhunge dharas due to insufficient municipal supply [7].
A pond must be manageable for controlled farming; Life in aquatic environment is largely governed by physico-chemical characteristics and their stability. Various changes that organisms bring about in the water are essential for their own existence. The determinant of good fish growth in water body includes dissolved oxygen, total hardness, alkalinity, temperature, etc. People around the world are under tremendous threat due to undesired changes in the physical, chemical and biological characteristics of air, water and soil [8]. Therefore it is necessary that the quality of drinking water should be checked at regular time interval, because due to use of contaminated drinking water, human population suffers from varied number of water borne diseases [9].

According to WHO estimate about 80% of water pollution is due to domestic waste [10]. The improper management of water systems may cause serious problems in availability of drinking water [11]. In this paper, some parameters assessing the quality of water has been presented with past work carried out by scientist and academicians related with quality of water.

2. Physico-Chemical Properties of Drinking Water of Kathmandu Valley

It is very essential and important to test the water before it is used for drinking, domestic, agricultural or industrial purpose. Water must be tested with different physico-chemical parameters. Selection of parameters for testing of water is solely depends upon for what purpose we going to use that water and what extent we need its quality and purity. Following different physic chemical parameters are required to for monitoring quality of water.

2.1. Temperature

Temperature can exert greater control over aquatic communities. If the overall water body temperature of a system is altered, an aquatic community shift can be expected. In water above 30 °C, a suppression of all benthic organisms can be expected. Also, different plankton groups will flourish under different temperatures. For example, diatoms dominate at 20-25 °C, green algae dominate at 30-35 °C, and cyano-bacteria dominate above 35 °C [12].

2.2. pH

pH is defined as the intensity of the acidic or basic character of a solution at a given temperature. pH is the negative logarithm of hydrogen ion concentration (pH=-log [H^+]). The pH in water samples ranges of 7.0 to 7.85 and it reported that the pH of water is important for the biotic communities as most of the plant and animal species can survive in a narrow range of pH from slightly acidic to slightly alkaline condition [13]. pH is an indicator of the existence of biological life as most of them thrive in a quite narrow and critical pH range. The pH is important parameter of water, which determines the suitability of water for various purposes such as drinking, bathing, cooking, washing and agriculture etc [14].

2.3. Dissolved oxygen (DO)

Dissolved oxygen (DO) refers to microscopic bubbles of gaseous oxygen (O2) that are mixed in water and available to aquatic organisms for respiration. DO is the most important indicator of the health of a water body and its capacity to support a balanced aquatic ecosystem of plants and animals. A low DO (less than 2mg/l) would indicate poor water quality and thus would have difficulty in sustaining sensitive aquatic life [15].

2.4. Colour

Colour is an optical parameter consisting in absorbing of a part of spectrum of visible radiation by substances dissolved in water, colloidal substances, and suspension particles present in water or sewage. Color is vital as most water usersusually prefer colorless water and determination of colour can help in estimated costs related to discoloration of the water [16].

2.5. Conductivity

Conductivity is the capacity of electrical current that passes through the water. It is directly related to concentration of ionized substances in water and may also be related to problems of excessive hardness. Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides and carbonate compounds. Compounds that dissolve into ions are also known as electrolytes. The more ions that are present, the higher the conductivity of water [17].

2.6. BOD

BOD is a measure of organic pollution to both waste and surface water. High BOD is an indication of poor water quality. For this tree plantation project, any discharge of waste into the waterways would affect the water quality and thus users downstream [18].

2.7. COD

COD is an indicator of organics in the water, usually used in conjunction with BOD. High organic inputs trigger deoxygenation. If excess organics are introduced to the system, there is potential for complete depletion of dissolved oxygen. Without oxygen, the entire aquatic community is threatened [19].

2.8. Ammonia

Ammonia levels in excess of the recommended limits may harm aquatic life. Although the ammonia molecule is a nutrient required for life, excess ammonia may accumulate in the organism and cause alteration of metabolism or increases in body pH. It is an indicator of pollution from the excessive usage of ammonia rich fertilizers [20].

2.9. Nitrate

The growth of macrophytes and phytoplankton is stimulated principally by nutrients such as nitrates. Many bodies of freshwater are currently experiencing influxes of nitrogen and phosphorus from outside sources. The increasing concentration of available phosphorus allows plants to assimilate more nitrogen before the phosphorus is depleted. Thus, if sufficient phosphorus is available, high concentrations of nitrates will lead to phytoplankton (algae) and macrophyte (aquatic plant) production. This is mostly due to the usage of fertilizers [21].

2.10. Potassium

Potassium is macro nutrient element for plant growth. It can occur naturally in minerals and from soils. High levels in surface water, especially in areas where there are agricultural activities as indicative of introduction of K due to application of fertilizers [22].

2.11. TDS

Water is a good solvent and picks up impurities easily. Pure water is tasteless, colorless, and odorless and is often called the universal solvent. Dissolved solids" refer to any minerals, salts, metals, cations or anions dissolved in water. Total dissolved solids (TDS) comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulfates) and some small amounts of organic matter that are dissolved in water.

TDS in drinking-water originate from natural sources, sewage, urban run-off, industrial wastewater, and chemicals

used in the water treatment process, and the nature of the piping or hardware used to convey the water, i.e., the plumbing. In general, the total dissolved solids concentration is the sum of the cations (positively charged) and anions (negatively charged) ions in the water. Therefore, the total dissolved solids test provides a qualitative measure of the amount of dissolved ions. Therefore, the total dissolved solids test is used as an indicator test to determine the general quality of the water [23].

3. Conclusion

A large number of factors and geological conditions influence the correlations between different pairs of physico - chemical parameters of water samples directly or indirectly. In the present study it is clear that the physico-chemical properties of water in the fragile ecosystem habitat (F) is similar to the natural habitat (NH) indicating that both the habitats have conditions suitable to support a biotic community. To create increasing awareness among the people to maintain the water at its highest quality and purity levels, the present study may prove to be useful in achieving this goal.

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