

## Physico-chemical properties of water and soil of Bhimsen Pokhari Wetland, Jhapa District, Eastern Nepal

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### Abstract

The functioning of an aquatic ecosystem and its stability support life forms, depend to a great extent on the physico-chemical characteristics of its water and soil. Physico-chemical properties of water and soil were determined in Bhimsen Pokhari wetland of Jhapa districts, eastern Nepal. Soil samples were collected from six sampling sites and analyzed triplicate for each samples. In all sampling site had sandy loam type of soil texture. The proportion of sand showed a marked increase from middle part to corner but clay decrease from middle to corner of the wetland. The acidic nature of soil increased from corner to middle part of the wetland. Soil organic carbon of wetland was higher in the middle part (2.31%) and lower in the North-west corner (1.72%). The result of water analysis showed that the middle part of wetland was slightly acidic than other sampling sites. From the same sampling sites the dissolved oxygen (5.81 mg L<sup>-1</sup>), total hardness of water (36 ppm) were found higher than other sampling sites. Dissolved oxygen was negatively correlated with the water temperature and pH but positive correlation with the total hardness of water. In conclusion, the middle part of the wetland may be the suitable site for the growth and development of aquatic flora and fauna as well as microbial activities due to having the higher amount of dissolved oxygen and soil organic matter.

**Key words:** Dissolved oxygen, pH, Soil organic carbon, Soil texture

### Introduction

Wetland represents the landmass saturated with water due to high water table through both ground water and atmospheric precipitation and are considered as the kidney of the landscape, because they perform in hydrological and chemical cycles (Rai, 2003). According to classification of wetlands Bhimsen Pokhari is a lowland-tropical wetland that is seasonally flooded riverine flood plain (old course of Adhuwa khola). This wetland has unique ecological significance and rebound a number of plants species in young stage which are only found on high altitude such as *Schima wallichii*, *Castanopsis indica*, *Lycopodium spp.* etc.

Soil is the loose, friable and unconsolidated top layer of earth's crust. It is the medium in which roots grow, anchor the plants and is the reservoir of water and nutrient necessary for the plant life. The selective absorption of nutrient elements by different plant species and their capacity to return them to the soil brings about changes in soil properties (Singh *et al.* 1986). Soil quality is the capacity of soil to sustain plant and biological productivity, to maintain environmental quality, and to promote plant and animal health. The growth and

reproduction of aquatic as well as terrestrial organism cannot be understood without the knowledge of soil. The soil and vegetation have a complex interrelation because they develop together over a long period of time.

The functioning of an aquatic ecosystem and its stability support life forms, depend to a great extent on the physico-chemical characteristics of its water and soil. So it is always good to observe the physico-chemical parameters of aquatic ecosystems. Monitoring oxygen concentration also helps to know the health of water body. Hence present study was under taken to determine amount of physico-chemical properties of water and soil of the Bhimsen Pokhari (now it is called Bhudho Holi) of Jhapa districts, eastern Nepal.

## Material and Methods

### *Study area*

The study was carried out in Bhimsen Pokhari wetland of Jhapa District, Eastern Nepal. The shape of this wetland is irregular, extended from North-west (inlet) to South-east (outlet). It is located from 26° 40' 37.7" N to 26° 40' 24.7" N latitude, and 88° 00' 37.6" E to 88° 00' 53.3" E longitudes. It is included in Arjundhara municipality about 3 km north from Birtamode and surrounded by Sal (*Shorea robusta* Gaertn.) dominated forest. As observed all sides of the wetland, its north side Bhimsen ghat, lying on the way to Sanischare-Charali road. East, Sarki Khola, with a small village Salbari, South-cultivated land, and West cultivated paddy land separating from Aduwa Khola respectively. The average climatic records of this wetland showed air temperature of 25.8°C, soil temperature of 23.3°C, relative humidity of 60%, and annual rainfall of 2377 mm.

### *Analysis of water physico-chemical properties*

Water samples were collected from six sampling sites. For this purpose, 6 dark containers were bought and carried to the field for collecting the water samples from each sampling sites. About one liter of natural water was collected into container from each site and brought to lab for analysis. The water temperature was recorded by centigrade mercury thermometer and pH with the help of pH meter. Dissolved oxygen (DO) and hardness of water were measured according to Zobel *et al.* (1987). Linear regression analysis was done in between the dissolved oxygen, pH and water temperature to find out the relationship in between chemical properties of water.

### *Analysis of Soil physico-chemical properties*

Soil samples were collected from six sampling sites. At each sampling site the soil was collected from three pits (10cm × 10cm × 15cm), mixed and pooled as one replicate. The air dried samples were sieved through a 2 mm mesh screen and used for physico-chemical analysis. The soil texture was determined following Piper (1966). Soil pH was measured by using a glass electrode (1:5, soil: water). Soil organic carbon (SOC) was analyzed by digestion of soil samples with conc. H<sub>2</sub>SO<sub>4</sub> along with potassium dichromate and titration with ferrous ammonium sulphate (Walkley & Black, 1934). Soil organic matter (SOM) was estimated as: % SOC × 1.724.

## Results

Soil texture was sandy loam type in all sampling sites. In the middle part of wetland the soil was composed of gravel (1%), coarse sand (17.21%), fine sand (34.47%), silt (21.92%) and

clay (25.40%) while in North-west corner composition of soil was gravel (1.52%), coarse sand (41.62%), fine sand (19.62%), silt (19.12%) and clay (18.12%). The proportion of sand showed a marked increase from middle part to corner but clay decrease from middle to corner of the wetland. The pH value was slightly higher in East-south part than other sampling sites. The acidic nature of soil increased from corner to middle part of the wetland. Soil organic carbon was higher in the middle part (2.31%) and lower in the North-west corner (1.72%) of the wetland (Table 1).

**Table 1.** Physico-chemical properties of soil in Bhimsen Pokhari Wetland, Jhapa, Nepal.

SN	Sampling sites	Gravel (%)	Coarse sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	pH	SOC (%)	SOM (%)
1	Near inlet of wetland	1.12	22.00	35.36	20.44	21.08	5.91	1.95	3.36
2	North- east corner	2.36	34.31	24.69	21.20	17.44	6.01	2.11	3.63
3	North-west corner	1.52	41.62	19.62	19.12	18.12	5.88	1.72	2.96
4	Middle part of wetland	1.00	17.21	34.47	21.92	25.40	5.51	2.31	3.98
5	East-south part	3.08	27.23	29.45	19.44	20.80	6.11	2.01	3.46
6	Near outlet of wetland	3.11	25.22	30.56	22.35	18.76	5.65	2.04	3.51

The water temperature was found higher in North-east corner of the wetland than other sampling sites. The result of water analysis showed that the middle part of wetland was slightly acidic than other sampling sites. From the same sampling sites the dissolved oxygen (DO) was found higher (5.81 mg L<sup>-1</sup>) than other sampling sites. The hardness of the water from respective sampling site showed the highest quantity (36 ppm) at the middle part of wetland, but lowest hardness (24 ppm) was found from near outlet area (Table 2). From the rest sampling sites the hardness water found in uniform condition.

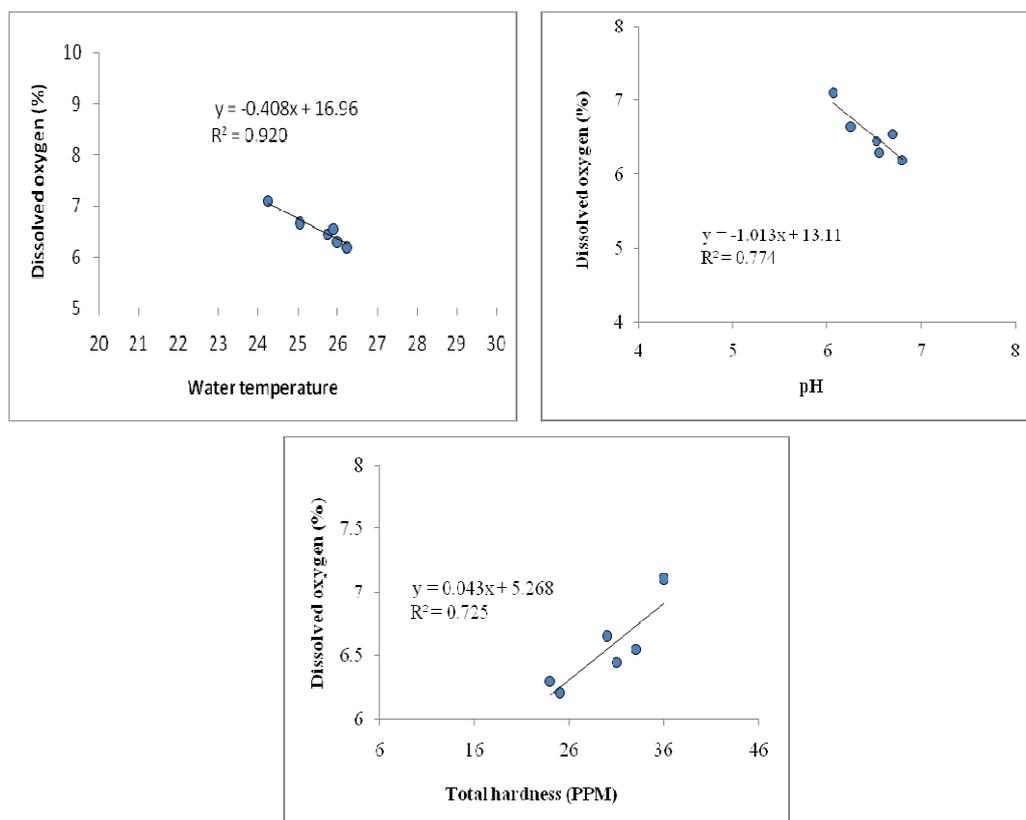
**Table 2.** Physico-chemical properties of water in Bhimsen Pokhari Wetland, Jhapa, Nepal.

SN	Sampling sites	Temp (°C)	pH	DO (%)	DO (mg L <sup>-1</sup> )	Hardness of water (PPM)		
						Temporary	Permanent	Total
1	Near inlet of wetland	25.75	6.92	6.65	5.33	2	29	31
2	North-east corner	26.25	6.30	6.20	4.95	4	26	30
3	North-west corner	25.05	6.45	6.65	5.49	2	23	25
4	Middle part of wetland	24.25	6.06	7.10	5.81	6	30	36
5	East-south part	25.91	6.90	6.55	5.53	7	26	33
6	Near outlet of wetland	26.00	6.45	6.30	5.12	4	20	24

Regression analysis showed that dissolved oxygen was negatively correlated with the water temperature and pH but positive correlation with the total hardness of water (Figure 1).

### Discussion

In the present study the soil texture in all sampling site of the wetland was sandy loam. This is common in Tarai, Siwalik and Dun valleys (Jackson, 1994). Values of clay were higher in the middle part of wet land than other study sites. The increased in clay formation in the middle part of wetland may be due to higher growth of leafy tissue which absorbed higher amount of the inorganic minerals and returned later to the soil upon the death of the plants (Barsad, 1955).



**Figure 1.** Relationship of dissolved oxygen with the water temperature, pH and total hardness in Bhimsen Pokhari wetland of Jhapa district, eastern Nepal ( $P < 0.001$ ).

Soil pH affects a wide range of soil chemical and biological properties. Soil acidification in middle part of wetland might be higher than other sampling sites due to formation of weak organic acid by dissolving the  $\text{CO}_2$  in soil water which is produced during root respiration and decomposition of soil organic matter by micro-organisms (Brady & Weil, 2013).

The middle part of wetland had higher value of soil organic carbon and soil organic matter which decreased along peripheral side of the wetland. Here, the higher soil moisture cause fast turnover of litter and fine root due to which there may be higher accumulation of organic matter (Bhattarai & Mandal, 2016). On the other hand lower accumulation of soil organic carbon and soil organic matter at other sampling sites may be due to low soil moisture causing reduced decomposition and slow turnover of organic matter.

The water temperature of the wetland in different sampling sites ranged between 24.25 °C to 26.25 °C. The maximum water temperature was found in North-east corner of the wetland and minimum in middle part of the wetland. Generally, water temperature is influenced by intensity and quality of solar radiation and air temperature of the surrounding. The pH was found almost similar in all sampling site. However, the pH value was slightly higher in near inlet of the wetland. The hardness of water was recorded higher in the middle part of the wetland and lower value in near outlet of the wetland. Lower value of hardness in outlet of the wetland may be due to dilution of water (Chhetri & Pal, 2012).

Dissolved oxygen is an important factor in assessing water quality. The concentration of dissolved oxygen is generally related to water current, temperature or substrate conditions. The dissolved oxygen was higher in middle part of the wetland and lower value in the North-east corner of the wetland. The lower value of the dissolved oxygen in North-east corner may be due to higher demand of oxygen for decomposition of the organic matter (Rai, 2003). The dissolved oxygen showed significant negative correlation with the pH and water temperature but positive correlation with the total hardness of water. Similar result was also found by Thapa and Pal (2012) in Baidya fish pond, Morang districts and Chhetri and Pal (2012) in Seepage stream at Shripur area of Sunsari districts of eastern Nepal. In conclusion, the middle part of the wetland may be the suitable site for growth and development of the aquatic flora and fauna as well as microbial activities due to having the higher amount of dissolved oxygen and soil organic matter.

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