

Report on Water Quality of Phewa Lake January to March 2005

(Collaborative program between FRC/PSMC -PLEACB)

1. Introduction

The main objective of water quality monitoring programs is to improve conservation management of Phewa Lake (particularly water quality) by enabling local communities and institutions for letting take initiatives on environmental awareness, capacity building and conservation programs. In connection with this, Phewa Lake Environment Awareness and Capacity building Project of Pokhara Sub-Metropolitan City (PLEACBP-PSMC) and Fisheries research Center, Pokhara signed a Minute of Understanding (MOU) on 1st March 2005 in order to evaluate water qualities and assist in promoting awareness program for the benefit of target group. Although the MOU was signed in March a detailed water quality-monitoring program have been prepared and implemented since January 2005.

2. General overview of limnological condition and its effect

It is acclaimed that eutrophication of water resources of Phewa lake is a serious problem. Different water quality parameters were monitored in past showed the lake is currently characterized by high nutrient level due to high rate of material discharge and as the flooded terrestrial vegetation decays. The decomposition of these large quantities of organic matter in the water produces inorganic nutrients such as ammonia, nitrate and phosphorus. This increased productivity caused by excessive organic loads resulting in decline in water quality; and these symptoms of overproduction are called eutrophication. Water hyacinth tends to flourish under such entropic conditions.

The eutrophication process of lakes is characterized by increased nutrient concentration, more specifically phosphorous condition, due to input, for example, of human sewage or fertilizer run-off from agricultural areas. The eutrophication process leads to considerable changes in the structure of the lake ecosystem, which in turn reduces the possibilities of using the lake for recreation, fishing, and other uses of lake water. Eutrophication process, with respect to Phewa Lake, is in increasing trend as evidenced by past limnological studies. For example, Jones et al. (1989) described the lake as obligoeutrophic while after a decade the lake was characterized as meso-eutrophic (FRC,1999). Such an increased trend of eutrophication of water resources of Phewa Lake has been believed to be caused by several catastrophic activities which includes, intensive agricultural practices in catchments area, municipal swerage disposal, excessive siltation due to deforestation and agronomic practices, and unhealthy water use by urban people (use of phosphorous containing detergent for washing clothes, disposing house garbage directly in the lake).

The project PSMC/PLEACBP in partnerships with Fisheries Research Center, Pokhara has undertaken water quality monitoring program in order to evaluate water qualities monitoring program in order to evaluate water qualities, assist in promoting environmental awareness program and capacity building of local people on Phewa lake conservation for the benefit of target group. The water quality monitoring of Phewa Lake was started from January 2005 and the monitoring scheme followed was as described in project proposal.

3. Methodology

Water samples were taken twice in a month, i.e first and last week, from 5 stations located in different part of lake namely Anadu, Khapaudi, Hallan Chowk, Inlet and Outlet. Water samples from Anadu were collected from 0m, 2.5m, 5.0m, 7.5m, 15m and 20m. Khapaudi site permitted

samples were taken only from surface and 1m depths. Water temperature, pH and secchi disk validity were measured in situ. Water samples for dissolve oxygen was fixed at the site and measured by Wrinkler's method. Nutrient analysis of water began immediately after collection of the samples in the laboratory. The standard methods involved in the nutrient analysis of water were: chlorophyll-a by SCOR/UNESCO (1960), ammonium-nitrogen (NH₄-N) by Bower and Hansen (1980), nitrite +nitrate-nitrogen (NO₂+ NO₃-N) by Dowens (1978) and phosphate-phosphorus (PO₄-P) by Murphy and Rilay (1966).

For phytoplankton, 100-ml portion of water was fixed with acid Lugol's solution at a final concentration of 1% and a phytoplankton samples was concentrated by natural sedimentation. Cells of phytoplankton were enumerated with maematocytometer under a microscope. Water samples for zooplankton were collected with 70-micron plankton net having 20cm diameters. Samples were preserved in 1% procaine and % formalin. Zooplankton samples were concentrated and enumerated with Sedgwick-Rafter cell under a binocular.

Samples for bacterial count were fixed with formaldehyde at 0.5% final concentration and stored 4.0°C. Bacterial density was estimated using the Acridine orange direct count method (Hobbie et al. 1977): 3 sub samples were made by filtering 0.25 to 5.0 ml of water sample onto Nucleopore filters (0.2µm pore size). Bacteria were enumerated under an Olympus epifluorescence microscope (1250x) with a B-excitation system (50W halogen lamp, IF 410-485 excitations filter). At least 300 bacterial cells were counted in each sample.

Aquatic plants coverage area is determined every fortnightly. Special attention has been given to water hyacinth coverage area in the lake. Every fortnightly the coverage area of water hyacinth is determined through eye estimation using the map of lake for sketching the parts of the lake covered by water hyacinth.

4. Results and discussion

Water quality Characteristics of Phewa Lake from January to March

Some physical characteristics of Lake Phewa are given in Table-1. Details of the values of water quality determined from January to March are given in Table 2.

The water temperature recorded minimum of 17.0°C in January to maximum of 23.4°C in March. The temperature at different station showed that there was only slight negligible change in water temperature at different stations.

The highest transparency of 2.7m was observed in January from inlet source while later on in decreasing trend possibly because of sedimentation originating from its feeding stream. The highest visibility was observed at Anaudi in February with 4.9m, this seems this is one of the cleanest spot in the lake. In February, in some station such as Inlet, h. chock and outlet the transparency could not measured because of the shallowness of the station.

The DO was sufficient in all the sites. The dissolve oxygen (DO) concentration in water was within normal range from 6.9 to 13.1 mg/l.

The pH range revealed acidic or alkaline nature of water. The pH ranged from 6.5 to 7.6 in Lake Phewa during sampling. The highest pH value was 7.6 in February.

Both nitrite + nitrate and ammonium nitrogen though did not show any definite pattern from January to March with the values ranging from 0 to 0.186 mg/l. In January both nitrite +nitrate could not be detected at the surface layer.

However considerable amount phosphorus was detected from all sampled site. The highest concentration (63 mg/L) of total phosphorus (TP) was observed at Hallan Chowk in January. This

might indicate that de-silting site and Harpahan Kola steam are the main source of nutrient input during the months of survey.

About 16 species of phytoplankton were recorded from January to March Phytoplankton is one of the important supplier of organic matter in lake ecosystem. The highest abundance of phytoplankton was observed in January at Khapaudi site with a value of 2091 cells/ml with lowest in Inlet stream.

Heterotrophic bacteria were observed only at Anaudi site. The bacterial abundance was highest in March (10.33×10^6). Since the bacterial number did not vary in all the station and there was problems in observation of water samples from inlet stream and Harpan Khola. Therefore, heterotrophic bacteria from Anaudi were estimated. Heterotrophic nano flagellates was also estimated from single site Anaudi station.

Twelve species of zooplankton were identified during this period. The maximum density of was 485 No/1 in March from Hallan Chowk area.

The effects of different environmental factors on growth and flowering in water hyacinth have been previously studied. It showed that the optimum temperature requirement of the plant is 27-30°C. The water temperature recorded minimum of 17.0°C in January to maximum of 23.4°C in March seems conducive for growth of water hyacinth; however it is obviously due to changes over the season.

The growth of water hyacinth has been shown to directly relate to level of nutrient in water, particularly nitrogen and phosphorus. Phosphorus considered to be directly related with eutrophication process where water hyacinth and other macrophytes growth become boost. The highest concentration of total phosphorus (TP) was observed from Hallan Chowk in all sampled date followed by inlet and outlet source. This might indicate that de-silting site and Harpan Khola stream was still contributed as input of organic materials.

5. Conclusion

The water quality parameter of the three months in Phewa Lake suggest its entropic status. Among many station Hallan Chowk input highest amount of phosphorus. Next to it was the inlet stream. It is very difficult to state and recommend anything based on the collected data; however, efforts should be made to cut off the nutrient sources from Hallan Chowk and inlet stream of the lake. Values of limonological parameters area also relatively high at Khapaudi is the main site where plankton is gathered due to wind blowing direction. This was the reason that cage of plankton feeder fish has been kept there. Therefore, this finding should not be interpreted in other ways.

Table 1. Physical parameters of three lakes of Pokhara Valley

Characteristics	Phewa
Elevation (msl)	742
Area (ha)	523
Catchments area (km ²)	110
Water Depth (m)	
Maximum	24.0
Average	7.5
Volume of Water (m ³)	393.2×10^5
Inlet stream	Harpan Khola & Seti Khola
Outlet Stream	Phusre Khola

Source: Rai et al. 1993

Table 2: water quality parameter of Phewa Lake

Month: January

Parameters	Observed Value				
	Inlet	H. Chowk	Outlet	Khapaundi	Anaudi
Parameters					
Physical					
- Water Temperature (°C)	17.0	18.0	17.0	18.0	17.5
- Visibility (m)	2.7	1.25	2.3	2.35	2.98
Chemical					
- Dissolve Oxygen (mg/L)	9.5	9.8	9.6	6.9	7.3
- Chlorophyll (mg/m ³)	3.6	4.0	0.0	3.6	1.6
- Nitrate + Nitrite (mg/L)	0.000	0.000	0.000	0.000	0.000
- Ammonia (mg/L)	0.030	0.000	0.000	0.006	0.006
- Total Phosphorus (mg/L)	26.0	63.0	21.0	14.0	19.0
- PH	6.0	7.1	7.0	6.7	6.8
Biological					
-Heterotrophic bacteria (cells/ml)	3.435*10 ⁶				
- Heterotrophic Nano flagellates (cells/ml)	0.632.10 ³				
- Phytoplankton abundance (cells/ml)	127	983	1112	422	676
- Zooplankton density (No/L)	31	133	174	278	536
- Water Hyacinth Coverage (Eye estimate)	10%				

Month: February

Parameters	Observed Value				
	Inlet	H. Chowk	Outlet	Khapaundi	Anaudi
Parameters					
Physical					
- Water Temperature (°C)	18.0	20.5	21.1	17.5	18.5
Visibility(m)	Shallow	Shallow	Shallow	3.1	4.9
Chemical					
- Dissolve Oxygen (mg/L)	9.0	13.1	12.7	9.6	10.0
- Chlorophyll (mg/m ³)	2.0	8.6	2.4	9.6	10.0
- Nitrate +Nitrite (mg/L)	0.186	0.060	0.164	0.06	0.154
Ammonia (mg/L)	0.000	0.000	0.002	0	0
- Total Phosphorus (mg/L)	17.0	38.0	15.0	14.0	2.0
- PH	6.5	7.6	7.3	6.8	7.0
Biological					
- Heterotrophic bacteria (cells/ml)	8.02 x 10 ⁶				
-Heterotrophic nanoflagellates (cell/ml)	0.7444 x 10 ³				
- Phytoplankton abundance (cell/L)	246	539	317	2091	414
- Zooplankton density (no/L)	191	294	57	320	62
- Water Hyacinth Coverage	8%				

(Eye estimate)	
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Month : March

Parameters	Observed Value				
	Inlet	H. Chowk	Outlet	Khapaundi	Anaudi
Parameters					
- Water Temperature (°C)	23.4	22.9	22.8	22.5	22.3
Visibility (m)	1.7	1.2	2.4	3.4	4.4
Chemical					
- Dissolve Oxygen (mg/L)	8.7	11.69	9.0	9.4	9.3
-Chlorophyll (mg/m ³)	2.0	10.5	3.3	2.9	1.6
- Nitrate + Nitrite (mg/L)	0.034	0.017	0.007	0.010	0.010
Ammonia (mg/L)	0.002	0.000	0.00	0.000	0.000
-Total Phosphorus (mg/L)	43.5	65.0	18.0	16.0	32.0
PH	6.6	7.5	7.1	7.2	7.2
Biological					
- Heterotrophic bacteria (cells/ml)	10.33x10 ⁶				
- Heterotrophic Nanoflagellates (cells/ml)	0.538 x 10 ³				
- Phytoplankton abundance (cells/L)	279	1117	809	1243	1529
- Zooplankton density (no/L)	638	485	171	358	118
- Water hyacinth Coverage (Eye estimate)	5%				

Table 3. Normal range of water quality parameters for different trophic status of Lakes

Parameters	Oligotrophic	Mesotrophic	Eutrophic
Chlorophyll-a(mg/m ³)	<3 mg/m ³	3-7 mg/m ³	1-40mg/m ³
Total Phosphorus (µg/L)	5—10	10*30	30-100
Total Nitrogen (µg/L)	0.0-4.0	4.0-1500.0	1500.0-5000.0
Heterotrophic Bacteria (cells/ml)	0.5-1 (x10 ⁶)	-	1-10(x10 ⁶)