

WALI-COME

The image features the text 'WALI-COME' in a bold, 3D, sans-serif font. The letters are rendered with a yellow-to-orange gradient and have a dark brown shadow on their right side, giving them a three-dimensional appearance. The text is set against a background that is split vertically: the left half is a solid light green, and the right half is white. A thick, dark blue horizontal bar with rounded ends is positioned below the text, extending across the width of the image.

Impact of Land Use on Water Quality of Phewa- Lake Pokhara, Nepal

Presenter

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1. Introduction

Nepal is renowned in the world on account of her natural beauty, geographical / biological diversity and culture heritage. Inadequate management and unwise utilization of these resources, despite their high potential, has been undergoing several environmental degradations.

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- One of such important natural area is Phewa lake in Pokhara valley .The Phewa Lake is one of the most beautiful place in Nepal and attracts a large number of tourists from all over the world. By the virtue of its natural beauty, the lake contributes significantly in local and national economy through tourist industry

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The analysis of water is the major subject in the modern environmental chemistry. Lakes are one of the most important resources of water for the mountainous country like Nepal.

Objective of the study

1. To identified the concentration of pollution in the lake
2. To estimate and predict sedimentation rate, lakes storage capacity and its expected life span.

Problem statement

However the lake and its watershed has been under immense and exhaustive pressure due to excessive human intervention since last couple of decade. This has resulted in various environmental problems as presented following

Lake of water quality deterioration making it unfit for recreational and aesthetic use.

- Discharge of domestic wastewater and sewer in to the lake through point source (Phirke khola, urban drain ,seti channel etc)
- Nutrient /fertilizers from agriculture fields (non point source)
- Non point source: influenced by precipitation runoff during rainy season eg. Agriculture land, forest ,urban area etc.
- Point sources : not influenced by precipitation discharge all year round eg. House , factories and domestic wastewater etc.
- Seepage and overflow of septage from septic tanks in to the lake.
- Direct discharge of toilet wastes in to the lake by lakeshore residents.
- Runoff carrying organic pollution load and solid waste in to the lake.
- Laundry washing by hotel and residents

2. Lake area shrinking at the rate of 2ha per year

- High sedimentation load from harpan ,andhari, sasurke khola (steams) and seti irrigation channel
- Land slide and soil erosion at watershed areas
- Deforestation for fuel wood ,fodder, encroachment
- Inadequately developed infrastructure (e.g. Baidham-pame road) at lake vicinity
- Soil erosion
- Improper hill slope terrace cultivation
- Over grazing by cattle

Lack of environment education

- Lack of incentive for improving daily habits that are detrimental to the lake.
- Lack of commitment and leadership
- Indifference of the rural people towards lake conservation as they do not get any benefit from the lake.

Lack of lake focused integrated environmental conservation program

- Lack of resources to undertake such program
- Lack of rural –urban linkage for collective endeavor for environmental conservational of the lake
- Lack of an active lake focused institution and sustainable utilization of resources
- The HMGN supported Phewa lake area Conservation committee does not have representation of beneficiaries hence more government dominant, and is grossly inactive.
- Benefit from the lake not shared to rural community, which are equally responsible for its conservation

2. Methodology

- 2.1 Study area

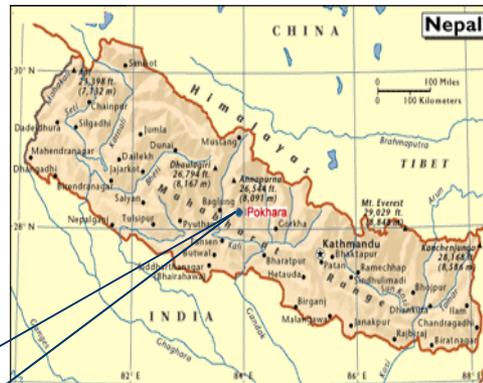


Fig 1:Nepal

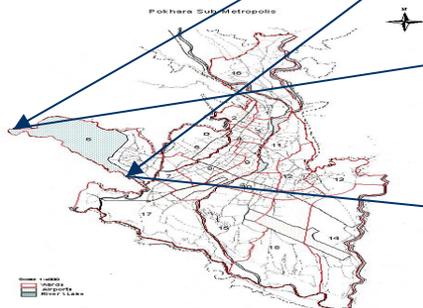


Fig 2:Pokharta S.M.S.

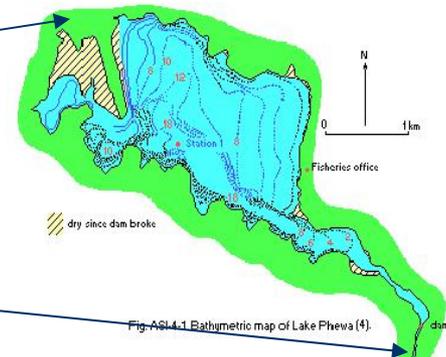


Fig-AS1.4.1 Bathymetric map of Lake Phewa (4).

Phewa lake

2.2 Method of water sampling

- 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.

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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.

2.3 Method of sedimentation survey

- **2.3.1 Echo sounding survey (Method I)**

The sedimentation survey of March 2006 is used as the base line information on the lake bed with reference to the high water level 794.15 m

The depth of the water in the lake is measured from a rowboat with an echo sounding instrument. The measured water depth is related to the reference water level (i.e.974.15m).

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The instrument used was a micro –processor – controlled depth recorder (eco-sounding) of the type ps-20r portable precision echo sounder. The manufacturer is kaijo dennico co ltd, Japan . It continuously records depth to the bottom of the lake as the boat moves along the survey line . The echo sounder is operated by DC 12 v (10 -15v), 3.5 A the recorder works at a high frequency of 200 kHz

2.3.3 Aerial photo graph

- The survey utilizes also the aerial photo graph from 1983,1998,2001,2002 and 2004 to review the growth of the delta over a long time period. The photo graph help to understand the sedimentation process near the river mouth and over a longer time period, show visually the growth of the delta..
- In the past, oblique photograph from a fixed point were taken from the near by hill top to understand the delta formation in the lake .some photo graph were taken during the survey. However, in the lake of the past photograph this could not be a success.

3. Result and discussion

- [presentation.doc](#)

Sedimentation calculation

- [Sediment calculation.doc](#)

Discussion

- **Water quality Characteristics of Phewa Lake from pre-monsoon to post monsoon**
- Some physical characteristics of Lake Phewa are given in Table-1. Details of the values of water quality determined from pre-monsoon to post monsoon are given in Table 2.
- The water temperature recorded minimum of 18.00C in post -monsoon to maximum of 26.80C in pre-monsoon. The temperature at different station showed that there was change in water temperature at different stations.
- The highest transparency of 3.1m was observed in pre monsoon 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 5.9m, this seems this is one of the cleanest spot in the lake. In monsoon , in some station such as Inlet, H. chock and outlet the transparency could not measure because of the shallowness of the station.
- The DO was not sufficient in all the sites. The dissolve oxygen (DO) concentration in water was within range from 6.5 to 9.9 mg/l. this amount of oxygen in different point shows the water is polluted and not suitable for drinking purposes.
- The BOD was found in all site from 2.9 to 4.6 .this value indicate the water quality of phewa lake is organic polluted.

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- The pH range revealed acidic or alkaline nature of water. The pH ranged from 5 to 8.1 in Lake Phewa during sampling. The highest pH value was 8.1 in pre- monsoon period .
- Both nitrite + nitrate and ammonium nitrogen though did not show any definite pattern from pre-monsoon to post monsoon with the values ranging from 0.01 to 0.186 mg/l.
- However high amount phosphorus was detected from all sampled site. The highest concentration (83 mg/L) of total phosphorus (TP) was observed at Hallan Chowk in pre-monsoon . This might indicate that de-silting site and Harpahan Kola stream are the main source of nutrient input during the season of survey .Harpahan khola is passing through the agriculture land where excess use chemical fertilizer by farmer in this watershed area.
- About 16 species of phytoplankton were recorded from pre-monsoon to post monsoon period .Phytoplankton is one of the important supplier of organic matter in lake ecosystem. The highest abundance of phytoplankton was observed in monsoon 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 post monsoon (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

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- 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 18.00°C in post-monsoon to maximum of 27.60°C in pre-monsoon which temperature is favorable for growth of water hyacinth at pre-monsoon season also the nutrient is high and growth of this plant in this 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 as well as chemical fertilizer.

3.3.1 Bathymetric map

- Bathymetric map of the reservoir was prepared based on the February 2006 data (because no any new data is found in Nepal) at the scale of 1:10,000 using 1 meter contour interval and is given in figure 4 with reference to the highest water level (794.15m), the area of the reservoir is about 439 ha

3.4 Water Depth

- The profile analysis for the February 2006 survey is given in annex I Annex II show the data computed for making bathymetric map with reference to the highest water level (794.15m) of the reservoir.
- With respect to the reference water level (794.15m) the maximum and the average water depth measure in march 2000, may 2001, april 2002, December 2002 and January 2004 surveys are presented in table 7 and changes in average water depth are given in table 6

Conclusion

Phewa Lake is mesotrophic to eutrophic status .most of the analyzed physo chemical parameters are destructive as found in natural surface water bodies.In such situation ,if the lake continuous to be polluted and fill up by sediment at present rate ,its recreational and aesthetic value as well as national economy of Pokhara ,Nepal will be diminished .

Recommendation

- Public awareness program will be launch for conservation of Phewa lake.
- SALT program will be launch to its watershed area for prevent the sedimentation of lakes .
- Encroachment is strictly probated by Government .
- Mapping and demarcation will be done by Government .

Photo





Thank You

The image features the words "Thank You" in a large, 3D, blocky font. The letters are a vibrant green with a marbled, stone-like texture. The text is arranged in a slightly descending line from left to right. Above the text, a solid blue horizontal bar spans across the frame. The background is white, with a light green decorative shape in the top-left corner.

Season: Pre-monsoon

Parameters	Observed value				
	Inlet	H.Chowk	Outlet	Khapaundi	Anaudi
Physical					
Water temperature (°C)	25.4	24.9	27.8	24.5	24.3
visibility(m)	3.1	3	2.9	4.1	5.9
Chemical					
Dissolve oxygen (mg/L)	8	6.5	6.6	7.5	7.3
Biological oxygen demand (mg/L)	2.9	3.5	4.6	4.5	4.3
Chlorophyll (mg/m ³)	4.6	5.0	1.0	4.6	2.6
Nitrate nitrite (mg/L)	0.100	0.200	0.100	0.100	0.200
Ammonia (mg/L)	0.040	0.020	0.030	0.006	0.006
Total phosphorous (mg/L)	36.0	83.0	31.0	24.0	29.0
pH	5.0	8.1	6.0	5.7	5.8
Biological					
Heterotrophic bacteria (cells/ml)	4.435*10 ⁶				
Heterotrophic Nano flagellates(cells/ml)	0.832.10 ³				
Phytoplankton abundance (cells/ml)	227	1083	622	722	976
Zooplankton density (No/L)	51	233	374	478	836
Water hyacinth coverage (Eye estimate)	10%				

Table 2: water quality parameter of Phewa Lake at pre-monsoon period

Season: Monsoon

Parameters	Observed value				
	Inlet	H.Chowk	Outlet	Khapaundi	Anaudi
Physical					
Water temperature (°C)	20.0	23.5	24.1	20.5	21.5
visibility(m)	2.8	2.9	2.1	2.3	2.7
Chemical					
Dissolve oxygen (mg/L)	7.0	9	8.7	7.6	8
Biological oxygen demand (mg/L)	4.5	3.2	3.8	4.2	4
Chlorophyll (mg/m ³)	6.0	13.6	20.4	19.6	30.0
Nitrate nitrite (mg/L)	0.186	0.060	0.164	0.06	0.154
Ammonia (mg/L)	0.080	0.030	0.009	0.032	0.004
Total phosphorous (mg/L)	77.0	58.0	35.0	34.0	40.0
pH	6.5	7.6	7.3	6.8	7.0
Biological					
Heterotrophic bacteria (cells/ml)	9.02 x 10 ⁶				
Heterotrophic Nano flagellates(cells/ml)	0.9444 x 10 ³				
Phytoplankton abundance (cells/ml)	446	739	317	2091	414

Zooplankton density (No/L)	291	394	87	420	92
Water hyacinth coverage (Eye estimate)	8%				

Table 3: water quality parameter of Phewa Lake at monsoon period

Season: Post monsoon

Parameters	Observed value				
	Inlet	H.Chowk	Outlet	Khapaundi	Anaudi
Physical					
Water temperature ($^{\circ}$ C)	18.0	22.5	18.5	19	19.5
visibility(m)	2.7	2.2	2.4	3.4	4.4
Chemical					
Dissolve oxygen (mg/L)	7.7	9.69	7.0	7.4	7.3
Biological oxygen demand (mg/L)	4.2	3.7	4	3.9	3.5
Chlorophyll (mg/m^3)	2.0	10.5	3.3	2.9	1.6
Nitrate nitrite (mg/L)	0.054	0.037	0.017	0.030	0.040
Ammonia (mg/L)	0.007	0.002	0.003	0.001	0.002
Total phosphorous (mg/L)	43.5	75.0	28.0	26.0	42.0
pH	5.6	6.5	6.1	6.2	6.2
Biological					
Heterotrophic bacteria (cells/ml)	10.33×10^6				
Heterotrophic Nano flagellates(cells/ml)	0.738×10^3				
Phytoplankton abundance (cells/ml)	379	1217	909	1443	1729
Zooplankton density (No/L)	738	685	271	458	218
Water hyacinth coverage (Eye estimate)	6%				

Table 4: water quality parameter of Phewa Lake at post-monsoon period

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

Table 5. Normal range of water quality parameters for different tropic status of Lakes

Sediment calculation, Phewa lake Echo sounding survey, January 2004 to February 2006.

Cross section	With reference to the highest water level(794.15m)					Change in water volume in ha –m.	Remarks	
	Surface area of lake in ha.	Average water depth in m.		Volume of water in ha-m.				
		Jan-2004	Feb-2006	Jan 04	Feb 06	Jan -04 to Feb 06		
Main reservoir								
Line 15-16 and 17-101	35.5	8.7	8.6	309	305	-3.4	The total area of the lake does not tally since the lake area downstream from 15-16 section is not included because of lack of survey lines.	
Line 17-101,17-18&14-18	95.2	10.3	10.2	982	974	-8.2		
Line14-18,19-4&14-3	78.0	13.8	13.8	1079	1073	-5.2		
Line19-4&3-20	41.5	11.2	11.0	463	454	-8.9		
Line 3-20&2-20	8.5	9.1	9.0	77	77	-0.5		
Line13-4&14-3	3.4	9.9	9.5	34	32	-1.6		
triangle								
Line2-20	13.7	8.64	8.79	40	39	-1.0		The sedimentation in the main reservoir is estimated as 30.7 hector meter and 27.1 in the silt trap area.
Line17-18	23.9	7.18	6.95	57	55	-1.9		
	37.6					-2.9		
	299.7	78.9	77.8	3040.9	3010.2	-30.7		
Silt Trap								
Line13_4&13_5	2.0	4.79	3.72	9.7	7.6	-2.2	Total sedimentation of the Phewa lake between January 2004 to February,06 is 57.8 -hectare meter.	
Line 12_13,13_5&12_5	9.7	4.65	3.59	45.1	34.8	-10.2		
22_23&12_13	6.8	7.49	6.58	51.0	44.8	-6.2		
Line12_5&6_11	8.6	2.45	2.14	21.1	18.4	-2.6		
6_11&7_10	13.4	1.82	1.75	24.4	23.5	-0.9		
Line7_10,9_10&8_9	15.1	3.11	2.91	46.9	43.9	-3.0		
Line9_10&9_21	3.4	4.5	4.39	15.5	14.9	-0.6		
Triangle								
Line22_23	3.8	2.72	2.50	3.9	3.6	-0.3		
Line8_9	2.3	4.56	4.53	3.5	3.4	-0.10		
Line9_21	4.2	8.96	8.27	11.5	10.6	-0.9		
Total	69.5	45.2	41.4	232.7	205.6	-27.1		
GrandTotal	369.1	124.1	118.2	3273.6	3215.8	-57.8		

Table 9; Sediment calculation, Phewa lake Echo sounding survey, January 2004 to February 2006.