

Analysis of Lower Lake Water in Bhopal Region of Madhya Pradesh, India

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Abstract

Lower Lake Water samples were collected from fifteen (03) locations during premonsoon, monsoon and post monsoon season. The physico-chemical parameters such as Total Alkalinity, Total Hardness, Chloride, Sulphate, Nitrate, total suspended solid, Total dissolved substance, Fluoride, Dissolved oxygen, Biological Oxygen Demand and Chemical Oxygen Demand were analyzed to know the present status of the lakewater quality. After statistical analysis it was cleared that the positive as well as negative co-relationship occurred between the attributes.

Keywords: lower lake, correlation, upper lake.

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INTRODUCTION:

Water is one of the most common and necessary resource on earth. Without water there would be no life on earth. Water is the source of all biological lives and their sustenance too. Water quality has become a major global concern due to increasing human developmental activities.

Correlation Matrix:

A **correlation matrix** is a table showing **correlation** coefficients between variables. Each cell in the table shows the **correlation** between two variables. A **correlation matrix** is used to summarize data, as an input into a more advanced analysis, and as a diagnostic for advanced analyses.

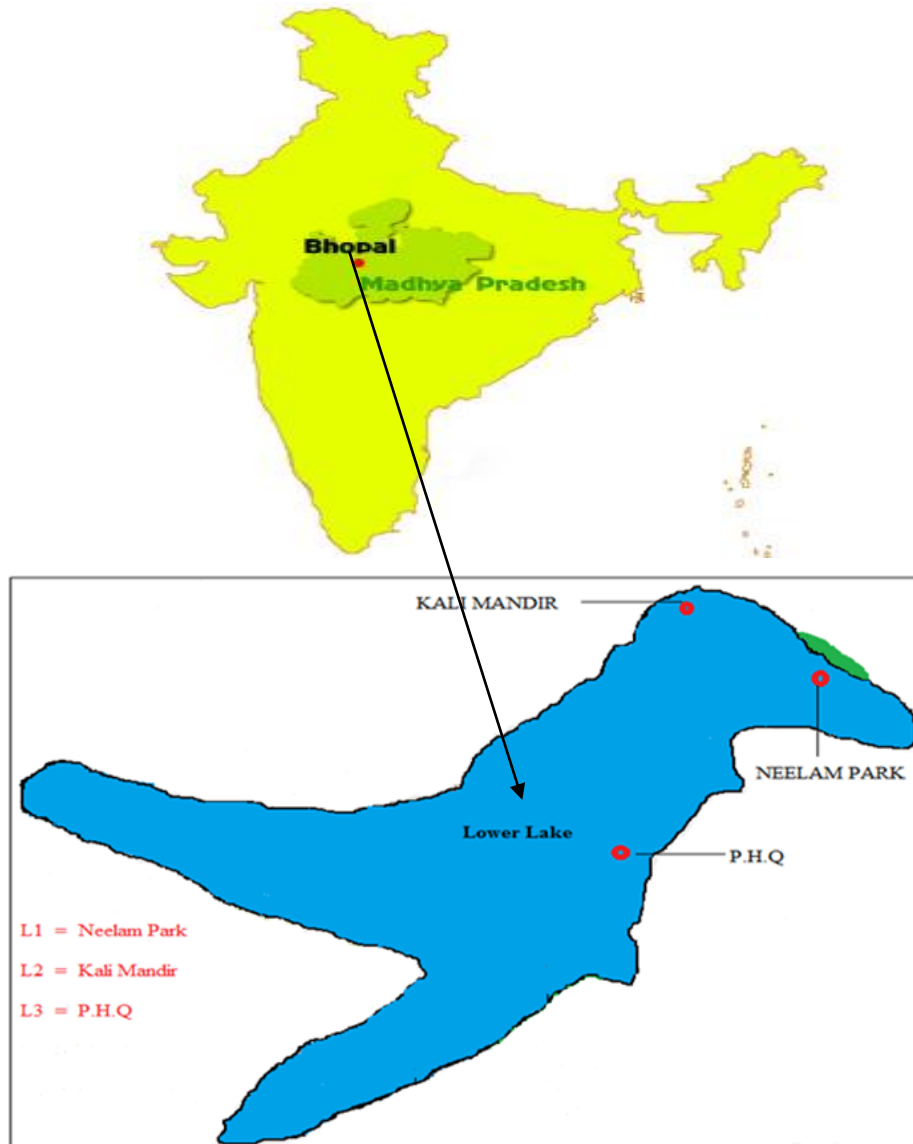
Study Area

The Lower Lake is located to the east of the Upper Lake. An earthen dam separates the two lakes. The two lakes are built in a terraced manner; the lowest level of the Upper Lake is just below the highest level of the Lower Lake.

The Lower Lake has an area (water spread) of 1.29 km², and its catchment area is 9.6 km². The lake receives subsurface seepage from the Upper Lake.

The Lower Lake does not have any fresh water source; it receives seepage water from the Upper Lake and drainage from 28 sewage-filled nullahs.

Location map of the Study area



SAMPLE COLLECTION:

The sampling locations consist of lower lake area. Lake water samples were collected from three (03) locations during pre monsoon, monsoon and post monsoon season. Samples were collected in plastic container to avoid unpredictable changes in

characteristic as per standard procedure (APHA, 1998).

PHYSICO-CHEMICAL ANALYSIS OF LOWER LAKE WATER:

The collected samples were analyzed for different physico-chemical parameters such as Total Alkalinity, Total Hardness, Chloride, Sulphate, Nitrate, total suspended solid, total dissolved substance, Fluoride, Dissolved oxygen, Biological Oxygen Demand and Chemical Oxygen Demand as per the standard methods (APHA, 1998).

RESULTS AND DISCUSSION:

The water quality analysis of different areas of Lake water samples have been carried out for Total Alkalinity, Total Hardness, Chloride, Sulphate, Nitrate, Total suspended solid, total dissolved substance, Fluoride, Dissolved oxygen, Biological Oxygen Demand and Chemical Oxygen Demand. The status of water quality of these lake water sources is presented in table 1, 2 and 3.

STATISTICAL TREATMENT OF DATA

Correlation matrix was prepared within the studied parameters in pre monsoon, monsoon and post monsoon and tabulated in Table 4, Table 5 and Table 6 for determining the relationship between the physico-chemical variables. All the attributes were positively co-related.

Table 1. Water Quality at different locations of Lower Lake in pre monsoon season (Laboratory Analysis) Units mg/l

Name of Area	Total Alkalinity	Total Hardness	Chloride	Sulphate	Nitrate
Neelam Park	678	684	195	228	48
Kali Mandir	676	681	192	230	51
Police Head Quarter	674	679	189	226	47

Total suspended solid	Total dissolved substance	Fluoride	Dissolved oxygen	Biological Oxygen Demand	Chemical Oxygen Demand
60	2	0.67	2.4	3.8	88.4
58	2.1	0.70	2.6	3.5	87.3
56	1.9	0.68	2.3	3.2	86.5

Table 2. Water Quality at different locations of Lower Lake in monsoon season
(Laboratory Analysis) Units mg/l

Name of Area	Total Alkalinity	Total Hardness	Chloride	Sulphate	Nitrate
Neelam Park	710	630	155	288	51
Kali Mandir	713	625	159	291	53
Police Head Quarter	709	628	161	285	51

Total suspended solid	Total dissolved substance	Fluoride	Dissolved oxygen	Biological Oxygen Demand	Chemical Oxygen Demand
54	1.84	0.57	2.7	3.6	90.4
53	1.90	0.60	2.9	3.5	92.3
51	1.85	0.58	2.6	3.3	91.5

Table 3. Water Quality at different locations of Lower Lake in post monsoon season
(Laboratory Analysis) Units mg/l

Name of Area	Total Alkalinity	Total Hardness	Chloride	Sulphate	Nitrate
Neelam Park	672	637	174	197	48
Kali Mandir	675	633	179	192	49
Police Head Quarter	673	638	176	195	46

Total suspended solid	Total dissolved substance	Fluoride	Dissolved oxygen	Biological Oxygen Demand	Chemical Oxygen Demand
60	2.0	0.62	2.6	3.8	98.5
59	1.9	0.65	2.5	3.9	97.3
61	1.84	0.63	2.8	3.8	99.5

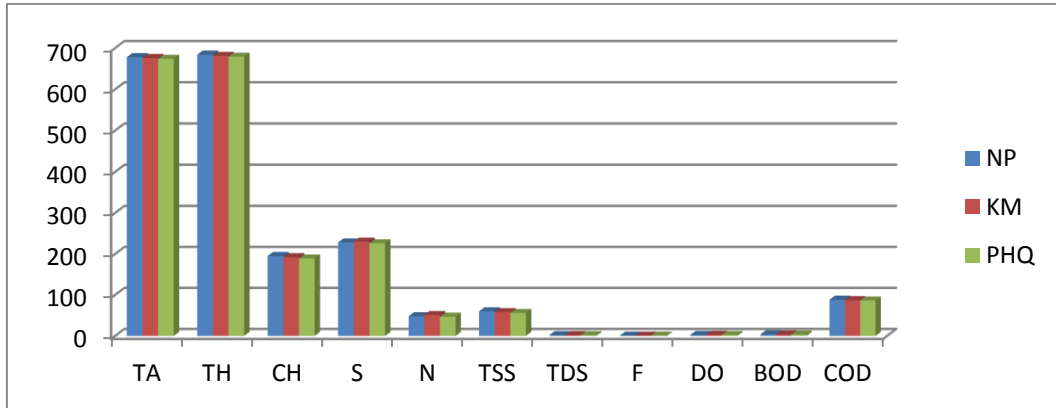


Fig 1: Graphical representation of data (PreMonsoonData)

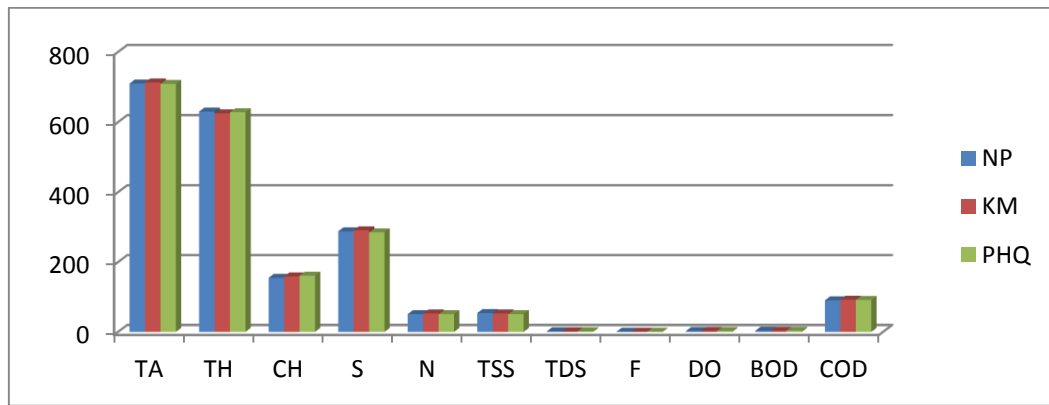
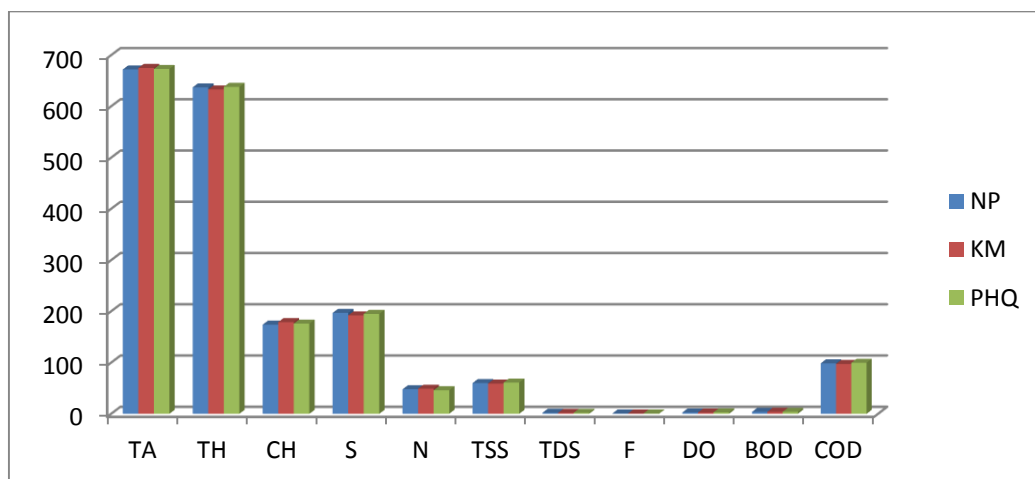


Fig 2: Graphical representation of data (MonsoonData)



NP: Neelam Park, KM: Kali Mandir, PHQ: Police Head Quarter
Fig 3: Graphical representation of data(Post MonsoonData)

Table 4. Pearson Correlation Matrix for pre monsoon

	TA	TH	CH	S	N	TSS	TDS	F	DO	BOD	COD
TA	1										
TH	0.993399	1									
CH	1	0.993399	1								
S	0.5	0.39736	0.5	1							
N	0.240192	0.127257	0.240192	0.960769	1						
TSS	1	0.993399	1	0.5	0.240192	1					
TDS	0.5	0.39736	0.5	1	0.960769	0.5	1				
F	-0.32733	-0.43355	-0.32733	0.654654	0.838628	-0.32733	0.654654	1			
DO	0.327327	0.216777	0.327327	0.981981	0.995871	0.327327	0.981981	0.785714	1		
BOD	1	0.993399	1	0.5	0.240192	1	0.5	-0.32733	0.327327	1	
COD	0.995871	0.999711	0.995871	0.419314	0.151074	0.995871	0.419314	-0.41176	0.240192	0.995871	1

Table 5. Pearson Correlation Matrix for monsoon

	TA	TH	CH	S	N	TSS	TDS	F	DO	BOD	COD
TA	1										
TH	-0.79536	1									
CH	-0.05241	-0.56362	1								
S	0.960769	-0.59604	-0.32733	1							
N	0.970725	-0.91766	0.188982	0.866025	1						
TSS	0.419314	0.216777	-0.92857	0.654654	0.188982	1					
TDS	0.921551	-0.9683	0.339422	0.777714	0.987829	0.033942	1				
F	0.838628	-0.99718	0.5	0.654654	0.944911	-0.14286	0.984324	1			
DO	0.995871	-0.73704	-0.14286	0.981981	0.944911	0.5	0.882498	0.785714	1		
BOD	0.419314	0.216777	-0.92857	0.654654	0.188982	1	0.033942	-0.14286	0.5	1	
COD	0.654654	-0.97888	0.720577	0.419314	0.817057	-0.41176	0.896792	0.960769	0.583324	-0.41176	1

Table 6. Pearson Correlation Matrix for post monsoon

	TA	TH	CH	S	N	TSS	TDS	F	DO	BOD	COD
TA	1										
TH	-0.86603	1									
CH	0.997176	-0.82603	1								
S	-0.99718	0.826033	-1	1							
N	0.5	-0.86603	0.433555	-0.43355	1						
TSS	-0.65465	0.944911	-0.59604	0.59604	-0.98198	1					
TDS	-0.45896	-0.04676	-0.52438	0.524379	0.539949	-0.37115	1				
F	1	-0.86603	0.997176	-0.99718	0.5	-0.65465	-0.45896	1			
DO	-0.5	0.866025	-0.43355	0.433555	-1	0.981981	-0.53995	-0.5	1		
BOD	0.944911	-0.98198	0.917663	-0.91766	0.755929	-0.86603	-0.14286	0.944911	-0.75593	1	
COD	-0.69338	0.960769	-0.63731	0.637307	-0.97073	0.998625	-0.32197	-0.69338	0.970725	-0.89104	1

TA: Total Alkalinity, TH: Total Hardness, CH: Chloride, S: Sulphate, N: Nitrate, TSS: Total suspended solid, TDS: Total dissolved substance, F: Fluoride, DO: Dissolved Oxygen, BOD : Biological Oxigen Demand, COD: Chemical Oxigen Demand.

CONCLUSIONS:

Result of the study indicated that lower lake water is contaminated and not totally safe for drinking purpose. Most of parameters showed analogous trend in seasonal variation. It requires proper monitoring and environment management plans to control the release of effluents. It indicates that the extent of pollution occurred due to mining, industrial discharge, domestic discharge and other anthropogenic. There are postive co-relationship beteen some attributes and also negative co-relationship beteen some attributes.

Conflicts of Interest: The authors declare that there is no conflicts of interest regarding the publication of this article.

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