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Analysis of water quality using physico-chemical parameters of Govind Sagar Lake H.P. (INDIA)

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ABSTRACT: The Himalaya form a shield of great importance right across the Northern facade of India from Jammu and Kashmir in west to Arunachal Pradesh in east. But it is only one state, Himachal Pradesh, to which given the honor to derive its name from the Himalayas. By virtue of its extensive geographical extent, varied terrain and climatic conditions, supports a rich diversity of inland wetland ecosystems. Wetlands are generally sandwiched between a terrestrial eco system and an open water system. Regions generally referred to, as wetlands are lakes, marshes, swamps, temporary ponds, riverbanks, mangroves and paddy fields[1].

Water is the most important in shaping the land and regulating the climate. It is one of the most important compounds that profoundly influence life. The quality of water usually described according to its physical, chemical and biological characteristics. Rapid industrialization and indiscriminate use of chemical fertilizers and pesticides in agriculture are causing heavy and varied pollution in aquatic environment leading to deterioration of water quality and depletion of aquatic biota. Due to use of contaminated water, human population suffers from water born diseases. It is therefore to check the water quality at regular interval of time.

Keywords: Govind Sagar Lake; DO; BOD; COD; TDS; Viscosity.

INTRODUCTION

Water is the most important in shaping the land and regulating the climate. It is one of the most important compounds that profoundly influence life. The quality of water usually described according to its physical, chemical and biological characteristics. Rapid industrialization and indiscriminate use of chemical fertilizers and pesticides in agriculture are causing heavy and varied pollution in aquatic environment leading to deterioration of water quality and depletion of aquatic biota. Due to use of contaminated water, human population suffers from water born diseases. It is therefore to check the water quality at regular interval of time[2]. Lakes and surface water reservoirs are the planet's most important freshwater resources and provide innumerable benefits. They are used for domestic and irrigation purposes, and provide ecosystems for aquatic life especially fish, thereby functioning as a source of essential protein, and for significant elements of the world's biological diversity. Water has important social and economic benefits as a result of tourism and recreation, and is culturally and aesthetically important for people throughout the world. Water also plays an equally important role in flood control[3]. However, the remarkable increase in population resulted in a considerable consumption of the water reserves worldwide[4].The lake ecosystem is disturbed by various factors such as natural and manmade. The natural factors may include climate, acid rain, nuclear fallout, landslide, etc. But impact of manmade factors, in most of the fresh water lakes, are pronounce and detrimental. Discharge of pollutants from point and non-point source ,deforestation, extensive cultivation, building construction, road construction and widening, setting of industries, discharge of untreated effluents, domestic sewage etc. not only pollutes the water but also causes increased silt flow in the lake basin making it shallow hence cutting short the life span of the lake. 21s[5-7]. The free style way of disposal of agricultural, industrial and domestic effluents into natural water bodies may cause serious contamination. Run-off from agricultural land and saline seeps subject the most vulnerable water pollution to increased salinity, so the freshwater

lakes are highly affected. Extensive evaporation of water from the lake due to high temperature and low rain enhances the amount of salts, heavy metals and other pollutants, which are conscientious factors for the poor quality of the lake ecosystem[8]. Among environmental pollutants, metals are of particular concern, due to their potential toxic effect and ability to bioaccumulation in aquatic ecosystems; therefore, it has public interest[9, 10, 11 & 12]. The serious environmental problems have been faced in developing as well as developed countries[13]. Dissolved constituents of water bodies are often determined as a major component for baseline limnological studies. The major ions Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, $SO4^{2-}$, HCO_3^{-}, and CO_3^{2-} are essential constitute of water and responsible for ionic salinity as compared with other ions[14]. Contamination of aquatic ecosystems with heavy metals is a serious problem, all over the world[15&16]. In this regard, tremendous work has been carried out for assessing physic-chemical parameters of various lakes throughout India[17-20]. Despite such an exhaustive work, up to now, there was no systematic study carried out for the physico-chemical analysis and quality control assessment of Gobind Sagar Lakes of Himachal Pradesh, India. Therefore, the present work requires being undertaken.

MATERIAL AND METHODS

Study Area - Description of lakes:

Lakes of H.P.: The state of Himachal Pradesh has 27 natural lakes covering an area of 15 hectares and 5 manmade lakes covering an area of 712 hectares. They are spread over an altitude range of 450 to 5093 mtrs. Above sea level and cover tropical, sub-tropical and the alpine regions of the state. One percent mass of Himachal is under some form of water-lake and rivers and glaciers, of the lakes, some are natural bequests that date back millions of years to the time when the region was a vast inland sea and today, they are fed by streams of pure snow melt or by ground water springs. Practically without exception, they are held sacred or at the very least, have fascinating legends lapping their crystal clear waters. Others lakes are far more recent and are made reservoirs. Many are sources of the rivers that start as tiny streams and grow to become the giants that feed the fertile valleys of the state and the gangetic plains of worth India. Several are home to a variety of resident and migratory birds, and a host of aquatic life. These water bodies have also opened a tremendous range of activity and adventure that includes boating, swimming, canoeing, and water-skating, kayaking, sailing, surfing and fishing.

Govind Sagar Lake: Gobind Sagar is a man-made reservoir situated in Bilaspur District of Himachal Pradesh. The lake is named in honor of Guru Gobind Singh, the tenth and last guru of Sikhs. Gobind Sagar Lake over the Sutlej River is a huge reservoir and is the result of Bhakra Nangal, the world's second highest gravity dam. It is a major landmark of Bilaspur District. It covers an area of 170 sq km and its length extends up to 90 km.

Criteria of Selection of Sampling Station of Govind Sagar Lake:

Sampling station will be selected on the basis of the identified pollution problems to assess the overall status of the lake. The thought will given before the selection of sampling points after having the activity survey that all sorts of problems should be represented through the sample analysis to access the limnological status of the lake. Sampling stations are representing the lake as the deeper water zone and sewage inflow points. The representative samples of the particular zone will be checked with the analysis to reflect the status of the spot. On the basis of above criteria following three sampling points will be selected. The location and description of the sampling points of Govind sager lake are as follows:-

Sampling Station $\mathbf{S_1}$ inflow point - Kandrour bridge (Kandrour)

Sampling Station $\mathbf{S_2}$ inflow point - Sandu ka maidan (Luhnu)

Sampling Station $\mathbf{S_3}$ inflow point - ACC pump house (Daiher)

The Physico chemical parameters of water will be analyzed by standard method devised by American Public Health Association[21], 1998 & others.

The water samples were collected during the month of November and December 2013.The samples for analysis were collected in satirized bottles. Almost care was taken, so that no bubbling should observe during sampling, which avoids influence of the dissolved oxygen. The temperature was recorded at the sample site. The chemicals used were of A. R. grade and was used without further purification. The solutions were prepared in distilled water. The pH of water sample was measured with the help of pH meter (Elico LI-120) with a glass electrode. The pH meter was calibrated using buffer of pH 4.0 and 7.0. The conductance of water samples was measured using conductometer (Elico CM 180). For COD determination aliquot of sample water was taken in a round bottom flask which was acidified by concentrated H_2SO_4 and solid $HgSO_4$ (0.4 gm) was added. A Standard $K_2Cr_2O_7$ solution was added to the resultant mixture and refluxed for two hours and unreacted $K_2Cr_2O_7$ was determined by titrating against known concentration of FAS. The chloride ions present in the sample was determined by Mohr's method. A known volume of sample was taken into conical flask. A 2% potassium chromate was used as indicator and resultant solution was titrated against standard silver nitrate solution. For determination of hardness, EDTA solution of its disodium salt was prepared in distilled water, it was standardize by using Zinc ion solution at pH 10 and using solochrome black T indicator. A definite amount of sample water was taken in conical flask. It was buffered to pH 10. Few drops of indicator solochrome Black T was added and titrated against standard EDTA Solution. Similar procedure as total hardness was used for the determination of calcium hardness the only difference is that instead of solochrome Black T another indicator murexide was used. Dissolved oxygen and BOD determined by Wrinkle's method. Turbidity is determined with turbidity meter. Viscosity and surface tension is determined with the help of Ostwald's viscometer and stalgmometer.

RESULT AND DISCUSSION

The fresh water body, whether a road-side or a lake, establishes a dynamic system with continuous interaction between the abiotic and biotic components. Fresh water has been one of man's have developed near fresh water bodies. In place where natural fresh water bodies for his use by digging out large areas in the form of lake and pounds where rain water may get accumulated to be utilized for various human needs. The morphometry location and various physico-chemical and nutrient parameters, along with the floral and faunal diversity, constitute a lake as a self-contained ecosystem. In an ecosystem the chemical substance are recycled.

Water plays a vital role in the ecology of flora and fauna. Quantity and quality are two major issues involved in the use of water. The main purpose of analyzing physical and chemical characteristics of water is to determine its ecological status.

One of the major problems of fresh water bodies is eutrophication due to allochthonous/ nutrient input (particularly of phosphorous and nitrogen) from external sources. In eutrophic lakes bottom acts as a sink for nutrients which is degradable organic matter. It plays an important role in determining the chemical nature of lake.

Social development and human activities greatly accelerate eutrophication. The main cause of eutrophication of reservoir is the discharge of nutrients through sewage.

A biotic component such as water and sediment control the quantity of biota but also affect the quality. Water quality may be affected in various ways by pollutants. The physico-chemical characteristics of water are affected by rainfall, temperature, availability of light and nature of pound bed. The Govind Sagar lake is highly eutrophic in nature. The study of Govind Sagar Lake is important because of its succession through various conditions which adversely affect its stability.

Table 1: Variation in Physico-chemical parameter of Govind Sagar Lake (G.L.) H.P.

NOVEMBER 2013				
Sr. No.	***Sampling Status Parameter Used***	**S_1 (G.L.)**	**S_2 (G.L.)**	**S_3 (G.L.)**
1.	*Water temperature*	13	13.5	13
2.	*Colour*	Light Greenish	Light Greenish	Light Greenish
3.	*Odour*	Odourless	Odourless	Odourless
4.	*pH*	2.91	5.89	2.86
5.	*Conductivity*	95.2	51.5	53.2
6.	*Dissolved oxygen*	2.3	2.9	2.5
7.	*BOD*	0.573	0.810	0.512
8.	*COD*	1.513	0.0512	0.0501
9.	*CO_2*	4.2	3.1	3.1
10.	*Total Hardness*	21.3	27.5	20.1
11.	*Chloride*	61.02	63.5	61.10
12.	*TDS*	95.2	182	90.5
13.	*Surface tension*	73.40	73.59	73.50
14.	*Viscosity*	0.0121	0.0118	0.0123
15.	*Alkalinity*	No	109	No

All the values are in mg/lit except pH, TDS (ppm), surface tension(dyne/cm), viscosity(poise), Conductivity (µmho/cm) and temperature (^0C).

Table-2: Variation in Physico-chemical parameter of Govind Sagar Lake (G.L.) H.P.

DECEMBER 2013				
Sr. No.	**Sampling Status Parameter Used**	**S_1 (G.L.)**	**S_2 (G.L.)**	**S_3 (G.L.)**
1.	Water temperature	14	14	14
2.	Colour	Light Greenish	Light Greenish	Light Greenish
3.	Odour	Odourless	Odourless	Odourless
4.	pH	2.92	5.90	2.89
5.	Conductivity	100.2	57.3	59.5
6.	Dissolved oxygen	2.1	2.8	2.4
7.	BOD	0.492	0.911	0.491
8.	COD	1.726	0.0623	0.071
9.	CO_2	4.3	3.2	3.2
10.	Total Hardness	22.4	28	21.5
11	Chloride	29.31	57.52	29.12
12.	TDS	101	185	99.2
13.	Surface tension	73.45	73.49	73.44
14.	Viscosity	0.01138	0.01139	0.01137
15.	Alkalinity	No	110	No

All the values are in mg/lit except pH, TDS (ppm), surface tension (dyne/cm), viscosity(poise), conductivity(µmho/cm) and temperature (^0C).

Table-3: Variation in Physico-chemical parameter of Govind Sagar Lake (G.L.) H.P.

JANUARY 2014				
Sr. No.	**Sampling Status Parameter Used**	**S_1 (G.L.)**	**S_2 (G.L.)**	**S_3 (G.L.)**
1.	Water temperature	14.7	14.5	14.5
2.	Colour	Light Greenish	Light Greenish	Light Greenish
3.	Odour	Odourless	Odourless	Odourless
4.	Ph	3.13	6.0	3.08
5.	Conductivity	105.2	60.2	62.5
6.	Dissolved oxygen	2.01	2.5	2.3
7.	BOD	0.791	1.015	0.790
8.	COD	1.09120	0.0828	0.081
9.	CO_2	4.4	3.3	3.3
10.	Total Hardness	22.1	28.2	21.3
11.	Chloride	30.12	56.73	30.01
12.	TDS	105	190	102
13.	Surface tension	73.44	73.48	73.43
14.	Viscosity	0.01131	0.01130	0.01132
15.	Alkalinity	No	125	No

All the values are in mg/lit except pH, TDS (ppm), surface tension (dyne/cm), viscosity (poise), conductivity (µmho/cm) and temperature (^0C).

Table-4: Variation in Physico-chemical parameter of Govind Sagar Lake (G.L.) H.P.

FEBURARY 2014				
Sr. No.	**Sampling Status Parameter Used**	**S_1 (G.L.)**	**S_2 (G.L.)**	**S_3 (G.L.)**
1.	Water temperature	18.8	18.5	18.5
2.	Colour	Light Greenish	Light Greenish	Light Greenish
3.	Odour	Odourless	Odourless	Odourless
4.	Ph	3.57	6.27	3.35
5.	Conductivity	119.2	76.2	77.1
6.	Dissolved oxygen	1.95	2.4	2.2
7.	BOD	0.795	1.121	0.791
8.	COD	1.296	1.05	0.092
9.	CO_2	4.5	3.4	3.4
10.	Total Hardness	23.4	30.5	22.1
11.	Chloride	29.62	54.62	28.32
12.	TDS	109	192	107
13.	Surface tension	73.07	73.12	73.06
14.	Viscosity	0.01122	0.01121	0.01123
15.	Alkalinity	No	130	No

All the values are in mg/lit except pH, TDS(ppm), surface tension(dyne/cm), viscosity(poise), conductivity(µmho/cm) and temperature (^0C).

Table-5: Variation in Physico-chemical parameter of Govind Sagar Lake (G.L.) H.P.

MARCH 2014				
Sr. No.	**Sampling Status Parameter Used**	**S_1 (G.L.)**	**S_2 (G.L.)**	**S_3 (G.L.)**
1.	Water temperature	20.3	20	20
2.	Colour	Light Greenish	Light Greenish	Light Greenish
3.	Odour	Odourless	Odourless	Odourless
4.	PH	3.59	6.25	3.38
5.	Conductivity	120.1	77.5	105.5
6.	Dissolved oxygen	1.90	2.3	2.1
7.	BOD	0.794	1.121	0.793
8.	COD	1.421	1.17	0.099
9.	CO_2	4.6	3.5	3.5
10.	Total Hardness	22.9	32.9	22.3
11.	Chloride	30.52	51.93	30.12
12.	TDS	150	251	157
13.	Surface tension	72.79	72.91	72.81
14.	Viscosity	0.0105	0.0109	0.0107
15.	Alkalinity	no	131	No

All the values are in mg/lit except pH, TDS (ppm), surface tension (dyne/cm), viscosity (poise), conductivity (µmho/cm) and temperature (^0C).

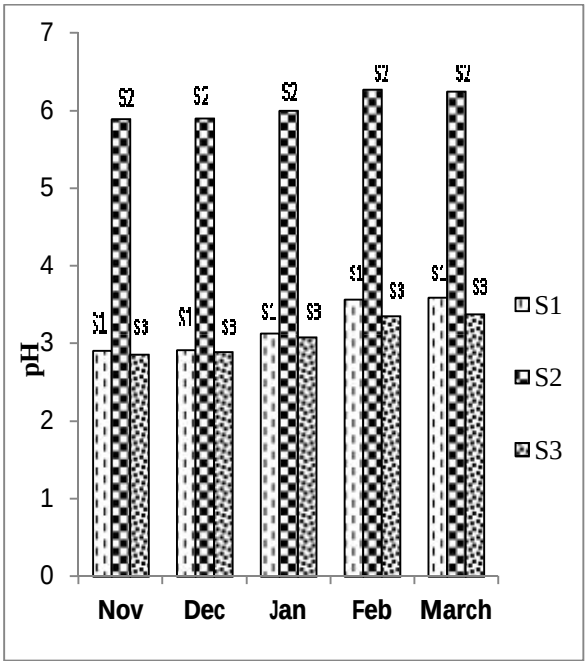

Figure 1: Monthly variation in pH during Nov. to March 2014.

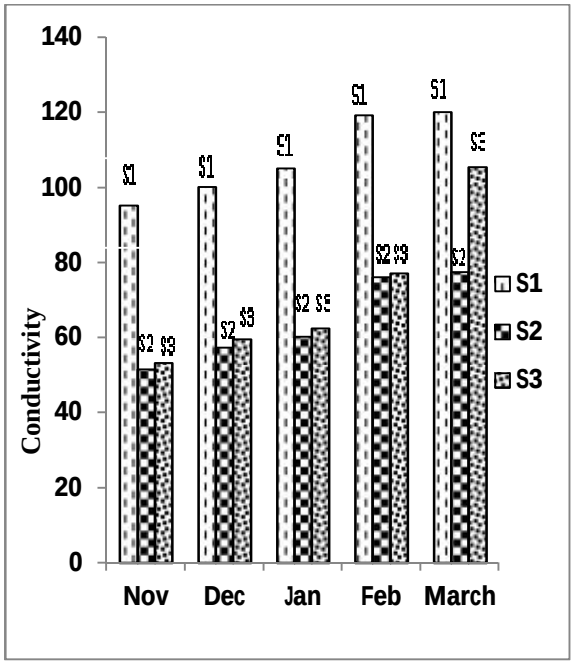

Figure 2: Monthly variation in conductivity during Nov. to March 2014

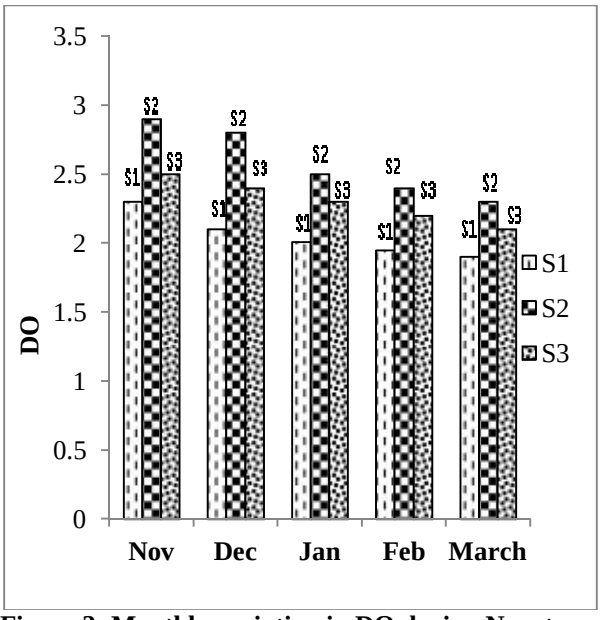

Figure 3: Monthly variation in DO during Nov. to March 2014.

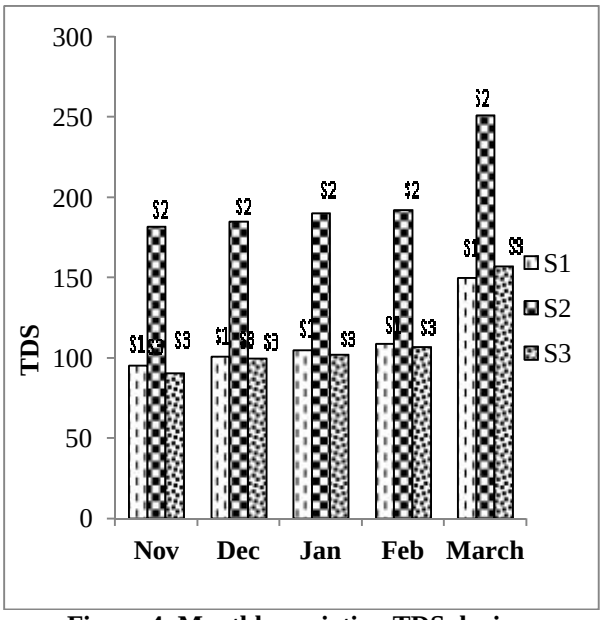

Figure 4: Monthly variation TDS during Nov. to March 2014

The results obtained were analyzed, compared with the WHO standards and discussed in brief, which had played a conclusive role in deciding the status of water quality of lakes under study.

1. Water temperature: The air and water temperatures have a direct effect on free CO_2, Acidity, pH, Nitrate and other parameters; show a slight variation during the seasonal changes. A minimum temperature of 13.0ºc in November and a maximum of 20.0ºc temperatures in March was recorded of the lake. The water temperatures are within optimum range of aquatic life supporting system in the water bodies and always higher than that of the air temperature due to its natural slow cooling phenomenon and intermolecular interaction occurring due to the wind action.

2. pH: pH of Govind Sagar lake varies from 2.86 to 6.28 maximum at station 2 in March and minimum at station 3 in November. It is found a slight acidic as well as basicity of water it may be due to addition of chemical pollutants from agriculture waste.

3. Conductivity: Conductivity is due the dissolved cation and anions in the water samples. The conductivity of Govind Sagar lake varies from51.5 to 120.1, minimum is at station 2 in November and maximum at station 1 in March. At this station addition of chemical pollutants of urban, weed infestation may take place.

4. Chloride: Chloride of Govind Sagar lake is varies from 30.12 to 63.5 minimum at station 3 in November and maximum at station 2 in March.

5. Total Hardness: Hardness of water is due to salts of Ca and Mg. Total hardness of Govind Sagar lake varies from 20.1 to 32.9 minimum is at station 3 in November and maximum is at station 2 in March.

6. COD: The chemical oxygen demand Govind Sagar lake varies from 0.0501 to 0.421, minimum is at station 3 in November and maximum is at station 1 in March.

7. Dissolve Oxygen: Dissolved oxygen reflects the status, physical and biological process in water, shows the metabolic balance and D.O. level acts as an indicator of water body. DO of Govind Sagar lake is varies from 1.90 to 2.9, minimum is at station 1 in March and maximum is at station 2 in November.

8. **BOD:** BOD of Govind Sagar lake varies from 0.512 to 1.121, minimum is at station 3 in November and maximum is at station 2 in March.

9. **CO_2:** The free CO_2 concentration change may be due to the micro bacterial activities, increase in temperature & biochemical reactions. CO_2 of Govind Sagar lake varies from 3.1 to 4.6, minimum is at station 2, 3 in November and maximum is at station 1 in March

10. **Surface tension**: Surface tension of Govind Sagar lake varies from 72.79 to 73.59 , minimum is at station1 in march and maximum is at station 2 in November.
11. **Viscosity:** Viscosity of Govind Sagar lake varies from 0.0105 to 0.0123, minimum is at station 1 in March and maximum is at station 3 in November.
12. **Alkalinity:** Alkalinity of Govind Sagar lake varies from 109 to 131, minimum is at station 2 in November and maximum is at station 2 in March.
13. TDS: The high TDS may adversely affect water quality by increasing the density of water, changing the osmoregulation and thus reduce the solubility of the gas and utility of water for drinking, irrigation, industries and other domestic purpose. TDS of Govind Sagar Lake varies from 95.2 to 251, minimum is at station 1 in November and maximum is at station 2 in March.

CONCLUSION

The man made activities, anthropogenic stress have a considerable effect on the physico–chemical characteristics of water and sediments of the lakes and affected the status of the water quality of the study sites. Some of the parameters are above the permissible limits which have made its water unsuitable for human consumption. However the water seems to be suitable for agriculture and other domestic needs during all seasons. The results reveal that the lakes water is polluted and the cumulative efforts to protect water bodies by bringing the National Lake Conservation Plan into action and creating awareness about its effect on health and environment.

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