Evaluation of Designated Best Use of Draupadi Taal Lake Panchkula, Haryana

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Abstract: Of 2.5% of fresh water on earth only 1% is accessible to humans which has become very less in quantity as compared to the ever increasing population of the world. There are many sources of water such as rivers, lakes, springs, wells, tube wells etc., out of these sources lakes and rivers can be considered as the two most important surface water sources available to the mankind for fulfilling the needs of increasing human population. Lakes act as the storehouse of fresh and potable water but the condition of this water resource has been deteriorating due to anthropogenic activities constantly posing a threat to the water quality of this resource. As the population increases it becomes necessary to either maintain the existing sources of water or to develop the new potential sources which can serve as a source of water at times of need.

Draupadi Taal Lakeis a sacred lake located near Morni Hills in Panchkula and can serve as a potential water source for the nearby towns during peak demands. The lakes is used for washing, cleaning and light irrigation purpose at local scale but the lakes once developed as a water source can be utilized for the other specific purposes as well around the place. In this regard the Designated Best Use (DBU) developed by Central Pollution Control Board (CPCB) can be of great help.The DBU defines the criteria for defining the uses of the water bodies based on certain parameters such as Biological Oxygen Demand (BOD), pH, Dissolved Oxygen (D.O.), Total Coliform, Ammonia, Conductivity and Sodium Absorption Ratio(SAR) which can be tested after sampling the lakes and compared with standards given in the DBU table for declaring the fitness of the water body to be used for drinking with or without treatment, bathing, recreational activities, irrigation and propagation of wildlife etc

The paper presents characteristics of water samples collected from the lake at variable depths to determine various parameters that can be compared with the standards prescribed in the DBU table and hence the designated uses of the lakes can be determined. This is the first step for the classification of lake as a potential water source. The depth sampling is important for knowing the extent of pollution so that the degree and extent of usage can be planned accordingly.

The study is elaborative and would also include water quality Index (WQI) calculations (depth wise) along with sampling and testing to be carried for duration of one year. As it is the initial phase of the project the paper would only consist of results of sampling and testing for determination of DBU of the lakes.

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Keywords: *Anthropogenic Activities, Designated Best Use(DBU), Central Pollution Control Board (CPCB), Biological Oxygen Demand (BOD), Dissolved Oxygen (DO), Sodium Absorption Ratio (SAR), Water Quality Index (WQI).*

I. Introduction

Water is an important component for sustenance of life. It contains all the necessary nutrients and minerals needed by humans for existence of life (Versari et al., 2002). There are many sources of water on earth but the main sources of fresh water are mainly springs, rivers and lakes (Bhateria et al., 2016).The quality of any water body is mainly dependent on the geology of earth surface in the area as well the human activities around the place which are mainly related to agriculture, construction, waste disposal and other such related factors (Tamiru, 2004; Mahananda et al., 2010; Mehari and Mulu, 2013) which mainly effect the quality of water at the place(Tank and Chippa, 2013). The geological factor may further contaminate the water adding dissolved and suspended impurities into the water through infiltration from the soil reducing the potability of water(Hartman et al., 2005)andtherefore the physico-chemical parameters not only vary spatially but also temporally and hence needs to be studied in greater detail (Wang and Yang, 2008).In this respect lakes are considered to be one of the great sources of fresh water and are usually divided into either man made or natural(Yogendra et al., 2008).The one alarming issue of today is the problem of water scarcity which makes it mandatory to characterize the lake for the purpose of restoration and improvement (Cosgrove et al., 2015).The aim of the determination of various parameters is to determine the present status of water quality in the area as well as to forecast the futuristic trends of these hydrological modifications (Thitame et al., 2010).The major purpose of classification of water body after analysis of parameters according to Designated Best Use (DBU) table by CPCB is to characterize the water body after comparison with the necessary guidelines (CPCB guidelines, 1978).

II. Materials and Methodology/Study Area and Methods

The Draupadi Taal is located near the Morni hills of Panchkulaat an altitude of 30° 42'N 77°5'Eand is one of the best known weekend getaways around Chandigarh because of a short distance from the city and a pleasant climate all the year around.
The lake is considered to be sacred and a temple is built along shore where offerings are made every day. The lake is located at a height of 4,157 feet from sea level. The lake has length & breadth of 365 meters with a depth of about 4-5 meters. The lake was earlier thought to have a depth of about 8-10 meters but the depth has considerably reduced due to continuous inflow of sediments into the lake either from nearby farms or along with the influx of water from the source into lake.

The lake was earlier used by Haryana Fisheries department for pisciculture but now the lake is not used ***for any purpose*** except for religious offerings and light irrigation by locals on their own levels. The population of the place is about 1200-1300 people with light tourist flow throughout the year.

There is a considerable amount of water in the lake throughout the year. The average influx of water from the source which is located at a hill nearby in form of a waterfall is for about 4-5 months from August to December. The lake being an excellent source of fresh-water has been

lacking all the attention from the government & is getting reduced in size due to constant siltation thereby causing a concern to locals of the place which consider the lake to be a pious one.
Figure 1 shows the top view of Draupadi Tall which has been sampled for the detailed analysis and Figure 2 shows the sampling points S1, S2 and S3 from where samples were collected for detailed analysis.

Fig 1 shows a 3 D view of the Draupadi Taal located at Morni hills in Panchkula.

The lake samples were collected in the month of August after the first shower for the determination of the concerned parameters. The physical, chemical and biological parameters were considered for analyses of lake water quality. the sampling was done from 3 sampling points located in the lake at considerable distance from each other for covering throughout area of the lake. The first sampling point was taken near the farms, the second sampling point was taken at the center of the lake and third sampling point was taken near the forest trees around the lake.

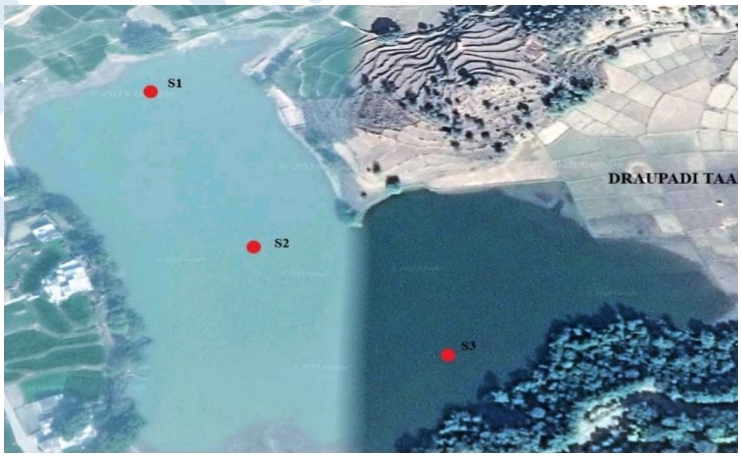

Fig 2 Sampling points (S1, S2 and S3) in Draupadi Taal for water sampling.

The samples were collected using the boat which was hired from the fisheries department and the sampler was used for collection of water at a 1m depth. The sampler was tied with a graduated rope and the sample was the collected. The samples were stored in a clean PVC bottle for physical and chemical analysis namely BOD, DO, Ammonia, Nitrate, Nitrite, Electrical Conductivity (EC), Total Dissolved Solids (TDS) and a glass BOD bottle with a glass plug at 4 °C for biological analysis namely Total & Fecal Coliforms. The EC, pH, DO and Temperature were recorded onsite through portable meters whereas the rest of the parameters were determined in the laboratory through standard APHA procedures.

Table 1 elaborates the Designated Best Use, Class of water quality and water quality criteria for the depiction of a water body, so that the water body can be used at its finest.

DBU	Class of water quality	Criteria for quality of water
potable water resource with chlorination but lacking any conventional treatment	A	1. Total coliform group count (MPN/100 ml)- 50 or less. 2. pH 6.5 to 8.5. 3. D.O. ≥ 6 mg/l . 4. BOD <2 mg/l.
Bathing outdoors (organized)	B	1. Total coliform group count (MPN/100 ml) organism shall be ≤ 500. 2. pH = between 6.5 & 8.5. 3. D.O. ≥ 5 mg/l 4. B.OD. < 3 mg/l.
Potable water source with treatment	C	1. Total coliform group count (MPN/100 ml) organism ≤ 5000 . 2. pH = 6.5 to 9. 3. D.O. ≥ 4 mg/l 4. B.OD. ≤ 3 mg/l
Development of Wildlife & fisheries.	D	1.pH between 6.5 & 9. 2. D.O. ≥ 4 mg/l 3. NH_3 (in form of Nitrogen) ≤ 1.2 mg
Irrigation, controlled Disposal & cooling in industries	E	1.pH between 6.0 & 8.5. 2. E. C. < 2250 micromhos/cm. 3. SAR < 26 4. Boron (B) quantity < 2 mg/l.

Table 1: Description of Designated best use for water (CPCB 1978, Vasistha and Ganguly, 2019)**.**

II. Results and Discussion

Values of various parameters that were evaluated through experimentation at all the three sampling points and the average values were then taken to obtain a single value for comparison with the data are presented in Table 2.Table 2 gives the necessary values of parameters obtained through the sampling and experimentation procedures.

Parameters	Sampling point 1 (S1)	Sampling point 2 (S2)	Sampling point 3 (S3)	Average value
pH	7.48	7.10	7.35	7.31
Temperature (°C)	27.9	28.7	29.4	28.66
DO (mg/l)	4.12	3.41	3.71	3.74
BOD (mg/l)	0.8	0.7	0.7	0.73
TDS (ppm)	74	65	99	79.33
E.C. (µmhos/cm)	145	132	201	159.33
Total Coliform	0	0	0	0
Boron	-	-	-	-
NO_3	-	-	-	-
NO_2	-	-	-	-
NH_4	-	-	-	-

Table 2: Physical, chemical & Biological Parameter values of Draupadi Lake Water.

The Table 3 gives the comparative results of the data presented in Table 2 after experimentation and the criteria described in Table 1 to give a detailed analysis of the Designated Best Use of Draupadi Lake for its best & suitable utilization for the various purposes such as bathing, drinking, outdoor activities, irrigation, development of fisheries, industrial cooling and waste disposal.

DBU	Class	Average parameter value	Criteria for quality of water	Status
Drinking water source with chlorination but without treatment	A	1. Total Coliform – 0	1. Total coliform group count (Most Probable Number /100 ml) ≥ 50	OK
		2. pH- 7.31	2. pH between 6.5 to 8.5.	OK
		3. DO- 3.74	3. D.O. ≥ 6 mg/l.	NOT OK

		4. BOD- 0.73	4. BOD <2 mg/l.	OK
Bathing outdoors (organized)	B	1.Total Coliform- 0	Total coliform group count (MPN/100 ml) organism shall be ≤ 500.	OK
		2. pH- 7.31	2. pH between 6.5 & 8.5.	OK
		3. DO- 3.74	3. Dissolved Oxygen (D.O.) – 5 mg/l or more.	NOT OK
		4. BOD- 0.73	4. B.OD. < 3 mg/l.	OK
Potable water source with treatment	C	1. Total Coliform- 0	1. Total coliform group count (MPN/100 ml) organism ≤ 5000.	OK
		2. pH- 7.31	2. pH between 6.5 & 9.	OK
		3. DO- 3.74	3. D.O. ≥ 4 mg/l	NOT OK
		4. BOD-0.73	4.Biological Oxygen Demand (B.OD.) ≤ 3 mg/l	OK
Development of Wildlife & fisheries.	D	1. pH- 7.31	1. pH between 6.5 & 9.	OK
		2. DO- 3.74	2. D.O. ≥ 4 mg/l	NOT OK
		3. NH_3 (as N)- nil	3. NH_3 (in form of Nitrogen) ≤ 1.2 mg	OK
Irrigation, controlled Disposal& Industrial Cooling	E	1.pH- 7.31	1. pH between 6.0 & 8.5.	OK
		2. E.C. – 159.33	2.ElectricalConductivity < 2250 micromhos/cm.	OK
		3. SAR- NA	3. SAR < 26	OK
		4. Boron- NILL	4. Boron (B) < 2 mg/l.	OK

(NA- Not available)

Table 3: Comparison of the necessary parameters for evaluation of DBU.

The table above clearly shows the results of various experiments and also the suitable comparison to obtain the best use of lake water.Total coliform test was performed through standard testing procedure as per APHA, it was seen that no visible colony formation was observed even on 2nd, 3rd and 4th day therefore confirming a lack of total coliform presence and fitness in all the three categories namely A,B & C.The pH test was done onsite using portable pH

meter the average value of pH was determined to be 7.31 which is well between the ranges described in categories A,B,C, D & E.The portable DO meter was used for determination of DO as well as temperature. The value of DO was not fit for any category as per the regulationsdescribed in the Table 3. The BOD was done in the laboratory using standard APHA procedures and the value was much below the described values of 2 mg/l for category A and 3 mg/l for category B&C.The Ammonia was calculated using APHA method of calorimetry; the value was negligible for all the samples showing fitness in category D.The electrical conductivity calculated using portable meter was evaluated to be 159.33micromhos/cm quite below the permissible value. The boron was determined using standard APHA procedure of UV absorption at value of 540 nm and 670 nm. The boron value was negligible making water fit for usage in category E. The SAR value is unavailable for the samples.

V. Conclusions and Recommendations

The parameters such as Total coliform DO, pH, BOD, EC, NH_3, SAR and Boron were evaluated using onsite equipment and standard laboratory procedures.The evaluated parameters for the different DBU characteristics meet all the requisite conditions except DO values were well within the permissible limits. However, since the DO values were not met, the water in the lake cannot be classified within the DBU categories A-D. The parameters in the DBU category E such as pH, EC, SAR and Boronwere well below the permissible values therefore water can be presently classified under category E of the DBU classification system. In particular, DO valueof 3.74mg/l is significantly less than limits for category A-D due to proper lack of circulation of water and total stagnation of the water.However, the results presented are based on study for one month and hence it is expected that the DO might improve in the coming months as per reported literature. Therefore, presently it can be concluded that the water is fit to be used forClass E (irrigation, industrial cooling and controlled disposal).

In the rest of the categories the water can only be used after application of necessary techniques for DO improvement is applied.

Acknowledgements

I would like to thank the local people of the lake site for extending a helping hand for sample collection and for providing useful information about the site. I would also like to thank fisheries department for allowing the use of their boat and the Sarpanch of the area for giving his support and co-operation.

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