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Seasonal Variation in the Water Quality of Lahru Pond Located In Himachal Pradesh

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ABSTRACT
In the present study water of Lahru pond was analyzed for various physicochemical parameters. The study was carried out for a period of one year. Monthly data has been collected and were represented seasonally along with standard error. Pollution is viewed as the release of substances and energy as waste product of human activities which result in harmful changes within the natural environment. Different parameters taken in the study were Temperature, Electrical conductivity, Turbidity, Total dissolve solids, pH, Alkalinity, Total Hardness, Calcium, Magnesium, Dissolved Oxygen, Biochemical oxygen demand, Chloride, Sodium, Nitrate and Phosphate. Therefore from the above result it was concluded that water of Lahru Pond Tehsil Jawali District Kangra (H.P.) shows very high level of pollution.
KEYWORDS: Lahru pond, Water Quality,

I. INTRODUCTION

Pollutants are defined as the substances which cause pollution. They can be physical or chemical.Each pond system is unique, and its dynamics can be understood only to a limited degree based on information from other ponds. Just as a physician would not diagnose an individual's medical condition or prescribe treatment without a personal medical examination, a limnologist or hydrologist cannot accurately assess a pond system or suggest a management strategy without data and analysis from that particular pond and its environment. The study was carried out to check the pollution status of Lahru Pond. Lahru Pond is located in Kangra district of Himachal Pradesh city.

Lahru Pond is an artificial pond. It is located in the northern part of Kangra district of Himachal Pradesh city. The half portions of the pond become dry during the summer season. The people in the surrounding region use to throw waste into the pond and the cattle also take bath in the pond. The pond covers an area of 9,940 m^2.

II. MATERIAL AND METHODS

The present study was carried out for Lahru Pond, located in Kangra district of Himachal Pradesh. In the present study the sampling was done during morning hour. The water samples were collected in the polyethylene bottles. The closed bottle was dipped in the pond at the depth of 0.5 to 0.7 m, and then a bottle was opened inside and was closed again to bring it out at the surface. The samples were collected from five different points and were mixed together to prepare an integrated sample. From the time of sample collection to the time of actually analyses, many physical and chemical reactions would change the quality of the water sample; therefore to minimize this change the sample were preserved soon after the collection. The water samples were preserved by adding chemical preservatives and by lowering the temperature. The water temperature, pH, DO, EC and TDS were analyzed immediately on the spot after the collection, whereas the analyses of remaining parameters were done in the laboratory.

The study was carried for a period of 1 year (March 2012 to February 2013). Monthly data was collected, but results were represented season wise. Four month make one season [March to June summer season, July to October monsoon season, and November to February winter season].The collected water samples were brought to the laboratory and relevant analysis was performed. pH was determined electrometrically using digital pH meter, electrical conductivity was measured by conductivity meter, dissolved oxygen is measured by DO meter, total dissolve solid was measured by using TDS meter and similarly turbidity is measured by Nepthalo turbidity meter. Alkalinity, chloride, TDS, calcium, magnesium, total hardness, nitrate and phosphate were determined by method suggested by [1] [2] [3]. Estimation of sodium was done by Flame Photometric method.

III. RESULT AND DISCUSSION

3.1 **Temperature**

Temperature is one of the most important factors in the aquatic environment [4].The temperature plays a crucial role in physico-chemical and biological behavior of aquatic system [5]. The temperature of Lahru Pond ranges between 5 ±1.47 to 22 ±1.58. The maximum temperature was recorded during summer season and minimum was recorded during winter season.

Generally water temperature correspond with air temperature indicating that the samples collected from shallow zone has a direct relevance with air temperature, shallow water reacts quickly with changes in atmospheric temperature [6] [7] [8] [9] [10] [11].

3.2 **Electrical Conductivity**

Electrical conductivity in the water is due to salt present in water and current produced by them. It measures the electric current which is proportional to mineral matter present in water. A high level of conductivity reflects on the pollution status as well as trophic levels of the aquatic body [12]. Conductivity of water depends upon the concentration of ions and its nutrient status and variation in dissolve solid content. Electrical conductivity recorded in Lahru Pond ranges between 2.65 ±0.07 to 3.38 ±0.26. The high value of conductivity was recorded during monsoon season were as low value was recorded during summer season.

. Therefore aquatic plants are in very rare amount in monsoon season, thus electrical conductivity is more in monsoon because water is free from vegetation and aquatic life therefore all the ion are accumulated in water. The water during the summer decrease as a result some of the aquatic plant got destroyed and very few plants remain in the water The decomposition of plants and animals released the ion back in water[13].

3.3 Turbidity

Turbidity is the measure of the light scattered by suspended particles. It is due to the substances not present in the form of solution. Clay, slit, organic matter, phytoplankton and other microscopic organisms cause turbidity in pond water [14]. Light penetration is also highly affected by turbidity. Turbidity in Lahru Pond recorded ranges between 14 ±1.47 to 18 ±0.91. The maximum turbidity in water was recorded during monsoon season and minimum turbidity was recorded during summer season.

High turbidity in pond water during monsoon season is due to addition of sand, clay, slit, dung and various other pollutant along with rain water from the surrounding area into the pond [15] [16] [17] . High turbidity during monsoon season may be due to inflow of storm water from the surrounding area [18] [19].

3.4 Total Dissolve solids

In natural water dissolved solids are composed mainly of carbonates, bicarbonates of calcium, magnesium, sodium, potassium, iron and manganese etc. Total dissolved solids denote mainly the various kinds of mineral present in the water. Dissolved solid do not contain any gas and colloids. The amount of total dissolve solid in Lahru Pond ranges between 942 ±23.5 to 1294 ±44. The maximum amount of total dissolve solid was recorded during monsoon season and minimum was recorded during winter.

The high value of TDS during monsoon may be due to addition of domestic waste water, garbage and sewage etc. in the natural surface water body. Indeed, high concentration of TDS enriches the nutrient status of water body which was resulted into eutrophication of aquatic ecosystem [5] [20].

3.5 pH

pH measure the concentration of hydrogen ion in water. It is the measurement of acidity or alkalinity. Generally in India many small confined water pockets particularly, are alkaline in nature [21].The pH value ranges between 8.5 ±0.17 to 9.4 ±0.18. The maximum pH was recorded during monsoon and minimum pH was recorded during summer season.

High pH values promote the growth of algae and results in heavy bloom of phytoplankton [22] [23] [24] [25]. The pH values above 8 in natural water are produced by photosynthetic rate that demand more CO_2 than quantities furnished by respiration and decomposition [26]. The pH of water also depends on the relative quantities of calcium, carbonate and bicarbonate.

3.6 Alkalinity

The change in alkalinity depends on carbonates and bicarbonates, which in term depend upon release of CO_2.Alkalinity in natural water is due to free hydroxyl ion and hydrolysis of salts formed by weak acid and strong bases and also due to salt containing carbonates and bicarbonates silicate and phosphate along with hydroxyl ion in the Free states. Change in carbonates and bicarbonates also depend upon release of CO_2 through respiration of living organisms. The amount of total alkalinity in Lahru Pond ranges between 188 ±3.45 to 216 ±5.22. The minimum value of alkalinity was recorded during summer season and maximum value was recorded during monsoon season

The degradation of plants, living organism and organic waste might also be one of the reasons for increase in a carbonate and bicarbonate, resulting an increase in alkalinity value [27] [28] [29]. The addition of large amount of sewage waste and organic pollutant in the pond also effect photosynthesis rate, which also result in death of plants and living organism. Increase in alkalinity during monsoon was due to input of freshwater and dissolution of calcium carbonate ions in the water column [30].

3.7 Total Hardness

Hardness of water is not a specific constituent but is a variable and complex mixture of cations and anions. Water hardness is the traditional measure of the capacity of water to react with soap, hard water requiring a considerable amount of soap to produce lather. The total hardness recorded in the water of Lahru Pond ranges between 298 ±4.58 to 342 ±8.36. The maximum amount of total hardness in the water of Lahru Pond was recorded during monsoon season and minimum amount was recorded during winter season.

Total hardness is mainly due to calcium magnesium and eutrophication [31]. The high value of hardness during monsoon may be due to presence of high content of calcium and magnesium in addition to sulphate and nitrate in the sewage waste added during monsoon [32] [33].

3.8 Calcium

Calcium is an important nutrient for aquatic, organism and it is commonly present in all water bodies [16]. The amount of calcium in the water of Lahru Pond ranges between 62 ±2.84 to 86 ±3.88. The maximum amount of calcium in the water of Lahru Pond was recorded during monsoon season and minimum amount was recorded during winter season.

Calcium is present in water naturally, but the addition of sewage waste might also be responsible for the increase in amount of calcium [32] [34]. The decrease in amount of calcium may be due to its absorption by living organisms.

3.9 Magnesium

Magnesium is found in various salt and minerals, frequently in association with iron compound. Magnesium is vital micronutrient for both plant and animal. Magnesium is often associated with calcium in all kind of water, but it concentration remain generally lower than the calcium [35]. Magnesium is essential for chlorophyll growth and act as a limiting factor for the growth of phytoplankton [18]. In Lahru Pond the amount of magnesium recorded ranges between 28 ±2.64 to 36 ±2.32. The maximum amount of magnesium in the water was recorded during winter season and minimum amount was recorded during summer season

Decrease in level of magnesium reduces the phytoplankton population [36] suggested that the considerable amount of magnesium influence water quality. Magnesium is essential for chlorophyll bearing plant. Magnesium enters into combination with anions other than CO_2 in ponds such as chloride and sulphate [37]. Various sub-processes like bating, picking, tanning, dyeing and fat liquoring causes water pollution [38]. Magnesium is vital micronutrient for both plant and animal.

3.10 Dissolved Oxygen

The solubility of oxygen also decreases with increasing salinity of water. The oxygen in water can be dissolved from air or is produced from the photosynthetic organism like algae and aquatic plants oxygen is poorly soluble gas in water and it solubility depend on the temperature of water and its partial pressure. [39] has established a direct relationship between photosynthesis and dissolved oxygen. Measurement of dissolved oxygen is a primary parameter in all pollution studies. The amount of dissolved oxygen recorded in the water of Lahru Pond ranges between 2.06 ±0.07 to 5.32 ±0.12. The minimum amount of dissolved oxygen in the water of Lahru Pond was recorded during winter season whereas maximum amount was recorded during monsoon season

The high temperature and addition of sewage and other waste might be responsible for low value of DO [40] [41]. Depletion of dissolve oxygen in water is due to high temperature and increased microbial activity [42]. Dissolve oxygen with high value observed during monsoon may be as a result of the increased solubility of oxygen at lower temperature [43].

3.11 Biochemical oxygen demand

BOD refers the oxygen used by the microorganism in the aerobic oxidation of organic matter. Therefore with the increase in the amount of organic matter in the water the BOD increases. The BOD value in Lahru Pond ranges between 1.82 ±0.08 to 3.42 ±0.34. The minimum demand of oxygen in the water was recorded during summer season, whereas maximum demand was recorded during monsoon season

The higher value of BOD during monsoon was due to input of organic wastes and enhanced bacterial activity [44]. The reason of high BOD in monsoon might also be due to presence of several microbes in water bodies, which accelerate their metabolic activities with the increase in concentration

of organic matter in the form of municipal and domestic waste which was discharge into water bodies and so the demand of oxygen increased [45].

3.12 Chloride

The greater source of chlorides in pond water is disposal of sewage and industrial waste. Human body release very high quantity of chlorides through urine and fasces. The chloride concentration was used as an important parameter for detection of contamination by sewage. Prior to development of bacteriological and other test like BOD and COD. The amount of chloride recorded in the water of Lahru Pond ranges between 84 ±4.92 to 126 ±4.67. The minimum amount of chloride in the pond water was recorded during winter season and the maximum amount was recorded during summer season.

The higher concentration of chloride during summer month may be associated with frequently run-off loaded with contaminated water from the surrounding [46] [47]. The high chloride concentration of the pond water may be due to high rate of evaporation [48] or due to organic waste of animal origin [49].

3.13 Sodium

Sodium is a natural constituent of raw water, but its concentration is increased by pollution sources such as rock salt, precipitation runoff, soapy solution and detergent. The amount of sodium recorded in the water of Lahru Pond ranges between 36 ± 4.97 to 68 ±2.89. The minimum amount of sodium in the water of Lahru Pond was recorded during winter and maximum amount was recorded during monsoon season

The high level of sodium during monsoon may be attributed to the rain water as it carries the salt dissolved from the surrounding area [50]. The addition of waste water containing soap solution and detergent from the surrounding slummy area are also responsible for the increase in sodium level in the water bodies.

3.14 Nitrate

Nitrates are contributed to freshwater through discharge of sewage and industrial wastes and run off from agricultural fields. Some ground waters naturally have high nitrate concentration. In Lahru Pond the amount of nitrate recorded ranges between 5.4 ±0.18 to 7.6 ±0.22. The minimum amount of nitrate in the water of Lahru Pond was recorded during summer season, whereas maximum amount of nitrate in the water was recorded during monsoon season.

The high nitrate concentration during monsoon might be due to influx nitrogen rich flood water that brings about large amount of contaminated sewage waste. The monsoon season was the period with the highest nitrate-nitrogen concentration which is known to support the formation of blooms [51] [52] [53]. Nitrate content was higher in monsoon season, which can be attributed to the nitrate leached from the surrounding area. But lower concentration in summer was due to utilization by plankton and aquatic plants [54].

3.15 Phosphate

Excess amount of phosphate may cause eutrophication leading to extensive algal growth called algal blooms. Total phosphates in water include both organic and inorganic phosphates. Organic phosphates are part of living and dead plants and animal; over 85% of total phosphorous is usually found in organic form. In Lahru Pond the amount of phosphate recorded ranges between 1.18 ±0.05 to 1.96 ±0.11. The minimum amount of phosphate recorded in the water of pond was during winter season and the maximum amount was recorded during monsoon season.

The maximum value of phosphate during monsoon may be attributed to surface runoff during rainy season receiving huge quantity of domestic sewage, cattle dung and detergents from the surrounding catchment area. Catchment area activities are enriching phosphate in the pond [55]. The lower value of phosphate in summer month may be due to more uptake of phosphate for luxuriant growth of macophytes.

IV. CONCLUSION

Therefore comparing the result with [56] [57] standard it was concluded that water of Lahru Pond shows very huge level of pollution and similar condition continue the pond will soon become ecologically inactive.

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RESULT TABLE: LAHRU POND

Sr. no.	PARAMETERS	March 2012 – February 2013		
		Summer Mean + S.E.	**Monsoon Mean + S.E.**	**Winter Mean + S.E.**
1.	Temperature (^{0}C)	22 ±1.58	15 ±1.29	5 ±1.47
2.	Electrical conductivity (mhos/cm)	2.65 ±0.07	3.38 ±0.26	2.91 ±0.12
3.	Turbidity (NTU)	14 ±1.46	18 ±0.91	16 ±1.44
4.	Total Dissolve Solid (ppm)	1020 ±56	1294 ±44	942 ±23.5
5.	pH	8.5 ±0.17	9.4 ±0.18	8.8 ±0.06
6.	Alkalinity (ppm)	188 ±3.45	216 ±5.22	207 ±4.6
7.	Total Hardness (ppm)	314 ±4.70	342 ±8.36	298 ±4.58
8.	Calcium (ppm)	74 ±2.94	86 ±3.88	62 ±2.84
9.	Magnesium (ppm)	28 ±2.64	32 ±1.82	36 ±2.32
10.	Dissolved Oxygen (ppm)	2.06 ±0.07	5.32 ±0.12	3.22 ±0.36
11.	Biochemical Oxygen Demand (ppm)	1.82 ±0.08	3.42 ±0.34	2.42 ±0.34
12.	Chloride (ppm)	126 ±4.67	94 ±4.56	84 ±4.92
13.	Sodium (ppm)	44 ±3.65	68 ±2.89	36 ± 4.76
14.	Nitrate (ppm)	5.4 ±0.18	7.6 ±0.34	6.2 ±0.58
15.	Phosphate (ppm)	1.66 ±0.12	1.96 ±0.11	1.18 ±0.05

[S.E. = Standard error]