

Full Length Research Paper

A study of physico-chemical characteristics of three fresh water springs of Kashmir Himalaya, India

Manzoor Ahmad Sheikh¹, Idrees Yousuf Dar^{2*}, Sayar Yaseen^{1,2}, Amit Pal¹ and Ashok K. Pandit^{2,3}

¹Institute of Environment and Development Studies, Bundelkhand University, Jhansi – 284 128 (U.P), India.

²Department of Environmental Science, University of Kashmir, Srinagar-190006 (J&K), India.

³Centre of Research for Development, University of Kashmir, Srinagar-190006 (J&K), India.

Accepted 16 April, 2013

The present study was carried out on the physico-chemical analysis of three fresh water springs in district Pulwama of Kashmir Valley viz: Sandyasara naag (Ladhu), Batenaag (Khrew) and Sonaraaz naag (Shar). The samples were collected on monthly basis from January to June 2011. The various parameters were analyzed after APHA (1992) and Gupta (2004). The determined values of the three springs depicted slight variations for depth, pH, temperature, alkalinity, ammonical Nitrogen, Calcium hardness, chlorides, DO, free CO₂ and nitrite Nitrogen. However marked differences were observed for conductivity, orthophosphorous and magnesium hardness. Moreover the variations for total hardness and TDS depicted ascending and descending trend.

Key words: Springs, physico-chemical analysis, Ladhu, Khrew, Shar, Kashmir.

INTRODUCTION

A spring is a concentrated discharge of ground water appearing at the ground surface as a current of flowing water. Springs are formed where the ground surface intersects the water supply. Springs occur in many forms and have been classified as to cause, rock structure, discharge, temperature and variability. Spring water is one of the important sources of fresh water used for the survival of life. However, due to anthropogenic activities the water bodies are under constant threat and the need of the time is for their effective management. Although vast literature is available on the physico-chemical analysis of a vast array of fresh water bodies of Kashmir particularly of lakes and wetlands (Zutshi and Vass, 1971; Zutshi et al., 1972; Kaul, 1977; Kaul et al., 1978; Pandit, 1996). Yet, an attempt has been made to prepare a report on the physico-chemical parameters of the three fresh water springs of Pampore Tehsil of Kashmir valley sustainable use of these freshwater springs bestowed

to us.

MATERIALS AND METHODS

The water samples were collected monthly in air tight PVC bottles. The ambient air temperature was measured by mercury bulb thermometer while avoiding direct exposure to sunlight (Welch, 1952). The pH and conductivity were measured by pH and conductivity meters respectively (APHA, 1998) Whereas chloride was assessed by Argentometric Method, Nitrite nitrogen was determined by Diazotization Method, Nitrate nitrogen by Phenol Disulphonic Acid Method, Ammonical nitrogen by Phenate Method and Orthophosphate by Stannous Chloride reduced by phosphomolybdate Method (APHA, 1998).

Study area

Pulwama District, the Rice Bowl of Kashmir occupies an area of 1398 km² in the heart of Kashmir Valley and is enclosed by Srinagar, Budgam and Pahalgam districts. Pulwama is located at

32.88°N 74.92°E. It has an average elevation of 1630 m (5347 feet), population of 4.47 lakh. The whole district of Pulwama is rich in livestock which contribute to production of milk. The district is famous for its milk production. The present study was carried out on the spring water quality of three springs of the Tehsil Pampore in district Pulwama namely; Ladhu (Sandyasar Naag), Khrew (Batenaag), Shar (Sonaraaz), is located at 34.02°N 74.93°E. It has an average elevation of 1,574 m. The Pampore town is situated on the eastern bank of Veth also known as Jhelum (in Urdu). The village Ladhu is located in the south of the Srinagar city just 8 km from the Tehsil Pampore. The spring is commonly known as "Sandyasar nag" in between which there is the historical monument of 10th century known as sun temple. The main source of water is aquifer. Water sprouts directly from below the ground. The town Khrew is located in the south of the Srinagar city just 10 km from the Tehsil Pampore. The spring is commonly known as 'Naagbal' or 'Batenag'. In the Middle of the spring there is the historical monument of statues of Hindu God's. The whole Khrew area is called "Naag Shahaar" as there are some total 15 mini springs. The village Shar-i-Shali is located in the south of the Srinagar city just 11 km from the Tehsil Pampore. The spring commonly known as "Sonaraaz" is one of the oldest historical springs. Since the impact of anthropogenic activities on these water bodies is growing, present physico-chemical analysis of the water bodies was carried out.

RESULTS AND DISCUSSION

Physico-chemical characteristics not only reflect the quality of an aquatic ecosystem but also its biological diversity (Ghazan et al., 2006; Tas and Gonulol, 2007). In fact such abiotic features deliberate on the health status and productivity of an ecological system. The average value of physico-chemical analysis of water in the present study is depicted in the Table 1. The pH values show fluctuations within a range from a minimum of 7.76 (Shar) to a maximum of 8.23 (Ladhu). However the value for (Khrew) that is, 7.8 lies in between the two. The pH of all the springs is towards the basic level. The desirable limit for pH is 6.0 to 8.0; however some springs crossed the desirable limit. The fluctuations may be due to low rates of decomposition and good amount of calcium carbonates and magnesium in the area. Moreover, due to greater photosynthetic activity greater utilization of CO₂ is responsible for increased pH (alkaline). The electrical conductivity exhibited as a variation within a range from a maximum of 400.33 µs (Shar) to a minimum of 172.66 µs (Ladhu). However the value for (Khrew) that is, 239.33 lies in between the two. The electrical conductivity values shows fluctuations and may be due to the contamination from domestic sewage and inorganic fertilizer inputs (Kumar et al., 1996) and also may be due to bicarbonate and calcium ions present in the rocks there. The depth exhibited a variation within the range from a minimum of 1.5 ft (Shar) to a maximum of 2.93 ft (Ladhu). While the value for (Khrew) that is, 2.0 ft lies in between the two.

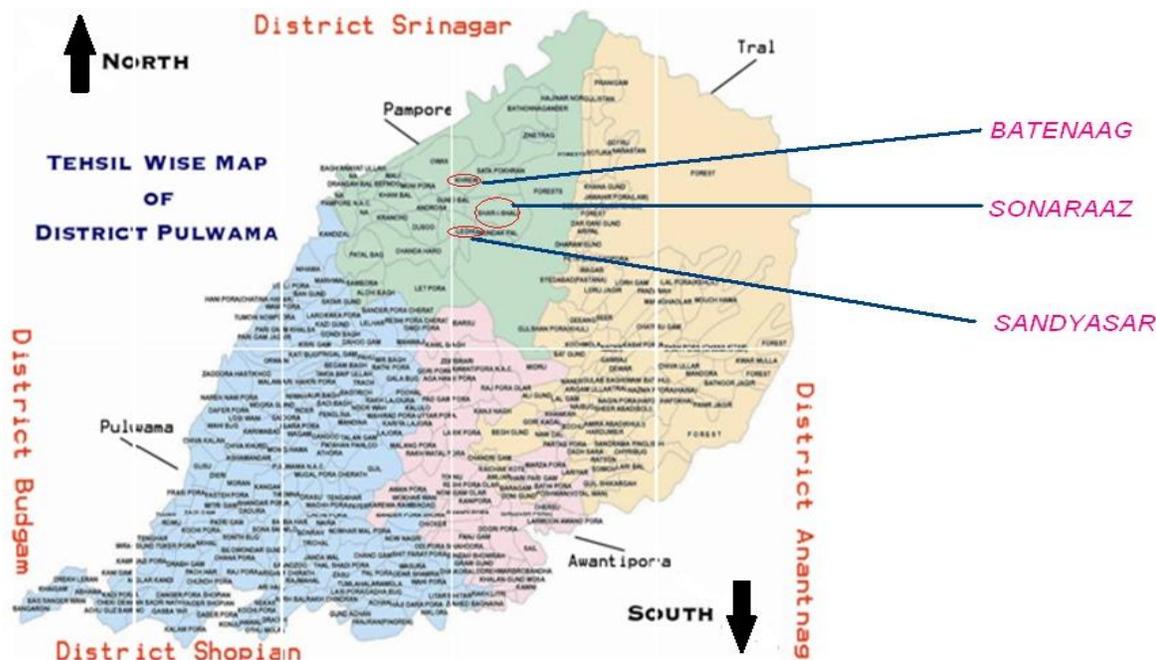
The variation in the depth may be due to the higher water table level and lower water table level due to the mining activities in the area and due to the presence of

seasonal variations. The values for temperature show variation within a range from a minimum of 4.33°C (Ladhu) to maximum of 5.33°C (Shar). While the value for (Khrew) that is, 5.0°C lies in between the two. The temperature values shows significant seasonal variation however the lower temperature may also be due to the shading effect of trees along the periphery of the spring like chinars and higher temperature may be due to the high pollution rates. The study gets further support from Pandit (1999).

The alkalinity shows variation within the range from a minimum of 42 mg/l (Khrew) to a maximum of 60 mg/l (Shar). While the value for (Ladhu) that is, 42.66 mg/l lies in between the two. Total alkalinity may be due to bicarbonates of calcium and magnesium in the springs. The richness of calcium in the springs owes its origin to the lacustrine deposits in the state (Pandit, 1999). The ammonical nitrogen values shows variation within a range from a minimum of 1.48 mg/l (Shar) to a maximum of 6.07 mg/l (Ladhu). However the value for (Khrew) that is, 2.67 mg/l lies in between the two. The fluctuations in the ammonical nitrogen values may be due to the presence of ammonia which results in pollution as a result of ammonification. Further due to the extensive use of soaps and detergents the water bodies have got most polluted in case of ammonical nitrogen. The fluctuations may also be due to decomposition of organic matter. The calcium hardness values shows variation within the range from a minimum of 13.73 mg/l (Shar) to a maximum of 21.30 mg/l (Ladhu). While the value for (Khrew) that is, 16.81 mg/l lies in between the two. The fluctuations showed the trend as, Shar < Khrew < Ladhu. The higher values of calcium and magnesium are in the rocks. Further, the springs owe its origin to the lacustrine deposits in the state. The chloride values show variation within the range from a minimum of 15.65 mg/l (Shar) to a maximum of 17.99 mg/l (Khrew). However the value for (Ladhu) that is, 17.32 mg/l lies in between the two. The chloride concentration exhibit small variation within the springs and the variation may be due to the same recharge zone and source of impurities that add chlorides. Bhatt and Yusuf (2002) have noted the chloride content of 36 mg/l in Sherebagh spring. The fractional variations of chloride in both springs depict the low level of pollution of animal origin (Thresh et al., 1976, c.f. The DO values shows variation within a range from a minimum of 5.33 mg/l (Khrew) to a maximum of 11.2 mg/l (Shar). While the value for (Ladhu) that is, 0.93 mg/l lies in between the two. The fluctuation in the DO value - the variation may be difference in water temperature (Kumar et al., 1996). Higher values of DO in case of Shar may be due also to the greater photosynthetic activity as compared to Khrew and Ladhu which are less eutrophic. The free CO₂ values shows variation within the range from a minimum of 9.33 mg/l (Ladhu) to a maximum of 12.66 mg/l (Shar). While the value for (Khrew) that is, 12.0 mg/l lies in between the two. The seasonal variation in the

Table 1. Comparison of mean values of various physico-chemical properties of the water of three studied springs during the study period.

--	Parameter	Springs			S.D
		Ladhu	Krew	Shar	
01	Conductivity ($\mu\text{s}/\text{cm}$)	172.66	239.33	400	117.04
02	Depth (m)	2.93	2.0	1.5	0.725
03	pH	8.23	7.8	7.76	0.260
04	Temperature ($^{\circ}\text{C}$)	4.33	5.0	5.33	0.509
05	Alkalinity (mg/l)	42.66	42.0	60	10.207
06	Calcium hardness (mg/l)	21.3	16.81	13.7	3.80
07	Magnesium hardness (mg/l)	5.03	47.85	24.3	21.44
08	Total hardness (mg/l)	71.33	64.66	38.0	17.63
9	Chlorides (mg/l)	17.32	17.99	15.7	1.20
10	Dissolved oxygen (mg/l)	8.93	5.33	11.2	2.96
11	Free CO_2 (mg/l)	9.33	12.0	12.7	1.76
12	Ammonical nitrogen (mg/l)	6.07	2.67	1.48	2.38
13	Nitrite nitrogen (mg/l)	2.40	2.59	3.87	0.79
14	Orthophosphorous (mg/l)	27.66	34.66	47.3	9.97
15	TDS (mg/l)	0.16	0.27	0.15	0.066

**Figure 1.** Location of the study sites in the map of Pulwama District (not in scale).

amount of free CO_2 may be due to the decomposition of huge quantities of organic matter releasing bulk of CO_2 . Further the stagnant water bodies have higher concentration of CO_2 . The values for magnesium hardness show variation from a minimum of 24.27 mg/l (Shar) to a maximum of 50.03 mg/l (Ladhu); while the value for (Khrew) that is, 47.85 mg/l lies in between the two. The presence of content in the springs may be due

to the presence of magnesium in the rocks which owes its origin to the lacustrine deposits of the states. Further, due to the presence of CaCO_3 rocks in the area the magnesium content is high. The nitrite nitrogen values shows variation within a range from a minimum of 2.4 μs (Ladhu) to a maximum of 3.87 μs (Shar). While the value for (Khrew), that is, 2.59 μs lies in between the two. The fluctuations in the nitrite nitrogen values or the higher

concentration of nitrogen compounds in water may be due to domestic sewage which enters into the ground water through leaching from soil. The orthophorous values show fluctuations from a minimum of 27.66 μs (Ladhu) to a maximum of 47.33 μs (Shar). However the value for (Khrew), that is, 34.66 μs lies in between the two. The orthophosphate content is higher in case of Shar as compared to Khrew and Ladhu. The variation may be due to function of drainage basin and agricultural practices around the water body. The total hardness values show fluctuations ranging from a minimum of 38 mg/l (Shar) to a maximum of 71.33 mg/l (Ladhu). While the value for (Khrew), that is, 64.66 mg/l lies in between the two. The variations in the total hardness values, that is, higher values may be due to carbonaceous or lime rich bed rock of the valley (Kaul et al., 1978; Zutshi et al., 1980; Pandit, 1999). The lower values may be due to seasonal variations. The TDS values shows variation within a range from a minimum of 0.15 mg/l (Shar) to a maximum of 0.27 mg/l (Khrew). While the value for (Khrew), that is, 0.27 mg/l lies in between the two. Higher fractional variations of TDS indicates the maximum amount of dissolved solids in water due to greater contamination by impurities and lesser values indicates lesser pollution of water.

Conclusions

The results of the present study indicate that a multitude of ecological stresses have disturbed the fresh water ecosystems as reflected by variability in physico-chemical characteristics of the three springs. The fluctuations in pH values may be due to low rates of decomposition and good amount of calcium carbonates and magnesium in the area. The fluctuations in EC may be due to the contamination from domestic sewage and in organic fertilizer inputs (Kumar et al., 1996) and also may be due to bicarbonate and calcium ions present in the rocks therein. However the higher values of different forms of phosphorus and nitrogen in water may be due to domestic sewage, washing and other agricultural activities within the catchment of these fresh water bodies.

ACKNOWLEDGEMENT

The authors highly acknowledge the support and help from the Centre of Research and Development, University of Kashmir, Srinagar, India.

REFERENCES

- A.P.H.A. (1998), Standard Methods for Examination of Water and Waste Water. 18th Ed. American Public Health Association, Washington, D.C.
- A.P.H.A. (1998). Standard Methods for Examination of Water and Waste Water. 20th Ed. American Public Health Association, Washington, D.C.
- Bhat FA, Yousuf AR (2002). Ecology of periphytic community of seven springs of Kashmir. J. Res. Dev. 2:47-59.
- Ghavzan NJ, Gunale VR, Trivedy RK (2006). Limnological evaluation of an urban fresh water river with special reference to phytoplankton. Pollut. Res. 25:259-268.
- Kaul V, Trisal CL, Handoo JK (1978). Distribution and production of macrophytes in some waterbodies Kashmir. In: Singh JS, and Gopal B (eds.) Glimpses of Ecology. International Scientific Publications, Jaipur, India, pp. 313-334
- Kaul V (1977). Limnological survey of Kashmir lakes with reference to trophic status and conservation. Int. J. Ecol. Environ. Sci. 3:29-44.
- Kumar PBAN, Dushenkov V, Motto H, Raskin I (1996). Phytoextraction: The use of plants to remove heavy metals from soils. Environ. Sci. Technol. 29(5):1232-1238.
- Pandit AK (1996). Lakes in Kashmir Himalaya. In: Ecology, Environment and Energy (A.H. Khan and Ashok K. Pandit, eds.). University of Kashmir, Srinagar, J&K, India, pp. 1-40.
- Pandit AK (1999). Freshwater Ecosystems of the Himalaya. Parthenon Publishing, New York, London.
- Tas B, Gonulol A (2007). An ecologic and taxonomic study on phytoplankton of a shallow lake, Turkey. J. Environ. Biol. 28:439-445.
- Thresh JC, Suckling EV, Baele JF (1976). The Examination of Water Supplies 6th edition (E. W. Taylor, ed.).
- Welch PS (1952). Limnology: McGraw Hill book Company, New York, Toronto and London (2nd Ed), pp. 538.
- Wetzel, R. G. 1975. Limnology W.B. Saunders Company, Toronto. pp 1-743
- Zutshi DP, Subla BA, Khan MA, Wanganeo A (1980). Comparative limnology of nine lakes of Jammu and Kashmir Himalaya. Hydrobiologia 72:101-112.
- Zutshi DP, Vass KK (1971). Ecology and production of *Salvinia natans* Hoffm in Kashmir. Hydrobiological 38(2):303-320.
- Zutshi DP, Kaul V, Vass KK (1972). Limnology of high altitude Kashmir lakes. Verh. Int. Verein. Limnol. 18:599-604.