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Water Quality Status of Selected Springs in Mohal Khad Watershed of Kullu District

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Abstract

Springs have historically been considered as a lifeline for urban and rural population living in hilly region for domestic and agricultural needs. Niti Aayog reported that there are 5 million springs across India, of which nearly 3 million are in the IHR alone. In recent times, it is observed that drying up or decline in spring discharge is more frequent due to anthropogenic activities and changing climatic regime. In addition to quantity issues, spring water quality was also reported to be declining due to anthropogenic development in spring recharge areas and therefore spring water needs to be treated before using for domestic purposes. Considering the magnitude of problem, spring conservation and management programme is on national agenda. In present study, we touched upon the spring water quality issue, where status of physico-chemical properties of 16 spring sources of Mohal khad watershed were studied.

Introduction

Historically springs are major source of water in hilly regions for satisfying domestic as well as agricultural demands of the population. As per one rough estimate nearly 40 millions of people across the Himalayas depend on this precious water resource. Under the geographical settings of hilly region where rivers flow through valley and population settling down on high hill slope, springs are the only lifeline for both rural and urban inhabitants apart from direct rainfall. However, due to unscientific changes in land use/land cover, infrastructural developments and changing rainfall patterns springs are drying up or become seasonal or their discharge is decreasing.

In recent times, it is observed that drying up or decline in spring discharge is more frequent due to anthropogenic activities and changing climatic regime. Drying of springs results in acute water shortage across the hilly population. In addition to quantity issues, spring water quality was also reported to be declining due to anthropogenic development in spring recharge areas and therefore spring water needs to be treated before using for domestic purposes. Considering the magnitude of problem, spring conservation and management programme is on national agenda. Many researchers working on different aspects of springs which includes hydro-geological studies, groundwater augmentation, spring rejuvenation, isotope studies, spring water quality studies etc. A spring water quality analysis was conducted in present study, where status of physico-chemical properties of 16 spring sources of Mohal khad watershed were studied.

Study Area and Methodology

Mohal Khad watershed is located in Kullu district of Himachal Pradesh (Figure 1) with an area of 54 km^2. This watershed is a forested watershed, where 65% of area is covered by forest; and the elevation ranges from 1110 m to 3250 m amsl. Total 18 spring sources were identified during filed survey with the help of local people, out of which 2 sources (SP6 and SP9 in Table 1) were dried; therefore, 16 spring water samples were collected from Kamand, Muthal, Khalogi, Kareri, and Paha Nala villages of the watershed. Villagers use the spring water for satisfying their domestic need and further some of the spring sources are tapped by Department of I & PH (Department of Irrigation and Public Health, Govt. of Himachal Pradesh) for domestic water supply in the watershed area. Altitudinally, these spring sources were mainly located from 1476 m to 2250 m amsl. Chasme, Dhara, Jairu and Bawari (Figure 2) are some of the local names of spring sources. Location details (Table 1) were recorded using hand-held GPS; and spring water samples collected and stored in polyethylene bottles, which were prewashed using distilled water. In-situ temperature of spring water were measured using thermometer and water samples were analyzed in the laboratory for physico-chemical parameters (pH, EC, TDS and Salanity) using ESICO Microprocessor based water and oil analysis kit Model-1160 instrument and standard methodology. Further, physico-chemical results were compared with the standards of WHO (2011) and BIS (2012) for its suitability for domestic use.

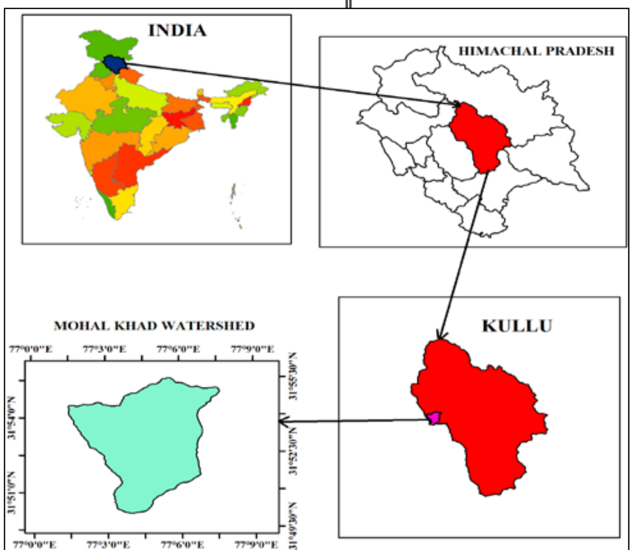

Figure 1: Location of study area - Mohal khad watershed

Results and Discussion

The spring water samples from all 16 sources were normal in taste and found not to have any foul odor. Temperature of spring water samples ranges from 9.2 to 12.8^{0}C. Temperature ranges shows the undulating wide spread of area of spring sources. High altitude spring shows cooler temperature close to 9.5^{0}C and temperature show elevated ranges of up-to 12.8^{0}C in lower

Table 1: Location details and physico-chemical status of spring water

Spring Code	Latitude	Longi-tude	Location of spring	Altitude (meter)	Tem-perature (°C)	pH	TDS (ppm)	EC (µS)	Salinity (ppm)	Observations at field sites/Remarks
SP1	31.89989	77.07469	Tishan Goli 2	1960	10	7.49	269	558	227	Cleanliness is good. Used for irrigation by locals
SP2	31.9002	77.07472	Tishan Goli 1	1967	9.7	7.54	386	642	465	Cleanliness is good. Used by IPH department for water supply
SP3	31.90097	77.07517	Tishan Goli 3	1985	9.7	7.45	382	697	425	Cleanliness is good. IPH department abandoned the source for water supply
SP4	31.89984	77.08433	Kamand Bavdi 1	2140	9.5	7.76	282	571	296	Cleanliness is moderate. Used by locals
SP5	31.90006	77.08452	Kamand Bavdi 2	2250	9.2	7.13	271	438	328	Cleanliness is moderate. Used by locals
SP6	31.89917	77.08964	Khalogi 1	1962	9.9	0	0	0	0	Cleanliness is good. On farm land

Table 1: Continue...

Spring Code	Latitude	Longi-tude	Location of spring	Altitude (meter)	Tem-perature (°C)	pH	TDS (ppm)	EC (µS)	Salinity (ppm)	Observations at field sites/Remarks
SP7	31.8987	77.0902	Khalogi 2	1928	10	7.35	173	256	225	Cleanliness is good
SP8	31.89507	77.07792	Kareri 1	1689	11	7.62	225	431	291	Cleanliness is good. Used by IPH department for supply to Kareri village
SP9	31.89463	77.08962	Muthal 1	1798	10.6	0	0	0	0	Collapsed under the sand from last 10-15 year (as per local information)
SP10	31.8963	77.08963	Muthal 2	1798	10.5	7.35	382	629	335	Prone to collapse as above
SP11	31.89453	77.0856	Nalcha Bai	1748	10.8	7.36	179	322	128.4	Low human intervention. Roadside - not in use
SP12	31.89453	77.08512	Kareri 2	1641	11.2	7.32	597	1212	763	Cleanliness is poor. Roadside - Used for Agriculture
SP13	31.88989	77.07852	Paha Nala	1476	12.8	7.56	326	653	358	Roadside. Potable water.
SP14	31.88179	77.07212	Near Paha Nala	1570	11.4	7.2	330	660	292	Used by IPH
SP15	31.87301	77.06188	Geda Nala	1889	10.2	7.16	153	309	187	Remote and low sunlight area
SP16	31.88354	77.07142	Shankri Nala 1	1553	12.2	7.28	330	659	359	Not in use. Remote and low sunlight area
SP17	31.88354	77.07143	Shankri Nala 2	1554	11.6	7.4	323	645	396	Not in use. Remote and low sunlight area
SP18	31.88354	77.07148	Shankri Nala 3	1554	11.8	7.44	325	651	342	Not in use. Remote and low sunlight area

altitude. In water quality analysis, pH is a measure of acidity or alkalinity of water sample or water-soluble substances. Analysis shows that pH varies in the range from 7.13-7.76 which lies under permissible limits of BIS and WHO (6.5-8.5) standard with mean value of 7.39, indicated that water is highly suitable for all purposes. Total dissolved solids (TDS) in water may originate from natural sources/weathering, generally consists of dissolved salts or due to sewage/waste discharge. The TDS values ranges from 153 to 597 mg/l, with mean of 308.31 mg/l. The highest TDS was found at Kareri 2 spring source attributed to roadside location disturbances and poor cleanliness condition of source. As per BIS, the desirable TDS limit of drinking water is 500 mg/l and the permissible limit in the absence of any other drinking source is 2000 mg/l. Therefore, all the spring samples are safe for drinking purpose. Electrical Conductivity (EC) of water is the ability

Figure 2: Pictures depicting Jairu/Dhara/Chashma/Bawadi sources

to conduct an electric current, which is further function of temperature and ion concentration present in the samples. The EC ranges from 256 to 1212 µS/cm with mean of 541.4 µS/cm. There are no guidelines available till date to regulate the water conductivity in drinking water. However, as per WHO standard, most desirable value for EC in drinking water is 1500 µS/cm. Whereas, for irrigation purposes it can be classified in five categories as < 205 (excellent), 250 -750 (good), 750-2000 (permissible), 2000-3000 (doubtful) and >3000 (unsuitable) (Fipps, n.d.). Therefore, all spring water is fit for both domestic and irrigation purpose. Further wide range of EC values of spring water indicates the multiple sources of ions such as atmospheric, geogenic and anthropogenic contamination. Salinity is a measure of the contents of salts in water. This can be a result of weathering of rocks and rain depositing salt over thousand of years. According to EPA, USA; salinity below 1000 mg/l is considered under the category of freshwater. From results, it is found that the maximum value of salinity was found at SP2 i.e. 465 mg/l, which is well below desirable limit, so all sources can be considered safe for drinking and agricultural purpose.

Conclusion and Future Outlook

The objective of this exercise was to analyze the physico-chemical status of spring water in order to develop baseline database and to determine suitability of spring water for domestic and agriculture purpose. Results showed that the spring water is good for human consumption and agriculture purpose. Rapid increase in population and pollution can/may deteriorate the quality of these natural water resources. Further, in-depth research should be done to evaluate the hydrochemistry and hydrogeology of these naturally found sources. Therefore, the present study will be continued for ionic and cation measurements in order to study the significance of land use pattern change and microclimate on spring water quality.

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