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Original Article

# Physico-chemical Study of Springs: A Case Study of Muchlad Gad Watershed Garhwal Himalaya, Uttarakhand, India

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## ABSTRACT

The present study was carried out on the physico-chemical analysis of 12 natural springs in the Muchlad Gad Watershed District Pauri Garhwal, Uttarakhand, The samples were collected on seasonal basis (summer, rainy and winter) during 2010-2011. The analyzed various water parameters viz: Temperature, Discharge, pH, Conductivity, Alkalinity, Total hardness, Chlorides, and Nitrite. The results indicated certain sources of water are not polluted and suitable for drinking and other purpose.

Keywords:
Garhwal Himalaya, Physico-chemical, Spring, Watershed.

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## Introduction

A watershed is an ideal unit for management of natural resources like land and water for achieving sustainable development. Watershed is defined as all the land and water areas which contribute runoff to a common point. A watershed is a geo-hydrological unit, which drains at a common point. The watershed above any point on a defined channel is therefore all the land and water areas which drain through that point (often the outlets). Watershed boundaries define the aerial extent of surface water drainage to a point. Watershed boundaries always follow the highest ridgeline around the stream channels and meet at the bottom or lowest point of the land where water flows out of the watershed. Every bodies of water viz., rivers, lakes, ponds and streams and a watershed. The boundary between watersheds is defined as the topographic dividing line from which water flows in two different directions. Watershed is marked by an elevated line (divide line) that forms a division between two areas drained by separate streams, river systems or lakes (Tidemann 1996).

Water is essential for the survival of humans, animals and plants. Fresh water is emerging as one of the most critical natural resource issues facing humanity. Water is, literally, the source of life on earth. The human body is 70% water. Human beings can survive for only a few days without fresh water. The quality as well as the quantity of water is deteriorating globally as a result of rapid urbanization, population growth and industrialization. Most countries however currently are aware of the necessity of fresh water as a requirement for survival. Fresh water needs to occupy highest priority, on the international agenda Scarce and unclean water supplies are critical public health problems in much of the World. Polluted water, water shortages, and insanitary living conditions kill over 12 million people a year (Davidson et al, 1992).

Springs provide the main source of freshwater for drinking and other household consumption in the Indian Himalayan Mountains. People in rural areas of Uttarakhand primarily depend for drinking water on natural water sources such as springs. It also forms a main source of irrigation water in many

parts of the mountain region. The mountain springs known as “Dharas”and “Naula”. Springs occure where sloping ground and impermeable strata intersect with the ground water table. The water sources of such as springs, in most of cases, are unconfined aquifers where the flow of water is under gravity. The data from this study will contribute to the knowledge of the physical and chemical properties of spring water of Muchlad Gad Watershed, District Pauri Garhwal, Uttarakhand.

## Study Area

Muchlad gad is the sub- tributary of the Nayaar River. Geographically the catchment is laying between 78048’12” to 78059’E longitudes and 3001’12” to 29051’24”N in latitudes the survey of India toposheet No 53K/13 and 53J/16. It comes under jurisdiction of district Pauri Garhwal Uttrakhand. The area is approached by Sanglakoti-Pauri Garhwal all weather roads.The Muchlad gad originates from the Damdewal and Gadri peak (2513m) and joins the Purvi Nayar River at Talla Gawana (750m).Dhundi Gad and Saintoli Gad are the two main sub streams / tributaries of the Muchlad Gad watershed.

## Materials And Method

Water samples from the various locations of Muchlad Gad Watershed districts Pauri Garhwal, Uttarakhand were collected in clean 1 liter polythene bottles in the basis of season, year 2010-11. Material requirement for sampling and analysis of water is sample containers, chemical and glassware, thermometer, tissue papers, other field measurement are, field note book, pen, pencil, markers, soap and towel, match box, spirit lamp, etc. All analysis was carried out as per APHA and WHO desirable limit for drinking water. Some material and methods are depicted as follows:

Physico-chemical parameters, Discharge are measured by the using of bucket and stop watch, Temperature is measured by the thermometer and pH was recorded at the time of sample collection by using pH Meter. Connectivity in the water is determined by the EUTECH Instrument” of Cyberscan in the laboratory. While other physico-chemical variables were studied using by the standard methods as appropriate (American Public Health Association (APHA), 2005).

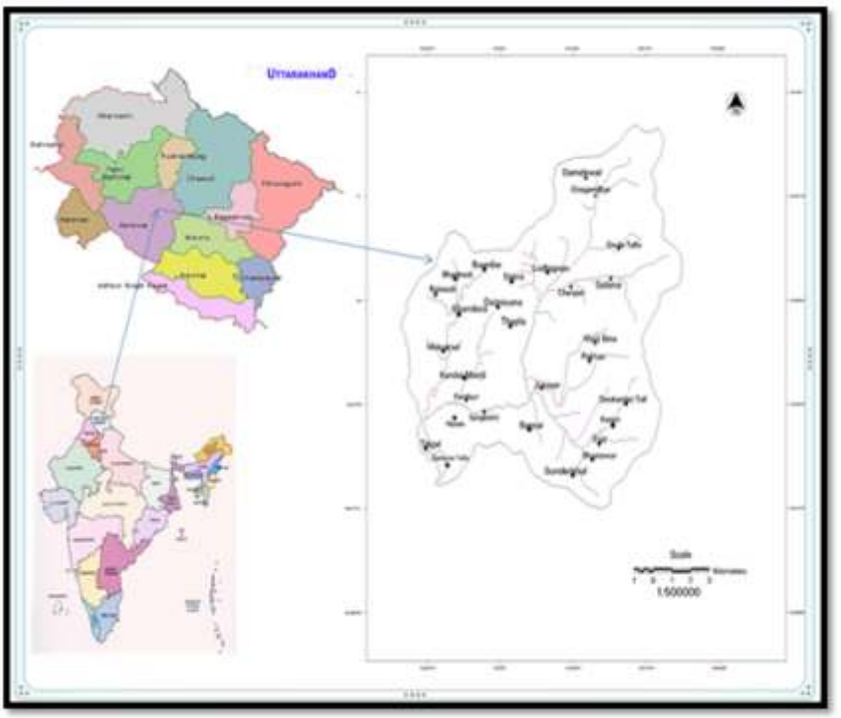

Fig-1: Study map of the area

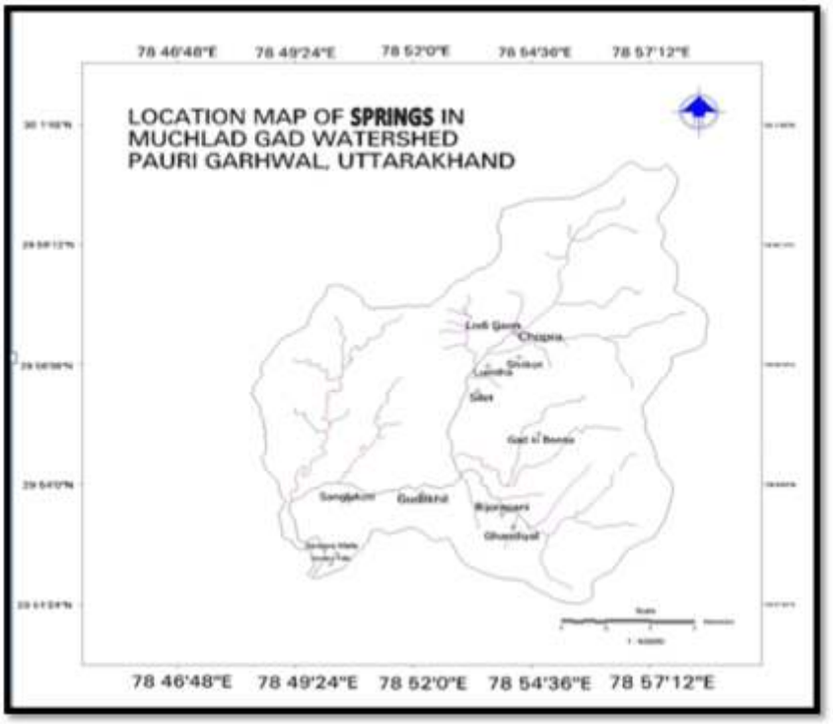


Fig-2: Location map of the springs in the watershed

## Results And Discussion

Discharge: The maximum discharge value 26.4 l/ min. (Bijorapani spring) was recorded in the rainy season and minimum 1.3 l/ min. (Gawana Malla) in the summer season. Geology, land use and level of biotic interference emerged as one of the controlling factor for the spring discharge.

Temperature: Water Temperature generally, the weather in study area is quite cool; however the water temperature plays an important factor which influences the chemical, bio-chemical characteristics of water body. The maximum temperature of 240C (Sileth spring) was recorded in summer season and a minimum of 180C (Sanglakoti spring) was recorded in winter season.
pH: The maximum pH value 8.3 (Luintha spring) was recorded in the rainy season and minimum 6.5 (Gad ki beena spring) in the summer season. Most of bio-chemical and chemical reactions are influenced by the pH. The higher pH values observed suggests that carbon dioxide, carbonate-bicarbonate equilibrium is affected more due to change in physico-chemical condition (Karanth, 1987; Trivedi et al., 2009).

Conductivity: The electrical conductivity exhibited as a variation within a range from 167.07 µs/cm to 897 µs/cm the a maximum value 897 µs/cm (Sileth spring) was recorded in the summer and minimum of 167.07 µs/cm (Ghandiyal spring) in the winter season. 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.

Alkalinity: Total alkalinity ranges from 85.49 mg/l to 193.65 mg/l the maximum value 193.65 mg/l (Gawana Malla spring) was recorded in the summer and minimum value 85.49 mg/l (Srikot spring) in the winter season. The alkalinity was maximum value in April (summer) due to increase in bicarbonates in the water. Hujare, M. S. 2008) also reported similar results that it was maximum in summer and minimum in winter due to high photosynthetic rate.

Hardness: The value of hardness fluctuates from 109.26 mg/l to 278.61 mg/l. The maximum value 278.61 mg/l (Srikot spring) was recorded in the rainy and minimum value 109.26 mg/l (Sileth spring) in the winter season.

Chlorides: The values of chlorides range from 24.12 mg/l to 89.37 mg/l. The maximum value 89.37 mg/l (Sanglakoti spring) was recorded in the summer and minimum value 24.12 mg/l (Gawana Malla spring) in the month of winter season.

Nitrates: The values of nitrate ranges from 2.1 mg/l to 10.9 mg/l. the maximum value 10.9 mg/l (Gad ki beena spring) was observed in the rainy season and minimum 2.1 mg/l (Sileth spring) in the winter season.

## CONCLUSION

The development and use of natural spring to provide water supply for hilly region is a good innovation and very well solution of water scarcity problem. The results of the present study showed that the some springs discharge the amount of water has significantly reduced and some may be declining after few years. The results of the physic-chemical analysis of the spring water, all parameters are within the permissible limits of APHA and WHO. The results indicate that the all springs are non-polluted and can be used for domestic, irrigation and other house hold proposes.

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Table-1: Physical parameters of the springs in Muchlad Gad Watershed

| Name of Springs | Season | Discharge l/min | Temperature in $^0$C | pH |
|---|---|---|---|---|
| Lodi Gaon | Summer | 4.2 | 23 | 6.7 |
| | Rainy | 11.4 | 22.4 | 7.4 |
| | Winter | 6.4 | 21.5 | 7.2 |
| Chopra | Summer | 2.4 | 22.8 | 7.6 |
| | Rainy | 9.7 | 21.5 | 8.1 |
| | Winter | 2.6 | 20.4 | 7.7 |
| Srikot | Summer | 4.7 | 22.5 | 6.9 |
| | Rainy | 9.7 | 22 | 7.8 |
| | Winter | 5.1 | 19.7 | 7.3 |
| Luintha | Summer | 4.5 | 22 | 7.1 |
| | Rainy | 10.5 | 21 | 8.3 |
| | Winter | 4.6 | 19.1 | 7.4 |
| Sileth | Summer | 2.4 | 24 | 6.8 |
| | Rainy | 13.4 | 22 | 8.1 |
| | Winter | 4.6 | 19 | 7.1 |
| Gad ki beena | Summer | 2.4 | 21.5 | 6.5 |
| | Rainy | 8.9 | 20 | 7.9 |
| | Winter | 4.3 | 19.5 | 6.6 |
| Bijorapani | Summer | 7.5 | 23 | 6.9 |
| | Rainy | 26.4 | 22 | 7.5 |
| | Winter | 9.7 | 19.2 | 7.2 |
| Ghadiyal | Summer | 4.7 | 23 | 7.1 |
| | Rainy | 23.4 | 22 | 7.6 |
| | Winter | 6.9 | 20.6 | 7.2 |
| Gudilkhil | Summer | 5.9 | 22.4 | 7.1 |
| | Rainy | 16.5 | 21 | 8.2 |
| | Winter | 7.2 | 19 | 6.9 |
| Sanglakoti | Summer | 9.5 | 24 | 6.7 |
| | Rainy | 22.6 | 22.5 | 7.6 |
| | Winter | 16.4 | 18 | 7.1 |
| Gawana malla | Summer | 1.3 | 22 | 7.3 |
| | Rainy | 7.8 | 20.5 | 7.6 |
| | Winter | 3.8 | 19 | 7.2 |
| Gawana Malla | Summer | 3.9 | 22.5 | 7.1 |
| | Rainy | 19.7 | 21 | 8.2 |
| | Winter | 14.5 | 19.5 | 6.8 |

Table-2: Chemical parameters of the springs in Muchlad Gad Watershed

| Name of Springs | Season | Conductivity, µs/cm | Alkalinity mg/l | Hardness mg/l | Chlorides mg/l | Nitrite mg/l |
|---|---|---|---|---|---|---|
| Lodi Gaon | Summer | 837.33 | 188.22 | 216.50 | 55.25 | 3.4 |
| | Rainy | 683.43 | 135.18 | 266.70 | 62.12 | 7.5 |
| | Winter | 421.29 | 90.20 | 190.00 | 47.12 | 4.1 |
| Chopra | Summer | 735.98 | 165.19 | 222.51 | 55.25 | 5.7 |
| | Rainy | 583.02 | 130.37 | 276.53 | 57.32 | 6.5 |
| | Winter | 455.07 | 118.91 | 175.24 | 41.32 | 4.3 |
| Srikot | Summer | 767.35 | 135.51 | 241.51 | 60.37 | 3.2 |
| | Rainy | 618.53 | 112.43 | 278.61 | 54.31 | 4.9 |
| | Winter | 503.53 | 85.49 | 210.05 | 33.21 | 3.8 |
| Luintha | Summer | 418.71 | 142.61 | 197.52 | 54.18 | 3.7 |
| | Rainy | 397.08 | 122.73 | 217.50 | 58.15 | 6.5 |
| | Winter | 313.21 | 110.69 | 143.29 | 40.36 | 4.2 |
| Sileth | Summer | 897.00 | 135.29 | 183.24 | 44.46 | 2.1 |
| | Rainy | 680.35 | 110.00 | 197.65 | 43.35 | 4.1 |
| | Winter | 215.35 | 97.91 | 109.26 | 29.34 | 3.6 |
| Gad ki beena | Summer | 488.08 | 147.27 | 251.70 | 57.35 | 3.5 |
| | Rainy | 367.87 | 127.83 | 276.33 | 47.31 | 10.9 |
| | Winter | 288.35 | 103.81 | 205.04 | 39.31 | 4.3 |
| Bijorapani | Summer | 767.67 | 167.61 | 201.61 | 57.31 | 5.4 |
| | Rainy | 663.37 | 121.33 | 266.51 | 83.35 | 9.7 |
| | Winter | 513.01 | 111.49 | 164.39 | 48.37 | 6.4 |
| Ghadiyal | Summer | 688.00 | 140.12 | 183.07 | 62.13 | 6.1 |
| | Rainy | 561.37 | 127.09 | 197.09 | 68.37 | 8.7 |
| | Winter | 167.07 | 103.38 | 159.63 | 52.31 | 6.9 |
| Gudilkhil | Summer | 707.65 | 147.06 | 222.81 | 45.12 | 2.6 |
| | Rainy | 693.84 | 120.00 | 243.10 | 56.12 | 3.7 |
| | Winter | 397.39 | 93.13 | 152.43 | 42.11 | 2.7 |
| Sanglakoti | Summer | 655.33 | 133.22 | 234.29 | 89.37 | 2.3 |
| | Rainy | 588.89 | 123.01 | 277.58 | 73.21 | 4.6 |
| | Winter | 504.00 | 89.57 | 204.51 | 63.43 | 3.5 |
| Gawana malla | Summer | 887.00 | 193.65 | 197.34 | 37.31 | 3.1 |
| | Rainy | 675.31 | 137.74 | 207.06 | 38.12 | 5.7 |
| | Winter | 453.81 | 102.23 | 183.51 | 24.12 | 4.2 |
| Gawana Malla | Summer | 661.08 | 162.17 | 200.61 | 55.43 | 2.4 |
| | Rainy | 497.03 | 128.68 | 232.57 | 68.47 | 6.8 |
| | Winter | 213.05 | 106.00 | 164.52 | 49.38 | 4.9 |