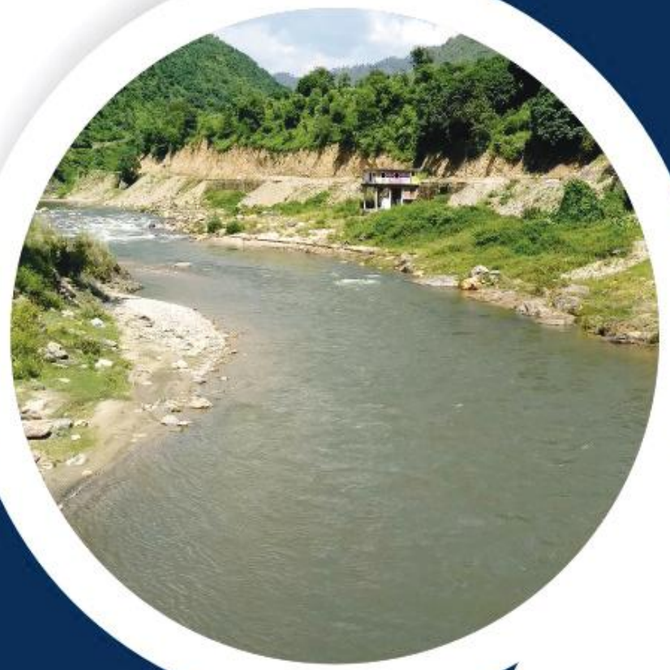

2018 Inventory of Springs of Kosi River basin

Technical Report-I

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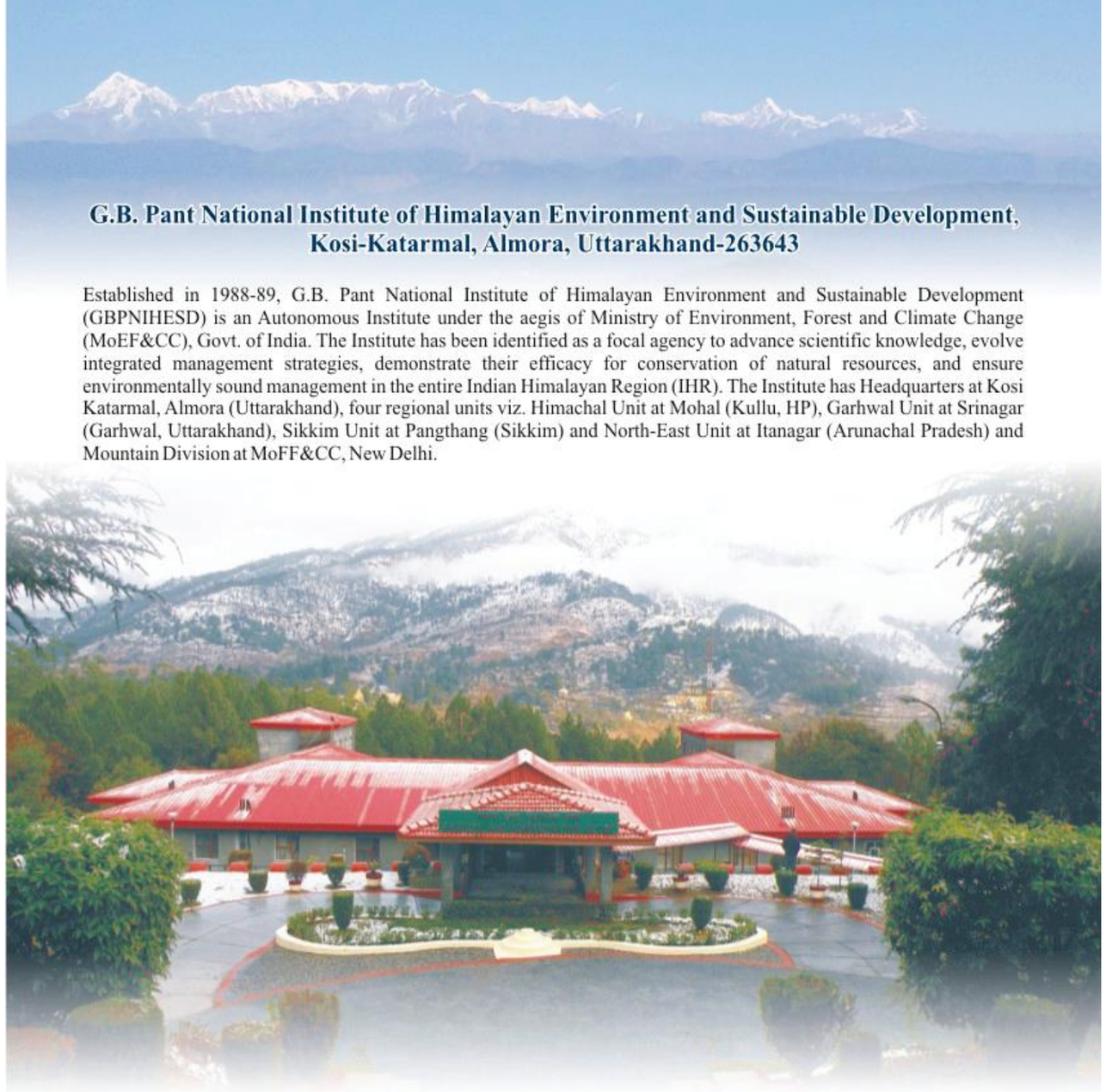

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Established in 1988-89, G.B. Pant National Institute of Himalayan Environment and Sustainable Development (GBPNIHESD) is an Autonomous Institute under the aegis of Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India. The Institute has been identified as a focal agency to advance scientific knowledge, evolve integrated management strategies, demonstrate their efficacy for conservation of natural resources, and ensure environmentally sound management in the entire Indian Himalayan Region (IHR). The Institute has Headquarters at Kosi Katarmal, Almora (Uttarakhand), four regional units viz. Himachal Unit at Mohal (Kullu, HP), Garhwal Unit at Srinagar (Garhwal, Uttarakhand), Sikkim Unit at Pangthang (Sikkim) and North-East Unit at Itanagar (Arunachal Pradesh) and Mountain Division at MoFF&CC, New Delhi.

National Mission of Himalayan Studies (NMHS)

Realizing the significance of the Himalaya necessary in view of "Ecological Security of the Nation", "Biodiversity Hotspot", "Climate Regulator for much of Asia", etc. the Government of India attached the highest priority in year 2015 by launching the Himalaya-dedicated **"National Mission on Himalayan Studies (NMHS)"** as a Central Sector (CS) Grant-in-Aid Scheme and entrusting its implementation responsibilities with the MoEF&CC, New Delhi and GBPNIHESD, Uttarakhand with a vision "to support the sustenance and enhancement of the ecological, natural, cultural and socio-economic capital assets and values of the IHR". The scheme NMHS envisages not only to foster quality action-oriented, demand-driven research studies but also to formulate evidence-based recommendations for sound policy and practice in participatory manner towards ensuring the sustained protection, conservation and development of all 12 States of the Indian Himalaya and its dependent communities.

Email: nmhspmu2016@gmail.com URL: http://nmhs.org.in GBPNIHESD URL: http://gbpihed.gov.in

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■ **Disclaimer:** This report represents work performed by the research team under project 'Rejuvenation of Springs and Spring-fed streams in Mid-Himalayan regions using Spring Sanctuary Concept' Funded by National mission on Himalayan Studies, Ministry of Environment, Forest and Climate Change (MOEF&CC), New Delhi, India and is released as Technical Report-I in the interest of making the information about springs in Upper Kosi basin of Kumaun Himalaya readily available.

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G.B. Pant National Institute of Himalayan
Environment and Sustainable Development

Foreword

For centuries, in high and mid hill regions of Indian Himalayan Region, the mountain communities have depended heavily upon springs for their household water needs and its contingent use in rainfed agriculture. These springs countless in numbers are widely distributed across the length and breadth of the IHR and the water from these springs also feeds into myriads of small and large streams that support growth of settlements, agriculture and economic activities in the region. Further, these small and large streams converging together have given rise to many large rivers and river systems that drain through the plains of North India and are responsible for its high agricultural productivity, industrial growth and development. These springs which are so vital for the subsistence, survival of the inhabitant mountain communities and maintain the perennial character and contribute to the water volumes and flow of the rivers and that provides sustenance of populations and economies downstream are now suffering due to deforestation and faulty development in recharge zone, neglect/improper management, weak community participation and climate change. The emergent scenario is evident in form of diminished discharge of springs, perennial springs becoming seasonal, and extinction and drying of many of the seasonal/ perennial springs. The cascading impacts are also revealing a similar trends for streams and small rivers; the shifting human dependence from springs and streams to rivers and ground water gives a tell-tale description of emerging water crisis which have repercussions for development, and survival and subsistence of future generations. Therefore, for management of water requirements for different developmental and household uses, a scientific study database development and monitoring of the changing water resources scenario is a must.

This publication which provides an inventory of springs of Kosi Watershed in Almora district of Uttarakhand together with their seasonal flow patterns, and description of physical/environmental settings, population served, and management system/ regime is an attempt in this direction. This work which is an outcome of the NMHS funded project on 'Rejuvenation of Springs and Spring fed Streams in Mid-Himalyana basins using Spring Sanctuary Concept' will provide a baseline information on status of springs for future comparisons and management planning of water resources in Himalaya.

(Kireet Kumar)
Director In-charge

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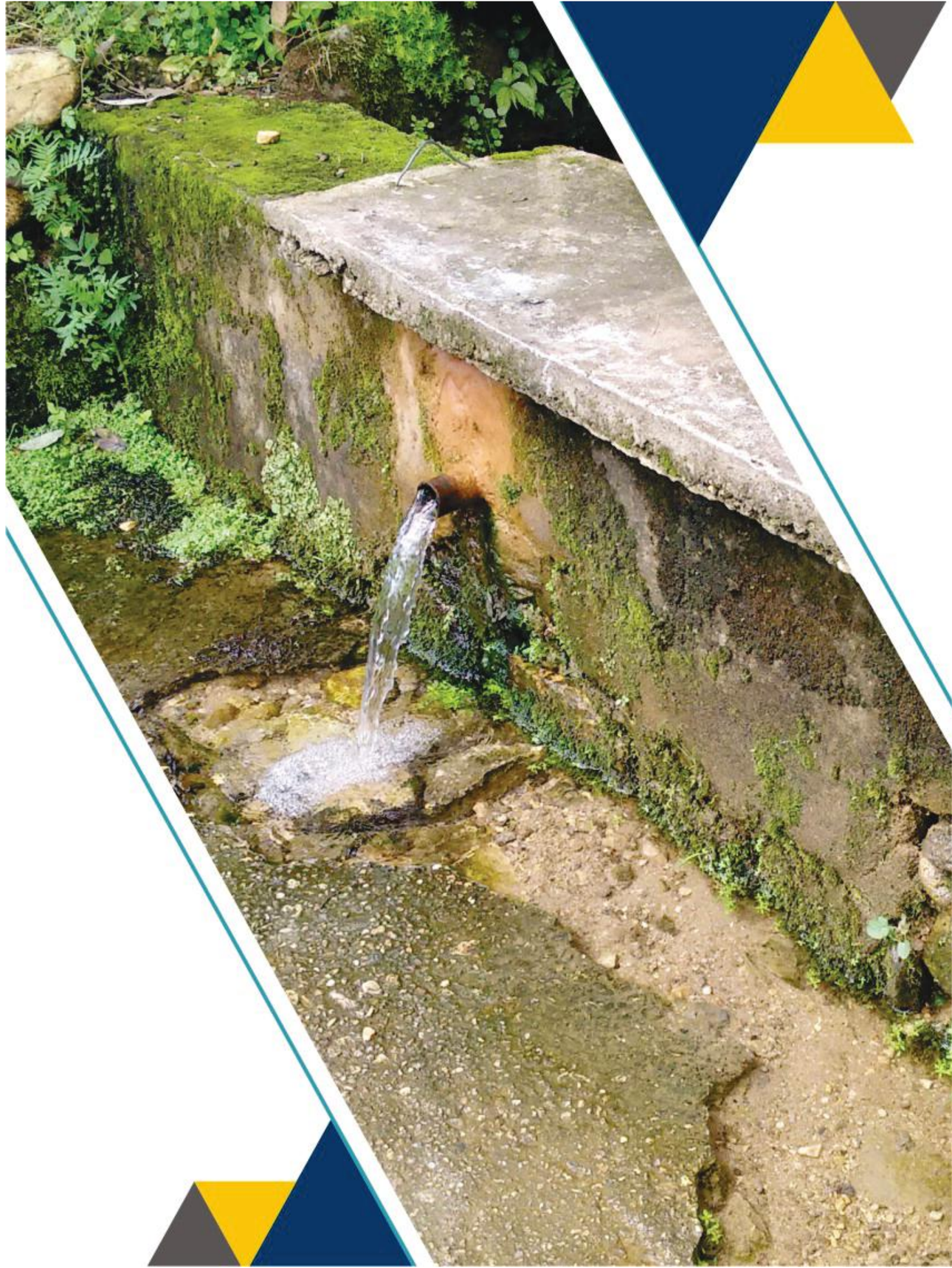

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Introduction

Springs and seeps are a reliable source of fresh water in Kumaun Himalaya of the Indian Himalayan Region (IHR) since ancient times. People of this region depend upon these sources to fulfil their water needs for household and irrigation. Approximately, 50% population in Kumaun Himalaya are dependent on spring water for their daily water requirements (Singh and Rawat, 1985). During the last few decades, it has been reported in various studies that discharge of water springs is declining and perennial springs becoming seasonal in this region due to changing rainfall patterns and anthropogenic activities. Apart from decreasing discharge, deteriorating water quality of some spring has also been reported by Kumar and Rawat (1996). Kumaun region of IHR is said to be one of the most vulnerable regions of the world in terms of water stress. Water security specifically in the spring-fed river system is highly vulnerable to seasonal changes in the spring hydrology. Although, large rural and urban population have depended upon spring water resource, little attentions have been given to investigate and protect these perennial springs. Water security in the spring-fed Kosi river watershed of the Kumaun Himalaya is not sustainable due to increasing population pressure/water demand, declining rainfall and water supply, and higher dependency of mountain people on spring water.

Information on seasonal changes in flows and quality of spring water, elevation, geology, soil and land use in spring catchment provides a major step toward understanding the characteristics of hydrological regime of springs and helps in preparing strategies to sustain spring discharge. In last two decades, short term studies have been conducted over Kumaun region on spring water quality, discharge and rainfall relationship, identification of spring aquifers and recharge area (Rai et al, 1998), and impacts of the recharge zone characteristics and land use land cover changes on quality of spring water (Kumar and Rawat, 1996; Negi and Joshi, 2004; Joshi & Kothyari, 2003). However, more focussed and planned research is required to address the problem of water crisis and ensure safe and sustainable access to water for all. In the Himalayan region, scarcity of continuous and reliable data on spring resources also puts challenges to water resource managers. The objective of this report is therefore, to catalogue selected springs in Upper Kosi basin for collection of information on physical, chemical and other aspect of springs along with use-pattern and associated anthropogenic threat so that the database on water resources and water use of Kumaun region could be strengthened.

Purpose and scope

The Ministry of Environment, Forest & Climate Change (MOEF & CC), under National Mission on Himalayan Studies (NMHS) has

initiated research and development project titled "Rejuvenation of springs and spring-fed streams in Mid-Himalayan region using spring sanctuary concept". Under the project, four different watershed representing diverse climatic conditions and elevation range were selected for springs rejuvenations and the work on spring monitoring in Upper Kosi watershed was initiated from April 2016. The work includes identification of spring locations using GPS and documentation of information on environmental settings in a pre designed inventory pro-forma (Annexure-I) along with photographs together with regular monitoring of water quality.

Characteristics of Area of Investigation

The Upper Kosi watershed in Kumaun region was selected as a representative watershed of spring fed-streams of Kumaun region. It is a showcase of different landscape (tectonically controlled and fluvial), landform (dissected valley, terraces, ridge, and streams), biodiversity (floral and faunal), micro-climate, habitat, demography and hydrogeology (soil, geology and water) that falls in Almora district of Uttarakhand, India. The Kosi river originates from its north most point at Pinath (near Kausani, district Almora), flows downward and join Ramganaga in Ramnagar as its major tributary. Geographically, the catchment of Upper Kosi River has its spatial extension between 29° 37' 30" N to 29° 52' 20" N and 79° 31' 00" E to 79° 51' 45.10" E which covers an area of about 462 sq. Km. The absolute relief of the catchment ranges between 1106 m and 2758 m above mean sea level.

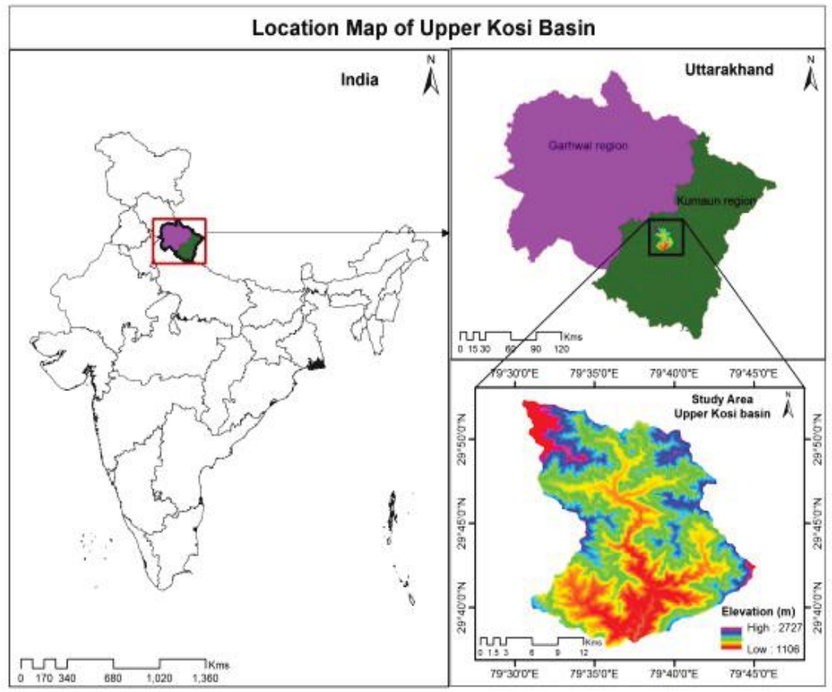


Figure 1: Location of study area in Kumaun Himalaya

Climate, land use and water resources

The climate of the watershed is temperate with summer, rainy and winter as three distinct seasons. It is the key controlling factor for land use; the complexities of the landscape promote variations in micro climatic

phenomena and influence the soil properties and vegetation. The watershed represents diverse agricultural land use i.e. irrigated to rain fed, less fertile terraces to highly productive valleys, variety of food grains (Wheat, Paddy) to vegetables etc. It is one of the most densely populated parts of the Kumaun Himalaya. The wide and open valley with bench terraces containing thick layer of alluvium and suitable climate conditions are the prime factors that encouraged the human settlements in the region.

The springs are the most important source of water in the upper/middle/downslope areas of the Upper Kosi watershed; the spring water is available in the form of 'naula' 'dhara' 'seeps' and 'gadheras'. At some gentle slopes and plain areas hand pumps and tube wells are also used to excavate water. Most of the people residing in rural and urban places heavily depend on these resources for drinking water and other uses. The undulating topography and diverse micro climatic conditions pose difficulty in the efficient distribution of natural water resources. Springs in the Kosi-watershed are now under stress due to climatic variation, increasing population/water demand, and poor management.

Background studies

The diminishing discharge of springs in Himalaya has been reported by various researchers since 1989 (Valdiya, and Bartarya, 1989; 1991; Joshi & Kothyari, 2003; Negi and Joshi, 2004) indicate that these traditional sources of water will become unsustainable to fulfill future water demand. The water sources of these springs, in most cases are unconfined aquifers where the water flows under gravity and hence, rainfall variability and pattern affect the spring water discharge. Rawat (2014) indicated that the perennial streams of the Kosi watershed are disappearing steadily, and the total length of perennial streams in the Kosi watershed decreased from 225.89 km (a situation across 40 years back) to 41.57 km during present time. Due to transformation of perennial streams to seasonal streams, summer flow of the Kosi River is dwindling. The minimum summer flow (i.e., the base flow) of the Kosi River was 790 L/s in 1992 which has drastically declined to mere 80 L/s in 2013. Another research conducted by G.B. Pant National Institute of Himalayan Environment & Sustainable Development (GBPNIHESD) indicated that demand for water in Kosi watershed has increased from 8836 cu.m/day in 2001 to 10910 cu.m/day in 2011 for human consumption and 6110 cu.m/day (2007) to 7393 cu.m/day (2014) for livestock (Final Technical report, 2015-16) and predicted rise in water demand from 45 to 85 per cent in the next 18 years under different socio-economic scenarios. It is now apparent that with climatic changes and declining precipitation, these springs are drying and will be unable to support future water demand of the increasing population.

Ignorance and poor management of springs, lack of research on resource status and data on human dependence on these traditional sources are the most conspicuous traits of the study area further compounded by faulty water harvesting and conservation measures. Recently, numerous construction works in the name of infrastructure development have further disturbed hydro-geological systems due to the lack of research inputs for planning such development activities for the region. The past studies also stressed on the need for intensive research on hydro-geological settings of river watersheds in system mode considering interactions of social, economic factor with biological and climatic variations for springs rejuvenations .

Spring concept and formation

A spring is a water source formed by intersection of a flowing body of groundwater by the side of a hill, a valley bottom or other excavation at the local water table. Alternatively, a spring is the result of an aquifer being filled to the point so that the water naturally overflows onto the land surface (Figure 2). The springs range in size from intermittent seeps, which flow only after much rain, to huge pools of water flowing hundreds of gallons of water per day.

Springs may be formed in any sort of rock. Naturally, the spring formed in a condition when an aquifer filled to the point that the water overflows onto the land surface. Different kinds of spring formed under different condition but essentially the permeable layer lies above impermeable layer. But the most favourable and common condition for spring formation is when saturated layer exposed to surface and make a way for water to come out (Figure 2) through joints, fractures, creeks and depression under hydrostatic pressure.

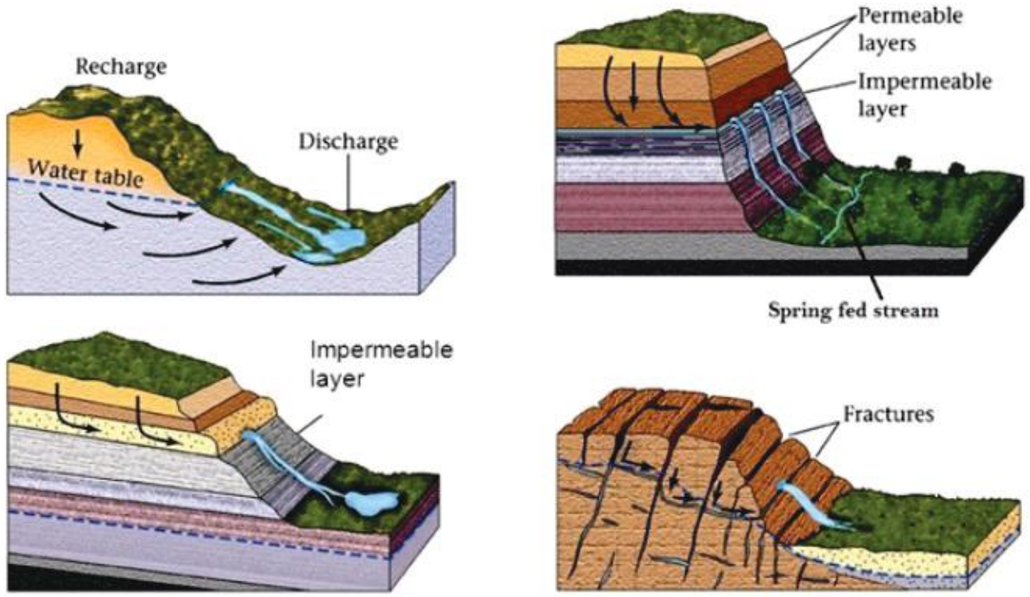


Figure 2: Different conditions of formation of spring **Copyright: Christian Rushford**

Type of springs

Based on origin of source, springs found in India have been classified into following five categories by Advanced Centre for Water Resources Development and Management (ACWADM).

Depression springs : Such springs are controlled by local flow system and have local discharge zone; these springs are formed at topographic lows when water table reaches the surface.

Contact springs : Contact springs are formed where relatively permeable rocks overlie rocks of low permeability; such springs are usually associated with perched aquifers in mountains, a lithological contact is usually marked by a line of springs.

Fault springs : Such springs are formed due to faulting in rocks where groundwater can move up under hydrostatic pressure.

Joint/ Fracture springs : These occur due to existence of jointed or permeable fracture zones in low permeability rocks. Water from shallow or deep aquifers moves up through these fractures; springs are formed where these fractures intersect the land surface.

Karst springs : These are springs in limestone terrains and can be interconnected to topographic depressions caused by sinkholes. Large quantities of water move through the cavities, channels, conduits and other openings developed in limestone.

Inventorization of springs in Kosi river basin

The inventorization of springs was undertaken to create a baseline information database on their status including their location, environmental settings, seasonal flow patterns, water quality characteristics, management, use and ownership etc. for future monitoring and comparisons. The inventorization involved recording of locational/environmental attributes of spring points/sources, their physico-chemical characteristics, and geo-tagging in maps. The process was carried out in phased manner and involved following steps.

Phase 1-Field survey and sampling

Intensive field survey was conducted for preparing village-wise spring inventory; in all 931 springs located across 241 villages were identified and their locations recorded by using GPS (Ertex -30); field measurements of Temperature, EC, PH etc. parameters of spring water were made by using handheld field instruments, and status i.e. seasonal/ perennial/ dried/closed etc., noted. In addition, water samples of springs were taken for laboratory analyses and general features and hydrological information on springs were collected as per enclosed pro-forma (Annexure-I)*.

Phase-II: Laboratory analysis of spring's water

Water samples of identified springs were analyzed for Turbidity (NTU), Na^+ (mg/L), K^+ (mg/L), TSS (mg/L), Total Hardness, Ca Hardness (mg/L), Alkalinity (mg/L), Calcium (mg/L), Magnesium (mg/L), F^- (mg/L,), Sulphate (mg/L), Nitrate (mg/L), Chloride (mg/L), Bicarbonate (mg/L)) etc. water quality parameters as per Drinking Water-Specification (IS 10500:2012) using standard methods and protocol listed in Annexure-I.

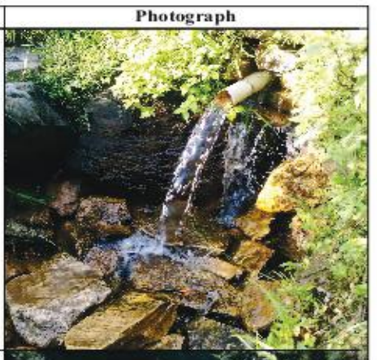
Inventory of springs

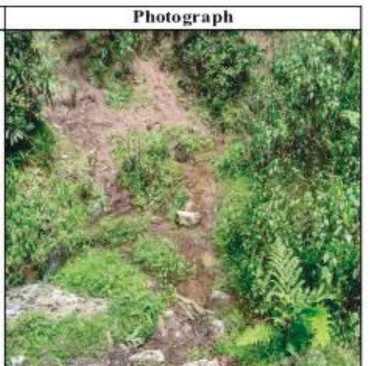
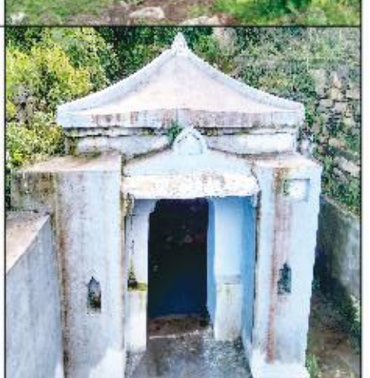
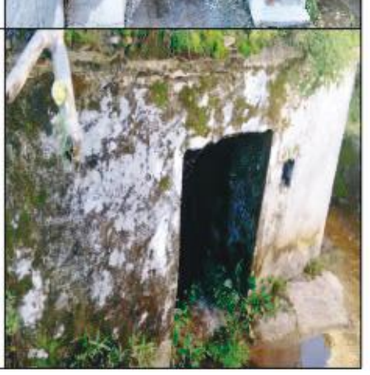
All the surveyed information collected in phase-I and II was compiled in the form of geo-database in Arc-GIS domain. Each spring was assigned a unique five-digit alpha-numeric code, the first two letters representing the spring type and last three the order of data entry in database. The final compiled data was saved as a Microsoft Access document as a shape file viewable in ArcGIS. Out of identified 931 springs of the Upper Kosi river basin, an inventory of 74 springs was made. This inventory which includes compilation of information on location co-ordinates, some basic physico-chemical parameters, and use etc. is presented in Table 1. Springs in these villages is used for drinking, irrigation, and various domestic uses. Several villages that have a water supply scheme also depend on springs during summer months, i.e. the dry/ water scarcity period.

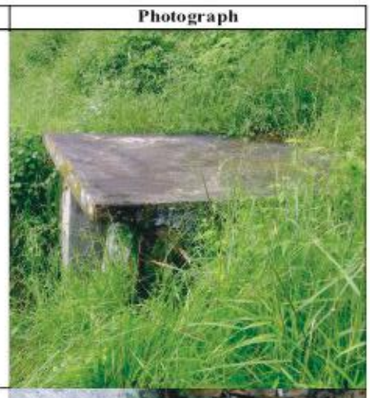
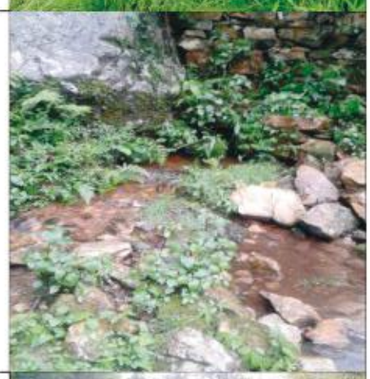
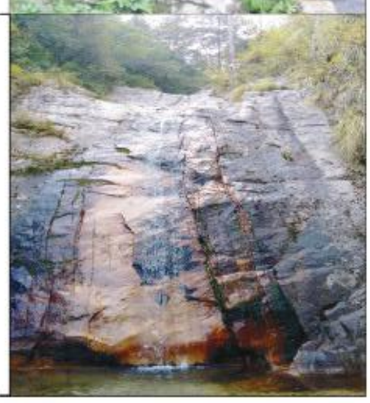
* Annexure -II provide detailed description of data elements and terminology used in Annexure-I

Table 1. Inventory of springs in Upper Kosi river basin

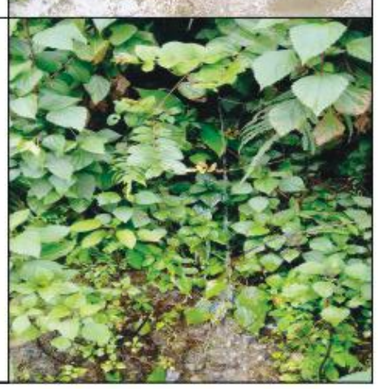
Spring	Coordinates	Physico-chemical characteristics	Photograph
Navgad Naula **Village :** Kantali **Block :** Takula **District :** Almora, UK **Spring code :** SP001	**Latitude :** 29°51'03.9"N **Longitude :** 79°34'04.1"E **Elevation (amsl) :** 1659.5 m	**Discharge** = 0.20 L/s **Temperature** = 18.9 °C. **EC** = 344 µS/cm **pH** = 6.26 **Use:** Water of Navgad spring (naula) is used primarily for drinking and washing. The naula is perennial and a small brook associated with this spring. **Landuse, soil and lithology:** Surrounding land use is built-up area. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** Higher EC and lower pH of water make it unfit for drinking as per IS 10500:2012. Rest of physico-chemical properties are within permissible limit of Indian drinking water specifications.	
Naule ki Gair naula **Village :** Kantali **Block :** Takula **District :** Almora, UK **Spring code :** SP002	**Latitude :** 29°51'13.6" N **Longitude :** 79°34'03.8"E **Elevation (amsl) :** 1689 m	**Discharge** = 0.005 L/s **Temperature** = 18.8 °C. **EC** = 231 µS/cm **pH** = 7.3 **Use:** This is a perennial spring (naula). It is open for public and used very rarely. **Landuse, soil and lithology:** Surrounding land use of naula is built-up area. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	
Ghusibagad dhara **Village :** Kantali **Block :** Takula **District :** Almora, UK **Spring code :** SP003	**Latitude :** 29°51'17.6"N **Longitude :** 79°34'7.9"E **Elevation (amsl) :** 1694 m	**Discharge** = 0.13 L/s **Temperature** = 17.9 °C. **EC** = 92.2 µS/cm **pH** = 6.4 **Use:** Ghusibagad dhara is perennial having Potable water primarily used for drinking. Ownership is private (Mr. K S Bhatt, for family use). **Landuse, soil and lithology:** Surrounding land use is built-up area. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** Turbidity is high (7.27 NTU) and pH is also slightly less than acceptable limit but other physico-chemical properties are within permissible or desirable limit.	

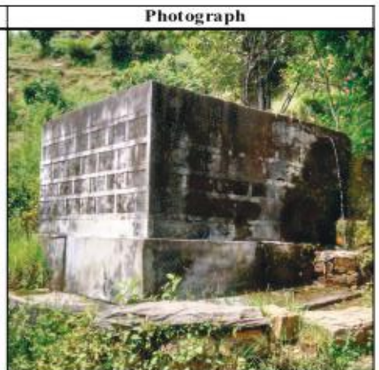
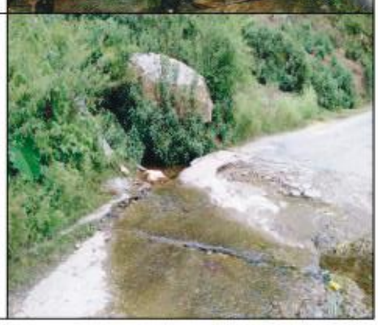
Spring	Coordinates	Physico-chemical characteristics	Photograph
Jokapani dhara **Village :** Kantali **Block :** Takula **District :** Almora, UK **Spring code :** SP004	**Latitude :** 29°51'12.61"N **Longitude :** 79°34'15"E **Elevation (amsl) :** 1677 m	**Discharge**= 0.784 L/s **Temperature**= 19.5 °C **EC**=38.6 F/cm **pH** =6.9 **Use:** It is perennial, used for bathing, sanitation, washing, some people also used for drinking. Secondary use of dhara is for irrigation in nearby fields. **Landuse, soil and lithology:** Jokapani dhara is 400 m from truss bridge towards Kausani. Surrounding land use of dhara is agricultural area. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** Turbidity is high (20.5 NTU) but all other physico-chemical properties are within permissible limit.	
Churadi brook **Village :** Kantali **Block :** Takula **District :** Almora, UK **Spring code :** SP005	**Latitude :** 29°51'19.1"N **Longitude :** 79°34'22.6"E **Elevation (amsl) :** 1854 m	**Discharge**= 0.48 L/s **Temperature**= 19.1 °C. **EC**=51.4 µS/cm **pH** =8.5 **Use:** The brook is perennial, potable for public use but supply only to few houses; it has two associated Government Water supply schemes. **Landuse, soil and lithology:** Surrounding land use of brook is forest on upstream and agricultural area on downstream side. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	
Bekuna spring **Village :** Kantali **Block :** Takula **District :** Almora, UK **Spring code :** SP006	**Latitude :** 29°51'23.5"N **Longitude :** 79°34'0.6"E **Elevation (amsl) :** 1708 m	**Discharge**= 0.007 L/s **Temperature**= 20.2 °C **EC**=63.4 µS/cm **pH** =6.6 **Use:** The spring is perennial source of water but it is currently not in use. It is located near Bhagwati Temple (Approximately 500 m from Truss bridge in Kantali village). **Landuse, soil and lithology:** Surrounding land use of spring is forest on uphill and wasteland on downhill. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	

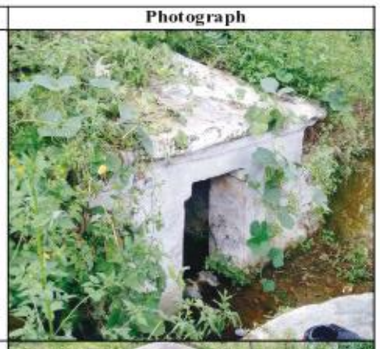
Spring	Coordinates	Physico-chemical characteristics	Photograph
Maltanki brook **Village :** Kantali **Block :** Takula **District :** Almora, UK **Spring code :** SP007	**Latitude :** 29°51'30.5"N **Longitude :** 79°34'18.0"E **Elevation (amsl)** : 1922 m	**Discharge**= 0.737 L/s **Temperature**= 17.9 °C **EC** =43.3 µS/cm **pH**= 7.4 **Use:** Maltanki brook is a perennial brook near army water storing Unit. The brook is used for cattles only. **Landuse, soil and lithology:** Surrounding land use of brook is forest on upstream and built-up on downstream side. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** Turbidity of spring water is high (12.93 NTU). All other physico-chemical properties are within permissible limit of drinking water specifications	
Pallagaon naula **Village :** Kantali **Block :** Takula **District :** Almora, UK **Spring code :** SP008	**Latitude :** 29°50'56.4" N **Longitude :** 79°33'58.6"E **Elevation (amsl) :** 1717 m	**Discharge**= is 0.002 L/s **Temperature**= 19.2 °C **EC** =32.9 µS/cm **pH**= 6.2 **Use:** It is perennial source of water but not used for any purpose. **Landuse, soil and lithology:** It is located between Kantali and Par Kantali. Surrounding land of naula is agricultural. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** Very high Turbidity of spring water (180 NTU) and pH less than acceptable limit made it non-potable whiles all other physico-chemical properties are within permissible limit of drinking water specifications.	
Mallakhola naula **Village :** Kantali **Block :** Takula **District :** Almora, UK **Spring code :** SP009	**Latitude :** 29°51'01.6"N **Longitude :** 79°33'57.7"E **Elevation (amsl) :** 1716 m	**Discharge**= 0.006 L/s **Temperature**= 20.9 °C **EC** =90.4 µS/cm **pH**= 6.3 **Use:** Mallakhola naula is perennial source of water but it is polluted and employed by a single family during water crisis. **Landuse, soil and lithology:** Surrounding land use of naula is built-up. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** High Turbidity (36 NTU) and lower pH make it unfit for drinking while rest of physico-chemical properties are within permissible limit of drinking water specifications.	

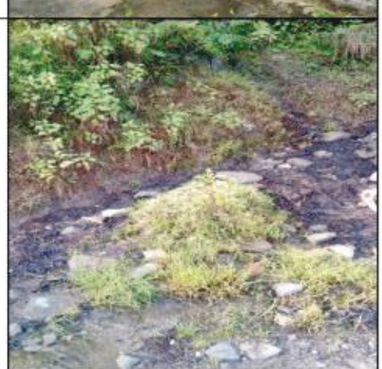
Spring	Coordinates	Physico-chemical characteristics	Photograph
Suryakhal naula **Village :** Kantali **Block :** Takula **District :** Almora, UK **Spring code :** SP010	**Latitude :** 29°50'48.8"N **Longitude :** 79°33'56.9"E **Elevation (amsl) :** 1734 m	**Discharge** = 0.006 L/s **Temperature** = 19.1 °C **EC** = 30.7 µS/cm **pH** = 6.3 **Use:** Suryakhal naula is perennial and potable source of water primarily used for drinking in summers only by people living in Par Kantali. **Landuse, soil and lithology:** Surrounding land use of naula is for agriculture. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** Although people use its water for drinking but Turbidity (36 NTU) is out of permissible limit and pH is out of acceptable limit of drinking water specifications. Rest of physico-chemical properties are within permissible limit.	
Sonijhal water scheme **Village :** Kantali **Block :** Takula **District :** Almora, UK **Spring code :** WS1	**Latitude :** 29°51'14.7"N **Longitude :** 79°33'27.9"E **Elevation (amsl) :** 1760 m	**Discharge** = 0.187 L/s **Temperature** = 17.6 °C **EC** = 33.4 µS/cm **pH** = 7.2 **Use:** The brook is perennial and used for general purpose of bathing, washing clothes and other daily needs. It has associated water supply scheme of Government. **Landuse, soil and lithology:** Surrounding land cover of brook is Bhatkot East Reserved Forest. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity which is slightly high (7.08 NTU) and pH which is slightly low (7.2).	
Rudradhari water scheme **Village :** Kantali **Block :** Takula **District :** Almora, UK **Spring code :** WS2	**Latitude :** 29°50'57.9"N **Longitude :** 79°33'20.6"E **Elevation (amsl) :** 1849 m	**Discharge** = 0.131 L/s **Temperature** = 17.2 °C **EC** = 19.9 µS/cm **pH** = 6.9 **Use:** This is second water scheme f for Kantali village located near Rudradhari temple drawn from lower side of Rudradhari water fall (about 1.2 km from the village). The brook is perennial and used for general purpose. **Landuse, soil and lithology:** Surrounding land cover of brook is Bhatkot East Reserved Forest. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity which is slightly high (14.97 NTU).	

Spring	Coordinates	Physico-chemical characteristics	Photograph
Reju Phase-I and Phase-II water scheme **Village :** Kantali **Block :** Takula **District :** Almora, UK **Spring code :** WS3	**Latitude :** 29°50'51.5"N **Longitude :** 79°33'19.7"E **Elevation (amsl) :** 1901 m	**Discharge** = 0.091 L/s **Temperature** = 16.2 °C **EC** = 33 µS/cm **pH** = 7.6 **Use:** This is third water scheme from a brook for Kantali village. The brook is perennial, potable and used for general purpose. **Landuse, soil and lithology:** Surrounding land cover of brook is Bhatkot East Reserved Forest. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications make its waters fit for drinking.	
Dhara **Village :** Math **Block :** Takula **District :** Almora, UK **Spring code :** SP012	**Latitude :** 29°50'22"N **Longitude :** 79°34'34.5"E **Elevation (amsl) :** 1607 m	**Discharge** = 0.118 L/s **Temperature** = 17.8 °C **EC** = 47 µS/cm **pH** = 7.3 **Use:** The water of dhara is used to fulfill all water related needs. **Landuse, soil and lithology:** Dhara of Math village is perennial and located at confluence of Kosi river and Deogad stream. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity which is slightly high (7.38 NTU).	
Dhara **Village :** Math **Block :** Takula **District :** Almora, UK **Spring code :** SP013	**Latitude :** 29°50'25.2"N **Longitude :** 79°34'37.2"E **Elevation (amsl) :** 1625 m	**Discharge** = 0.289L/s **Temperature** = 20 °C **EC** = 37.8 µS/cm **pH** = 6.2 **Use:** Dhara of Math village is potable and used by public for general purpose. Secondary use of Dhara is for irrigation. **Landuse, soil and lithology:** Surrounding land use of Dhara is agriculture. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except pH which is slightly lower than acceptable limit.	

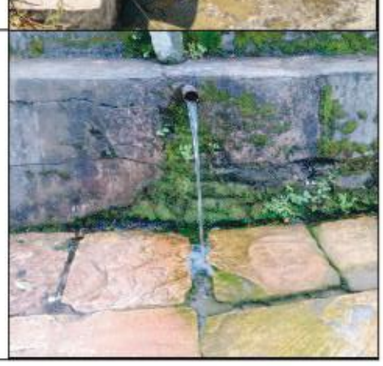
Spring	Coordinates	Physico-chemical characteristics	Photograph
Bijoria dhara **Village :** Bijoria **Block :** Takula **District :** Almora, UK **Spring code :** SP014	**Latitude :** 29°50'08.2"N **Longitude :** 79°35'31.3"E **Elevation (amsl) :** 1586 m	**Discharge** = 0.183 L/s **Temperature** = 21.1 °C **EC** = 142.4 µS/cm **pH** = 7.0 **Use:** Water of Bijoria dhara is potable and used for general purpose (washing, bathing etc.). **Landuse, soil and lithology:** Surrounding land use of dhara is built-up on uphill and agricultural field on downhill. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications make its waters fit for drinking.	
Spring **Village :** Lwesal **Block :** Takula **District :** Almora, UK **Spring code :** SP015	**Latitude :** 29°50'27.2"N **Longitude :** 79°35'45.1"E **Elevation (amsl) :** 1647 m	**Discharge** = 0.027 L/s **Temperature** = 28.3 °C **EC** = 115.6 µS/cm **pH** = 7.6 **Use:** The Spring is perennial but not accessible due to growth of shrub surrounding the source and therefore measurement has been taken on road side. **Landuse, soil and lithology:** This Spring is located near starting point of PMGSY Road to Kantli Village. Surrounding land cover of spring is forest. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is quartzite of Berinag formation (Jaunsar group) and gneiss of Augen gneiss (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications make its waters fit for drinking.	
Spring **Village :** Lwesal **Block :** Takula **District :** Almora, UK **Spring code :** SP016	**Latitude :** 29°50'25.5"N **Longitude :** 79°35'42.1"E **Elevation (amsl) :** 1654 m	**Discharge** = 1.182 L/s **Temperature** = 20.8 °C **EC** = 144 µS/cm **pH** = 7.8 **Use:** The water of this spring is tapped by people living downhill for general use of bathing washing clothes etc. **Landuse, soil and lithology:** This Spring is also located near starting point of PMGSY Road to Kantli Village. Surrounding land cover of spring is forest. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is quartzite of Berinag formation (Jaunsar group) and gneiss of Augen gneiss (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications make its waters fit for drinking.	

Spring	Coordinates	Physico-chemical characteristics	Photograph
Spring **Village :** Bijoria **Block :** Takula **District :** Almora, UK **Spring code :** SS017	**Latitude :** 29°50'11.8"N **Longitude :** 79°35'19.3"E **Elevation (amsl) :** 1652 m	**Discharge** = 0.12 L/s **Temperature** = 22.9 °C **EC** = 143 µS/cm **pH = 7.9** **Use:** The spring is located in Pachchisi village but water is used by villagers of Bijoria through supply line. The water of this spring is tapped by people for general use of bathing washing clothes etc. **Landuse, soil and lithology:** Surrounding land cover of spring is mixed type (agriculture and built-up). Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity which is high (37 NTU) than permissible limit of drinking water specifications.	
Dharabhakhi dhara **Village :** Bijoria **Block :** Takula **District :** Almora, UK **Spring code :** SP018	**Latitude :** 29°50'08.4"N **Longitude :** 79°35'19.4"E **Elevation (amsl) :** 1605 m	**Discharge** = 0.141 L/s **Temperature** = 20.5 °C **EC** = 111 µS/cm **pH** = 6.4 **Use:** Water of Dharabhakhi dhara is used for drinking and general purpose. **Landuse, soil and lithology:** Surrounding land use of dhara is built-up. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except pH which is slightly lower than acceptable limit.	
Kafadi Gadhera **Village :** Kafadi **Block :** Takula **District :** Almora, UK **Spring code :** SP019	**Latitude :** 29°50'21.9"N **Longitude :** 79°34'59.9"E **Elevation (amsl) :** 1654 m	**Discharge** = 2.443 L/s **Temperature** = 20.3 °C **EC** = 66 µS/cm **pH** = 6.1 **Use:** The brook is primarily used for general purpose (washing, bathing for cattles etc.). Secondary use of brook is for irrigation **Landuse, soil and lithology:** Surrounding land of brook is built-up on upstream and agricultural land on downstream. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except pH which is slightly lower than acceptable limit.	

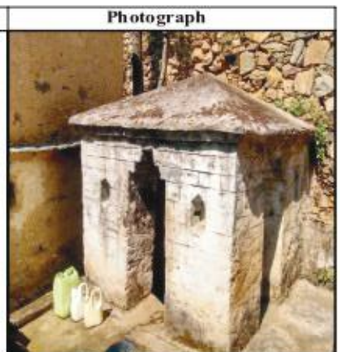
Spring	Coordinates	Physico-chemical characteristics	Photograph
Naula **Village :** Raulayana Guth **Block :** Takula **District :** Almora, UK **Spring code :** SP020	**Latitude :** 29°50'11.2"N **Longitude :** 79°34'51.1"E **Elevation (amsl) :** 1635 m	**Discharge** = 0.004 L/s **Temperature** = 20.9 °C **EC** = 574 µS/cm **pH** = 7.1 **Use:** This naula is used for general purpose of bathing sometimes. **Landuse, soil and lithology:** This naula is located at roadside in the village. Naula is surrounded by agricultural fields. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** Higher EC of water make it unfit for drinking as per IS 10500:2012. Rest of physico-chemical properties are within permissible limit of Indian drinking water specifications.	
Kholigair 1 naula **Village :** Raulayana Guth **Block :** Takula **District :** Almora, UK **Spring code :** SP021	**Latitude :** 29°50'18.0"N **Longitude :** 79°34'44.09"E **Elevation (amsl) :** 1656 m	**Discharge** = 0.039 L/s **Temperature** = 20.9 °C **EC** = 109 µS/cm **pH** = 6.7 **Use:** Water of the naula is potable and used by villagers for meeting all their daily water needs. **Landuse, soil and lithology:** Naula is surrounded by built-up land. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications make its waters fit for drinking.	
Kholigair 2 naula **Village :** Raulayana Guth **Block :** Takula **District :** Almora, UK **Spring code :** SP022	**Latitude :** 29°50'18.2"N **Longitude :** 79°34'44.1"E **Elevation (amsl):** 1658 m	**Discharge** = 0.131 L/s **Temperature** = 20.6 °C **EC** = 290 µS/cm **pH** = 6.8 **Use:** This naula is not used for drinking but used for other general purpose (bathing, washing clothes). **Landuse, soil and lithology:** Naula is surrounded by built-up land. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications make its waters fit for drinking.	

Spring	Coordinates	Physico-chemical characteristics	Photograph
Naula **Village :** Raulayana Guth **Block :** Takula **District :** Almora, UK **Spring code :** SP023	**Latitude :** 29°50'16"N **Longitude :** 79°34'43.8"E **Elevation (amsl) :** 1650 m	**Discharge** = 1.155 L/s **Temperature** = 18.7 °C **EC** = 485 µS/cm **pH** = 7.0 **Use:** The naula is used by public for all water needs except drinking. **Landuse, soil and lithology:** This naula is located near primary school surrounded by built-up land. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** Higher EC of water make it unfit for drinking as per IS 10500:2012. Rest of physico-chemical properties are within permissible limit of Indian drinking water specifications.	
Spring **Village :** Bijoria **Block :** Takula **District :** Almora, UK **Spring code :** SP024	**Latitude :** 29°50'23.6"N **Longitude :** 79°35'39.1"E **Elevation (amsl) :** 1668 m	**Discharge** = 0.021 L/s **Temperature** = 22.3 °C **EC** = 29.4 µS/cm **pH** = 7.5 **Use:** Water of this spring is used by people living downhill for general use other than drinking. **Landuse, soil and lithology:** This spring is located on the way to Kantali village in Bijoria. Surrounding land of spring is forest cover. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is quartzite of Berinag formation (Jaunsar group) and gneiss of Augen gneiss (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications make its waters fit for drinking.	
Dhara **Village :** Garura **Block :** Takula **District :** Almora, UK **Spring code :** SP029	**Latitude :** 29°49'00.7"N **Longitude :** 79°36'49.7"E **Elevation (amsl) :** 1468 m	**Discharge** = 0.074 L/s **Temperature** = 21.3 °C **EC** = 51.8 µS/cm **pH** = 7.3 **Use:** Water of dhara is potable and used for drinking and all other general purpose. Soil is Typic-Udorthents and rock type is dolomite of Deoban formation (Tejum group). **Landuse, soil and lithology:** This dhara is located near primary school in Garura. Dhara is surrounded by built-up land. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group) **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications make its waters fit for drinking.	

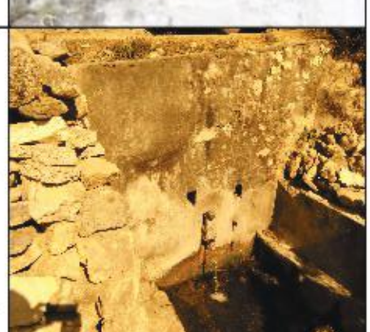
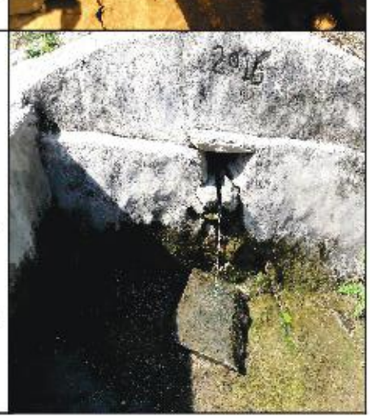
Spring	Coordinates	Physico-chemical characteristics	Photograph
Dhara **Village :** Garura **Block :** Takula **District :** Almora, UK **Spring code :** SP030	**Latitude :** 29°49'10.8"N **Longitude :** 79°36'45.1"E **Elevation (amsl) :** 1482 m	**Discharge** = 0.287 L/s. **Temperature** = 20.8 °C **EC** = 36.4 µS/cm **pH** = 6.3 **Use:** This dhara in Garura village is located on roadside. Water of dhara is potable and used for general purpose. **Landuse, soil and lithology:** Dhara is surrounded by built-up land. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except pH which is slightly lower than acceptable limit.	
Dhara **Village :** Bartola **Block :** Takula **District :** Almora, UK **Spring code :** SP031	**Latitude :** 29°49'58.4"N **Longitude :** 79°36'08.8"E **Elevation (amsl) :** 1504 m	**Discharge** = 0.378 L/s **Temperature** = 21.3 °C **EC** = 62.6 µS/cm **pH** = 6.9 **Use:** The spring is potable and used for general purpose of drinking, clothing and sanitation. **Landuse, soil and lithology:** Dhara is surrounded by built-up land. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications make its waters fit for drinking.	
Naula **Village :** Kausani **Block :** Takula **District :** Almora, UK **Spring code :** SP039	**Latitude :** 29°50'17.9"N **Longitude :** 79°36'29.2"E **Elevation (amsl) :** 1742 m	**Discharge** = 0.004 L/s **Temperature** = 20.8 °C **EC** = 125.3 µS/cm **pH** = 6.5 **Use:** Water is potable and used primarily for drinking and alternatively for all daily water requirements. **Landuse, soil and lithology:** The naula is located in Laxmi Ashram. Naula is surrounded by mixed agricultural and built-up land. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications make its waters fit for drinking.	

Spring	Coordinates	Physico-chemical characteristics	Photograph
Dhara **Village :** Channi Lwesal **Block :** Takula **District :** Almora, UK **Spring code :** SP042	**Latitude :** 29°49'45.6"N **Longitude :** 79°36'00.5"E **Elevation (amsl) :** 1542 m	**Discharge** = 0.432 L/s **Temperature** = 19.1 °C **EC** = 46.3 µS/cm **pH** = 6.2 **Use:** Dhara of Channi village is potable and used for general purpose. **Landuse, soil and lithology:** Dhara is surrounded by mixed agricultural and built-up land. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity which is slightly high (6.32 NTU) and pH which is slightly low (6.2).	
Malla dhara **Village :** Tola **Block :** Takula **District :** Almora, UK **Spring code :** SP044	**Latitude :** 29°49'13.4"N **Longitude :** 79°36'23.3"E **Elevation (amsl) :** 1516 m	**Discharge** = 0.343 L/s **Temperature** = 21 °C **EC** = 55.5 µS/cm **pH** = 6.7 **Use:** Water is potable but primarily used for irrigation. Secondary use of Dhara is washing clothes. **Landuse, soil and lithology:** Dhara is surrounded by agricultural land. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit	
Dhara **Village :** Donni **Block :** Takula **District :** Almora, UK **Spring code :** SP062	**Latitude :** 29°50'33.2"N **Longitude :** 79°38'02.1"E **Elevation (amsl) :** 1654 m	**Discharge** = 0.216 L/s **Temperature** = 17.9 °C **EC** = 27.5 µS/cm **pH** = 6.2 **Use:** Dhara of Donni village is not potable and therefore used for all other water requirements other than drinking. **Landuse, soil and lithology:** Dhara is surrounded by forest cover. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity which is slightly high (9.2 NTU) and pH which is slightly lower (6.2) than acceptable limit.	

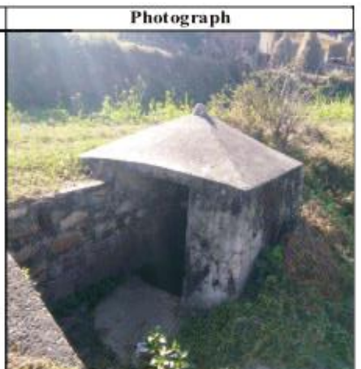
Spring	Coordinates	Physico-chemical characteristics	Photograph
Dhara **Village :** Bheta **Block :** Takula **District :** Almora, UK **Spring code :** SP080	**Latitude :** 29°48'53.6"N **Longitude :** 79°37'58.6"E **Elevation (amsl) :** 1497 m	**Discharge** = 0.224 L/s **Temperature** = 19.2 °C **EC** =91.6 µS/cm **pH** = 6.4 **Use:** Dhara of Bheta village is perennial, potable and used for General Purpose. **Landuse, soil and lithology:** Dhara is surrounded by built-up land. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except pH which is slightly lower than acceptable limit.	
Dhara **Village :** Saijari **Block :** Takula **District :** Almora, UK **Spring code :** SP083	**Latitude :** 29°49'17.2"N **Longitude :** 79°38'13.5"E **Elevation (amsl) :** 1554 m	**Discharge** = 0.045 L/s **Temperature** = 20.7 °C **EC** =40.1 µS/cm **pH** = 6.8 **Use:** Dhara of Saijri village is perennial. Water is potable and used for general Purpose. **Landuse, soil and lithology:** Dhara is surrounded by agricultural land. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity which is slightly high (9.52 NTU).	
Dhara **Village :** Khakoli **Block :** Takula **District :** Almora, UK **Spring code :** SP094	**Latitude :** 29°48'00.2"N **Longitude :** 79°37'05.4"E **Elevation (amsl):** 1493 m	**Discharge** = 0.073 L/s **Temperature** = 19.6 °C **EC** = 148.6 µS/cm **pH** = 7.1 **Use:** Dhara is perennial potable and used for drinking, bathing and washing clothes. **Landuse, soil and lithology:** Dhara is surrounded by mixed agricultural and built-up land. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is slate of Rautgara formation (Damtha group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	

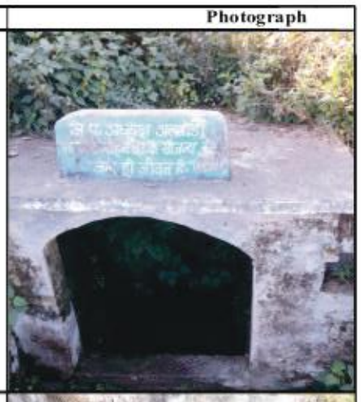
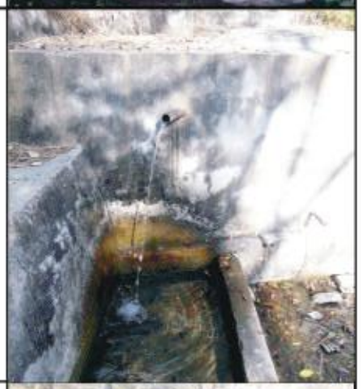
Spring	Coordinates	Physico chemical characteristics	Photograph
Naula **Village :** Adhuria **Block :** Takula **District :** Almora, UK **Spring code :** SP110	**Latitude :** 29°47'52.8"N **Longitude :** 79°36'11.1"E **Elevation (amsl) :** 1481 m	**Discharge** = 0.014 L/s **Temperature** = 20.9 °C **EC** = 160.2 µS/cm **pH** = 7.2 **Use:** This naula is perennial source of water. Water is potable and primarily used for drinking purpose. **Landuse, soil and lithology:** Naula is surrounded by built-up land. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is slate of Rautgara formation (Damtha group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity which is slightly high (8.32 NTU).	
Narukutli dhara **Village :** Dalmori **Block :** Takula **District :** Almora, UK **Spring code :** SP129	**Latitude :** 29°46'37.1"N **Longitude :** 79°35'48.5"E **Elevation (amsl) :** 1407 m	**Discharge** = 0.128 L/s **Temperature** = 17.9 °C **EC** = 63.5 µS/cm **pH** = 6.5 **Use:** Source of water of Narukutli dhara is perennial and primarily used for drinking. **Landuse, soil and lithology:** Dhara is surrounded by agricultural land. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity which is slightly high (12.8 NTU).	
Balle dhara **Village :** Balle **Block :** Takula **District :** Almora, UK **Spring code :** SP165	**Latitude :** 29°47'24.0"N **Longitude :** 79°33'05.3"E **Elevation (amsl) :** 1574 m	**Discharge** = 0.103 L/s **Temperature** = 20.3 °C **EC** = 78.5 µS/cm **pH** = 6.3 **Use:** Water of Balle dhara is potable and primarily used for drinking and clothing. **Landuse, soil and lithology:** Dhara is surrounded by built-up land. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except pH which is slightly lower than acceptable limit.	

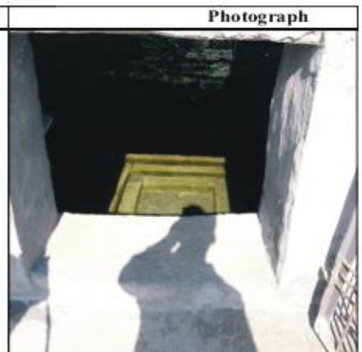
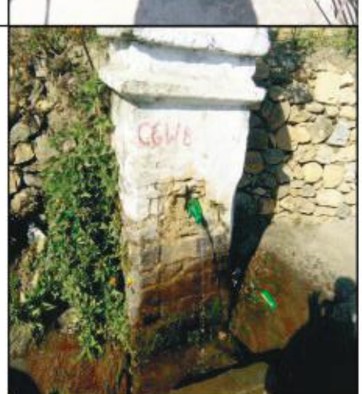
Spring	Coordinates	Physico-chemical characteristics	Photograph
Quarali dhara **Village :** Kwerali **Block :** Takula **District :** Almora, UK **Spring code :** SP168	**Latitude :** 29°47'1.7"N **Longitude :** 79°33'24.9"E **Elevation (amsl) :** 1556 m	**Discharge** = 0.834 L/s **Temperature** = 19.8 °C **EC** = 53.4 µS/cm **pH** = 6.2 **Use:** Water is potable and primarily used for general purpose. Secondary use of dhara is for irrigation purpose. **Landuse, soil and lithology:** Dhara is surrounded by built-up land. Soil is Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except pH which is slightly lower than acceptable limit.	
Brakhi dhara **Village :** Sutoli **Block :** Takula **District :** Almora, UK **Spring code :** SP179	**Latitude :** 29°47'21.6"N **Longitude :** 79°35'05.6"E **Elevation (amsl) :** 1461 m	**Discharge** = 0.206 L/s **Temperature** = 19.3 °C **EC** = 179 µS/cm **pH** = 7.6 **Use:** Water is potable and used for drinking purpose. **Landuse, soil and lithology:** Dhara is surrounded by built-up land. Soil is Typic-Udorthents and rock type is slate of Rautgara formation (Damtha group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	
Mungru dhara **Village :** Salooj **Block :** Takula **District :** Almora, UK **Spring code :** SP203	**Latitude :** 29°47'14.1"N **Longitude :** 75°33'59.4E **Elevation (amsl) :** 1521 m	**Discharge** = 0.112 L/s **Temperature** = 18.9 °C **EC** = 35.2 µS/cm **pH** = 6.4 **Use:** Water of Mungru dhara is potable and primarily used for drinking purpose. **Landuse, soil and lithology:** Dhara is surrounded by built-up land. Soil is Typic-Udorthents and rock type is slate of Rautgara formation (Damtha group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except pH which is slightly lower than acceptable limit.	

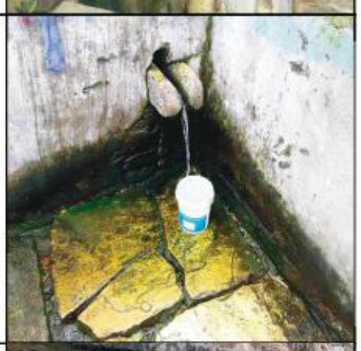
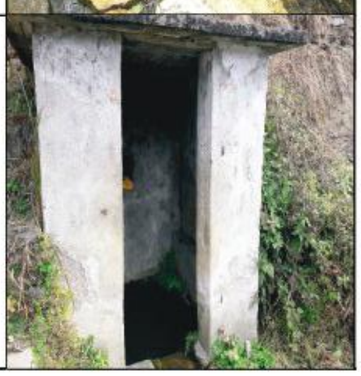
Spring	Coordinates	Physico-chemical characteristics	Photograph
Dhara **Village :** Lodh **Block :** Takula **District :** Almora, UK **Spring code :** SP210	**Latitude :** 29°47'04.7"N **Longitude :** 79°31'47.0"E **Elevation (amsl) :** 1651 m	**Discharge** = 0.012 L/s **Temperature** = 15.3 °C **EC** = 81.2 µS/cm **pH** = 7.6 **Use:** Water of dhara in Lodh village is potable and used by people for drinking purpose. **Landuse, soil and lithology:** Dhara is surrounded by mixed agricultural and built-up land. Soil is Dystric Eutrochrepts associated with Typic-Udorthents and rock type is quartzite of Berinag formation (Jaunsar group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	
Dhara **Village :** Bholgaon **Block :** Takula **District :** Almora, UK **Spring code :** SP23	**Latitude :** 29°47'57.5"N **Longitude :** 79°40'53.2"E **Elevation (amsl) :** 1562 m	**Discharge** = 0.454 L/s **Temperature** = 14.3 °C **EC** = 237 µS/cm **pH** = 7.3 **Use:** Water is potable and primarily used by people for drinking purpose. Dhara in Bholgaon is located near roadside (road to Bageshwar). Secondary use of water is for clothing. **Landuse, soil and lithology:** Dhara is surrounded by mixed agricultural and built-up land. Soil is Typic-Udorthents and rock type is dolomite of Deoban formation (Tejum group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	
Talla dhara **Village :** Bhaisal Gaon **Block :** Takula **District :** Almora, UK **Spring code :** SP253	**Latitude :** 29°47'26.2"N **Longitude :** 79°39'18.2"E **Elevation (amsl) :** 1468 m	**Discharge** = 0.075 L/s **Temperature** = 19.9 °C **EC** = 79.2 µS/cm **pH** = 6.5 **Use:** Water is potable and used for drinking purpose. The dhara has been repaired in 2016. **Landuse, soil and lithology:** Talla dhara is located approximately 500 m left side of road to village. Surrounding land is used for agriculture. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is slate of Rautgara formation (Damtha group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	

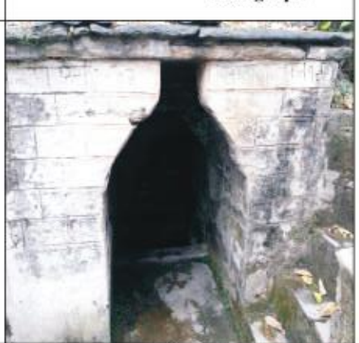
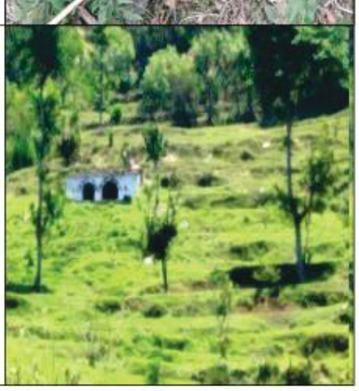
Spring	Coordinates	Physico-chemical characteristics	Photograph
Moti Banj dhara **Village :** Satreshi Arediya **Block :** Takula **District :** Almora, UK **Spring code :** SP266	**Latitude :** 29°46'37.3"N **Longitude :** 79°37'58.5"E **Elevation (amsl) :** 1454 m	**Discharge** = 0.131 L/s **Temperature** = 14.4 °C **EC** = 24.7 µS/cm **pH** = 6.9 **Use:** Primary use of water is for drinking. **Landuse, soil and lithology:** Moti Banj dhara is located in middle part of village. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is slate of Rautgara formation (Damtha group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity which is slightly high (33.3 NTU).	
Dhara **Village :** Bhanarat **Block :** Takula **District :** Almora, UK **Spring code :** SP270	**Latitude :** 29°44'15.7"N **Longitude :** 79°35'33.5"E **Elevation (amsl) :** 1477 m	**Discharge** = 0.04 L/s **Temperature** = 20.8 °C **EC** = 50.6 µS/cm **pH** = 6.9 **Use:** Water of dhara in Bhanarat village is potable and used for drinking. **Landuse, soil and lithology:** Dhara is surrounded by mixed agricultural and built-up land. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is slate of Rautgara formation (Damtha group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	
Toiya ka naula **Village :** Sunari **Block :** Takula **District :** Almora, UK **Spring code :** SP303	**Latitude :** 29°44'56.1"N **Longitude :** 79°37'27.1"E **Elevation (amsl) :** 1399 m	**Discharge** = 0.005 L/s **Temperature** = 14.8°C **EC** = 415 µS/cm **pH** = 7.6 **Use:** Teer ka naula is perennial source of water located lower side of starting point of village .Water is potable and used for drinking by nearby people. Secondary use of naula is for clothing and bathing. **Landuse, soil and lithology:** Surrounding land use is agricultural land. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** Higher EC and turbidity (33.3 NTU) of water make it unfit for drinking as per IS 10500:2012. Rest of physico-chemical properties are within permissible limit of Indian drinking water specifications.	

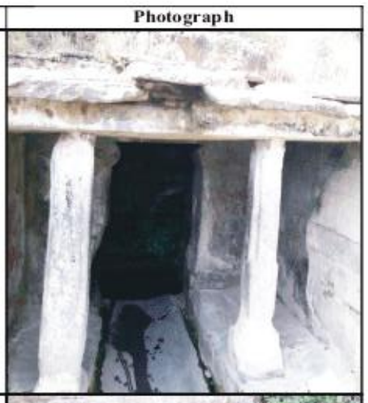
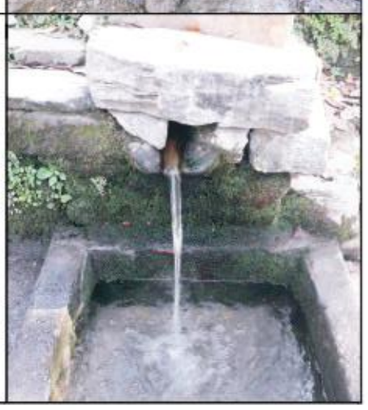
Spring	Coordinates	Physico-chemical characteristics	Photograph
Murachoy ka naula-1 **Village :** Tana **Block :** Takula **District :** Almora, UK **Spring code :** SP287	**Latitude :** 29°46'11.7"N **Longitude :** 79°37'02.8"E **Elevation (amsl) :** 1356 m	**Discharge** = 0.018 L/s **Temperature** = 14.5°C **EC** = 60.2 µS/cm **pH** = 6.2 **Use:** Murachoy ka naula-1 is perennial located near road to Someshwar (200 m down to road) and water is potable. Primary use of naula is clothing. **Landuse, soil and lithology:** Surrounding land use is agricultural land. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity (66.6 NTU) which is higher and pH which is slightly lower than acceptable limit of Indian drinking water specifications.	
Toiya ka naula **Village :** Sunari **Block :** Takula **District :** Almora, UK **Spring code :** SP303	**Latitude :** 29°44'56.1"N **Longitude :** 79°37'27.1"E **Elevation (amsl) :** 1399 m	**Discharge** = 0.003 L/s **Temperature** = 13°C **EC** = 307 µS/cm **pH** = 6.3 **Use:** Toiya ka naula is located approximately 250 m upward of road at the end/ margin of Sunari village. Source is perennial and water is potable used by people of nearby 02 household for all purpose (i.e. drinking, bathing, clothing etc). **Landuse, soil and lithology:** Surrounding land use is forest. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** Higher EC and turbidity (148 NTU) of water and pH lower than acceptable limit make it unfit for drinking as per IS 10500:2012. Rest of physico-chemical properties are within permissible limit of Indian drinking water specifications.	
Dhar ka naula **Village :** Nireai **Block :** Takula **District :** Almora, UK **Spring code :** SP316	**Latitude :** 29°45'53.4"N **Longitude :** 79°38'32.3"E **Elevation (amsl) :** 1402 m	**Discharge** = 0.006 L/s **Temperature** = 16.4°C **EC** = 26.1 µS/cm **pH** = 6.8 **Use:** Dhar ka naula is located in mid of village having perennial source of water used by people for drinking only. **Landuse, soil and lithology:** Surrounding land use is built-up. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity which is slightly high (11.0 NTU).	

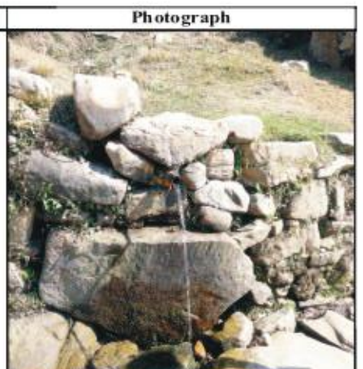
Spring	Coordinates	Physico-chemical characteristics	Photograph
Kanai ka naula **Village :** Majhera Mafi **Block :** Takula **District :** Almora, UK **Spring code :** SP335	**Latitude :** 29°43'19.2"N **Longitude :** 79°37'04.6"E **Elevation (amsl) :** 1298 m	**Discharge** = 0.006 L/s **Temperature** = 15.2 °C **EC** = 133.5 µS/cm **pH** = 6.8 **Use:** Water is potable and used for general purpose of drinking and bathing. Kanai ka naula is located at roadside in Majhera Mafi village. **Landuse, soil and lithology:** Surrounding land use is built-up and agriculture. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Gneiss of Augen Gneiss formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity which is slightly high (9.3 NTU).	
Dhara **Village :** Shakaniyakot **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP365	**Latitude :** 29°42'23.4"N **Longitude :** 79°38'21.4"E **Elevation (amsl) :** 1421 m	**Discharge** = 0.207 L/s **Temperature** = 19.1 °C **EC** = 106 µS/cm **pH** = 7.1 **Use:** Dhara in Shakaniyakot village is located downward left hand side of ending point of village (way to access is 5 km trekking from Bhagtola village). Water is potable and used for general purpose like drinking and bathing. **Landuse, soil and lithology:** Surrounding land use is forest. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Gneiss of Augen Gneiss formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	
Naugair naula **Village :** Patlibagad **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP377	**Latitude :** 29°40'33.2"N **Longitude :** 79°38'26.1"E **Elevation (amsl) :** 1216 m	**Discharge** = 0.714 L/s **Temperature** = 13.7 °C **EC** = 67.4 µS/cm **pH** = 7.0 **Use:** Naugair naula is located near Walsa village but in the boundary of Patlibagad village. People of Walsa village used its water for drinking only. Secondary use is clothing and bathing. **Landuse, soil and lithology:** Surrounding land use is agricultural land. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	

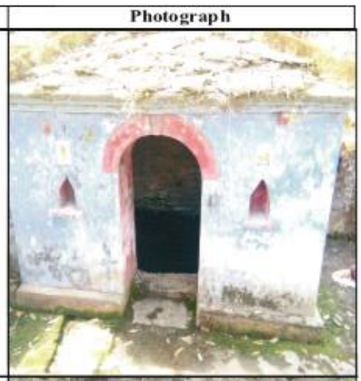
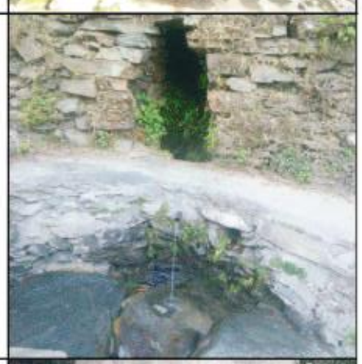
Spring	Coordinates	Physico chemical characteristics	Photograph
Naula **Village :** Neanoli **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP377	**Latitude :** 29°41'35.9"N **Longitude :** 79°37'10.6"E **Elevation (amsl) :** 1487 m	**Discharge** = 0.006 L/s **Temperature** = 16 °C **EC** = 72.3 µS/cm **pH** = 7.6 **Use:** Water of naula is potable and used for general purpose of drinking. **Landuse, soil and lithology:** Surrounding land use is fallow land. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	
Dhara **Village :** Gulkande **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP398	**Latitude :** 29°39'40.1"N **Longitude :** 79°38'16.3"E **Elevation (amsl) :** 1188 m	**Discharge** = 0.042 L/s **Temperature** = 19.2 °C **EC** = 93.5 µS/cm **pH** = 6.3 **Use:** Dhara in Gulkande is located on left side of road (Kosi to Manan) in Gulkande village. Water of dhara is potable and used for drinking. **Landuse, soil and lithology:** Surrounding land use is agricultural land. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except pH which is slightly lower than acceptable limit.	
Dhara **Village :** Gulkande **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP423	**Latitude :** 29°38'48.3"N **Longitude :** 79°38'46.3"E **Elevation (amsl) :** 1278 m	**Discharge** = 0.428 L/s **Temperature** = 14.3 °C **EC** = 114 µS/cm **pH** = 7.4 **Use:** Dhara is located on roads to Hawalbagh to Pilkha (500 m upward) in Jyoli village. Water of dhara is primary used for clothing. Water of Dhara is potable and Some people also used for drinking. **Landuse, soil and lithology:** Surrounding land use is agricultural land. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	

Spring	Coordinates	Physico chemical characteristics	Photograph
Parbakhai dhara- 1 **Village :** Barsimi **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP455	**Latitude :** 29°39'53.6"N **Longitude :** 79°36'52.2"E **Elevation (amsl) :** 1358 m	**Discharge** = 0.06 L/s **Temperature** = 19.8 °C **EC** = 86.4 µS/cm **pH** = 6.2 **Use:** Parbakhai dhara- 1 is located at the end of village. Water of dhara is potable and used for drinking only. **Landuse, soil and lithology:** Surrounding land use is wasteland. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity (8.19 NTU) which is slightly higher and pH which is slightly lower than acceptable limit of Indian drinking water specifications.	
Khadau dhara **Village :** Kharau **Block :** Takula **District :** Almora, UK **Spring code :** SP466	**Latitude :** 29°41'34.2"N **Longitude :** 79°40'38.0"E **Elevation (amsl) :** 1311 m	**Discharge** = 0.112 L/s **Temperature** = 18.3 °C **EC** = 89.6 µS/cm **pH** = 7.2 **Use:** Khadau dhara is located in mid of Kharau village. Water is potable and primarily used for drinking. Secondary use of dhara is for clothing and bathing. **Landuse, soil and lithology:** Surrounding land use is built-up. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	
Naula **Village :** Daulaghat **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP511	**Latitude :** 29°40'03.9"N **Longitude :** 79°34'43.9"E **Elevation (amsl) :** 1276 m	**Discharge** = 0.007 L/s **Temperature** = 16.6 °C **EC** = 171.5 µS/cm **pH** = 8.5 **Use:** The selected naula in Dhaulaghat is located at the end of market area. General purpose of water is for drinking. Source is perennial and water is potable. **Landuse, soil and lithology:** Surrounding land use is built-up. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	

Spring	Coordinates	Physico-chemical characteristics	Photograph
Govindpur naula **Village :** Ramda Govindpur **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP524	**Latitude :** 29°40'48.0"N **Longitude :** 79°34'01.9"E **Elevation (amsl) :** 1311 m	**Discharge** = 0.004 L/s **Temperature** = 14.2 °C **EC** = 90.1 µS/cm **pH** = 7.6 **Use:** Govindpur naula is located at downward side of market. Primary use of naula is for drinking and clothing. **Landuse, soil and lithology:** Surrounding land use is agriculture. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity which is slightly high (8.7 NTU).	
Mungru ka naula **Village :** Odala **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP553	**Latitude :** 29°41'28.4"N **Longitude :** 79°34'3.1"E **Elevation (amsl) :** 1413 m	**Discharge** = 0.375 L/s **Temperature** = 16.4 °C **EC** = 81.3 µS/cm **pH** = 7.0 **Use:** Mungru ka naula is located at the end of village (1.5 km trekking from road). Naula is filled with silt and water coming out of aquifer is collected in a water tank for use of drinking, clothing and bathing. Although, there are two other naula in the village but they have very less use value due to pollution in one and very less flow in other. **Landuse, soil and lithology:** Surrounding land use is wasteland. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	
Naula **Village :** Rikhe **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP561	**Latitude :** 29°40'40.1"N **Longitude :** 79°35'35.5"E **Elevation (amsl) :** 1371 m	**Discharge** = 0.01 L/s **Temperature** = 14.9 °C **EC** = 148.6 µS/cm **pH** = 7.3 **Use:** Naula is located at upper right hand side of the way to village (400 m before entering to village). The naula is primarily used for clothing. Secondary use is for drinking in summer season/ water scarcity condition. **Landuse, soil and lithology:** Surrounding land use is agricultural land. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	

Spring	Coordinates	Physico-chemical characteristics	Photograph
Naula **Village :** Dwarso **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP580	**Latitude :** 29°39'31.3"N **Longitude :** 79°32'23.0"E **Elevation (amsl) :** 1670 m	**Discharge** = 0.01 L/s **Temperature** = 13.6 °C **EC** = 106.4 µS/cm **pH** = 6.7 **Use:** This naula is located on roadside (leftside on road from Katpuria to kwerala) at the end of village. Primary used for clothing, water is potable and some people also used its water for drinking. **Landuse, soil and lithology:** Surrounding land use is agricultural land. Soil is Dystric Eutrochrepts associated withTypic Udorthents and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	
Dhara **Village :** Papoli **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP594	**Latitude :** 29°39'00.8"N **Longitude :** 79°34'26.4"E **Elevation (amsl) :** 1468 m	**Discharge** = 0.088 L/s **Temperature** = 13.2 °C **EC** = 75.4 µS/cm **pH** = 6.4 **Use:** This dhara is located near Punchayat Ghar of Papoli Gram Sabha. Water of dhara is potable and used for drinking by villagers of Papoli and Garhwali village. **Landuse, soil and lithology:** Land use surrounding of dhara is built-up. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	
Dak Bangla dhara **Village :** Katarmal **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP610	**Latitude :** 29°38'20.7"N **Longitude :** 79°36'52.5"E **Elevation (amsl) :** 1271 m	**Discharge** = 0.207 L/s **Temperature** = 18.2 °C **EC** = 151 µS/cm **pH** = 6.5 **Use:** Dak Bangla dhara is located on left hand side of road from Kosi to Ranikhet (1 Km ahead of Paryavaran Sansthan). Source is perennial and water is potable. Water of dhara is supplied for Katarmal village and GB Pant Institute). **Landuse, soil and lithology:** Land use surrounding of dhara is forest. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	

Spring	Coordinates	Physico-chemical characteristics	Photograph
Madi dhara **Village :** Madi **Block :** Takula **District :** Almora, UK **Spring code :** SP621	**Latitude :** 29°48'25.0"N **Longitude :** 79°34'59.2"E **Elevation (amsl) :** 1728 m	**Discharge** = 0.227 L/s **Temperature** = 16.6 °C **EC** = 57.2 µS/cm **pH** = 7.2 **Use:** Madi dhara is located between Madi and Tana village. Primary use of water is for drinking. **Landuse, soil and lithology:** Land use surrounding of dhara is agricultural. Soil is Dystric Eutrochrepts associated with Typic-Udorthents and rock type is dolomite of Deoban formation (Tejam Group) **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	
Dhara **Village :** Jainal **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP679	**Latitude :** 29°42'52.8"N **Longitude :** 79°35'48.2"E **Elevation (amsl) :** 1626 m	**Discharge** = 0.025 L/s **Temperature** = 10.5 °C **EC** = 61.8 µS/cm **pH** = 6.4 **Use:** Water of dhara inJainal village is drinkable and used for drinking primarily. **Landuse, soil and lithology:** Surrounding land use is forest. Soil is Dystric Eutrochrepts associated withTypic Udorthents and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except pH which is slightly lower than acceptable limit.	
Pan dhara **Village :** Pilkha **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP689	**Latitude :** 29°39'51.6"N **Longitude :** 79°39'31.7"E **Elevation (amsl) :** 1300 m	**Discharge** = 0.006 L/s **Temperature** = 8.2°C **EC** = 159 µS/cm **pH** = 7.4 **Use:** Pan dhara in Pilkha village is located at lower side of village near houses of scheduled cast and primarily used by these people to fulfill all water requirements. A tank was constructed in 2005-06 to store excess water. **Landuse, soil and lithology:** Land use surrounding of dhara is wasteland. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	

Spring	Coordinates	Physico-chemical characteristics	Photograph
Naula **Village :** Bhatgad **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP719	**Latitude :** 29°43'56.1"N **Longitude :** 79°38'00.4"E **Elevation (amsl) :** 1574 m	**Discharge** = 0.007 L/s **Temperature** = 18.1 °C **EC** = 71.1 µS/cm **pH** = 7.5 **Use:** This naula is located in mid of village. Water is potable and used for drinking primarily. Secondary use are bathing and clothing. **Landuse, soil and lithology:** Surrounding land is built-up on upper side and agricultural land at lower side. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	
Shilangiya ka dhara **Village :** Shilangiya Gaon **Block :** Hawalbagh **District :** Almora, UK **Spring code :** SP739	**Latitude :** 29°43'28.2"N **Longitude :** 79°39'24.5"E **Elevation (amsl) :** 1588 m	**Discharge** = 0.083 L/s **Temperature** = 15.8 °C **EC** = 97.8 µS/cm **pH** = 8.2 **Use:** Shilangiya ka dhara is located at lower side of village and used for drinking water. Source of water is perennial and potable. **Landuse, soil and lithology:** Surrounding land use is agricultural land. Soil is Dystric Eutrochrepts associated with Typic Udorthents and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except turbidity which is slightly high (11.9 NTU).	
Dhara **Village :** Patiya **Block :** Takula **District :** Almora, UK **Spring code :** SP788	**Latitude :** 29°40'41.1"N **Longitude :** 79°40'53.5"E **Elevation (amsl) :** 1292 m	**Discharge** = 0.147 L/s **Temperature** = 12.4 °C **EC** = 127.6 µS/cm **pH** = 6.2 **Use:** This dhara is located on road in Patiya village (Patlibagad to Kapad Khan). Water of dhara is used for drinking only. **Landuse, soil and lithology:** Surrounding land use is wasteland. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications except pH which is slightly lower than acceptable limit.	

Spring	Coordinates	Physico-chemical characteristics	Photograph
Dhara **Village :** Bhanarigair **Block :** Takula **District :** Almora, UK **Spring code :** SP838	**Latitude :** 29°42'2.5"N **Longitude :** 79°43'14.9"E **Elevation (amsl) :** 1535 m	**Discharge** = 0.075 L/s **Temperature** = 11.8 °C **EC** = 89.3 µS/cm **pH** = 7.3 **Use:** Dhara of Bhanarigair is located on roadside (left side) at the ending of village. Water of dhara is used for drinking purpose only. **Landuse, soil and lithology:** Surrounding land of dhara forest. Soil is Typic-Udorthents and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	
Dhara **Village :** Jharkote **Block :** Takula **District :** Almora, UK **Spring code:** SP868	**Latitude :** 29°43'58.9"N **Longitude :** 79°41'30.2"E **Elevation (amsl) :** 1416 m	**Discharge** = 0.21 L/s **Temperature** = 18.4 °C **EC** = 65.0 µS/cm **pH** = 7.8 **Use:** Dhara of Jharkot is located at 3 km left side of road from Basoli to Takula. Water of dhara is primarily used for drinking. **Landuse, soil and lithology:** Land surrounding of dhara is wasteland. Soil is Typic-Udorthents associated with Dystric Eutrochrepts and rock type is Schist and Gneiss of Saryu-Munsiyari-Gumalikhet formation (Almora group). **Remarks:** All physico-chemical properties of water are within permissible limit of drinking water specifications.	

Geo-tagging spring information

The geo-tagged information of all 931 springs is depicted in Figure 3. The locations of springs whose inventory has been made are shown in red colour symbol, while the other springs are shown in green. The information collected by these surveys is supposed to be helpful in ascertaining the present status and the spatio-temporal change in physico-chemical attributes.

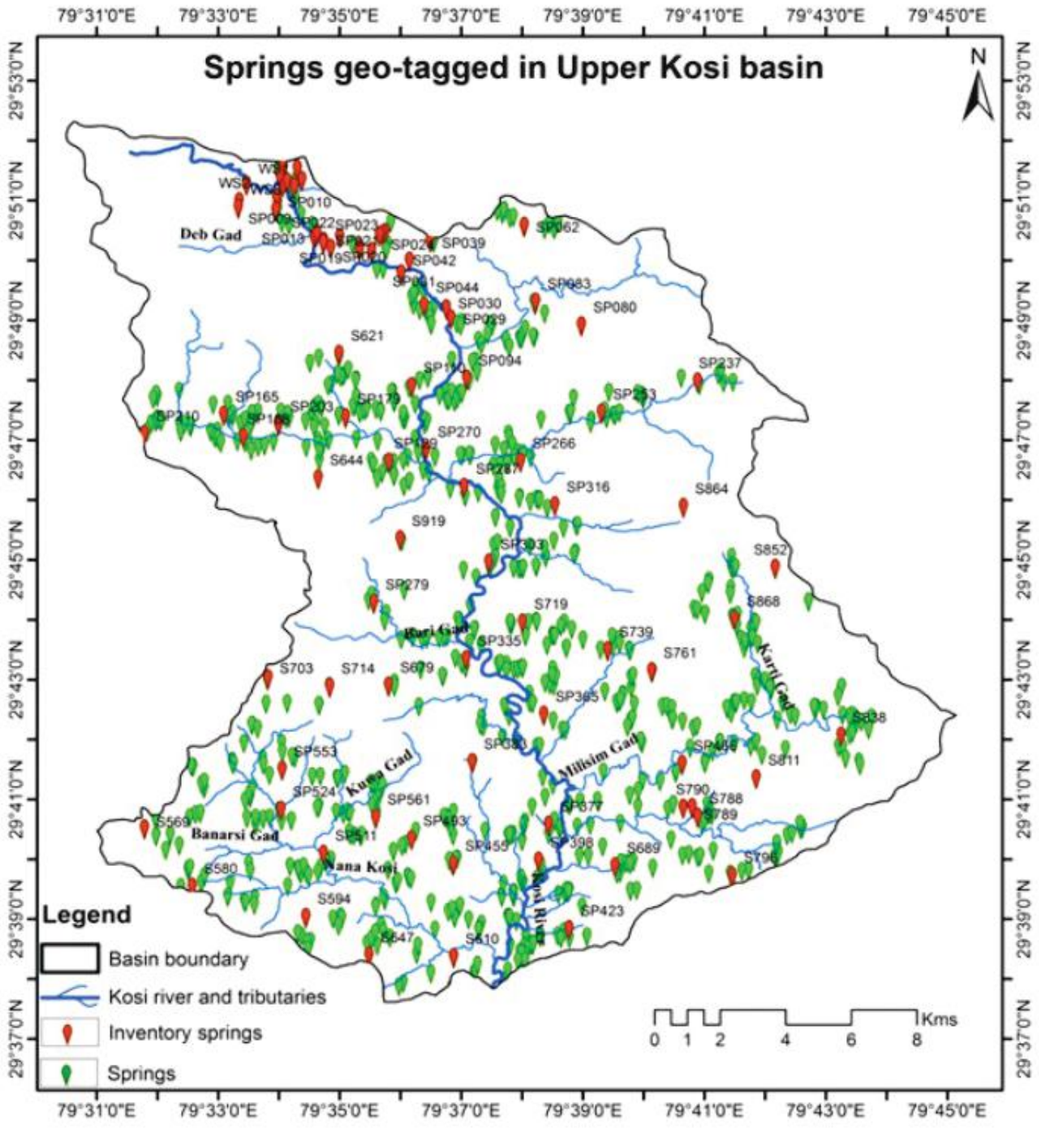


Figure 3 : Geo-tagged springs in Upper Kosi basin

Seasonal change in physico-chemical properties of springs water

The seasonal range of some physico-chemical parameters and discharge of 74 identified springs is shown in Table 2, and the spatial annual range of pH, EC, and temperature is depicted in Figure 4. The monitoring of the springs done during the year 2017, reveals a temperature range of 7.3 to 23.1 °C (average=17.2 °C) in summers and 6.9 to 21.3 °C (average=15.7 °C) in winters. The EC of springs ranged from 19.9-574.0 µS/cm (average=110.8 µS/cm) in summers and 14.3-706 µS/cm (average=95.4 µS/cm) in winters. All the springs except 2, indicate rise in EC value in summers as compared to winters. The EC of water is directly related to recharge of aquifer through precipitation. The reason of high EC in summer could be negligible recharge of groundwater due to less rainfall during winters. Moreover the pH of spring water found to be higher in winters as compared to summers (5.2-8.4; average=7.0 in winters and 6.0-8.6; average=7.2 in summers).

Table 2. Seasonal values of physico-chemical parameters of identified springs

Parameter	Winter		Summer	
	Range	Average Value	Range	Average Value
Temperature (°C)	6.9 - 21.3	15.7	7.3 - 23.1	17.2
pH	6.4 - 8.4	7.4	6.0 - 8.5	6.9
EC (µS/cm)	14.3-706	95.4	19.9-574	110.8
Discharge (L/s)	0.001 -2.05	0.23	0001 1.6	0.13

All the springs indicated lower discharge in summer (min=0.001 L/s, max=1.6 L/s, average=0.13 L/s) as compared to winters (min=0.001 L/s, max=2.05 L/s, average=0.23 L/s). The major reason seems to be less rainfall in winters. Quick response of rainfall on spring discharge indicated low depth and small size of aquifers in this basin. None of the identified springs were found to have the discharge greater than 6.3 L/s during dry weather which put them in the category of magnitude 5 or greater. A few zero magnitude springs were also identified in Upper Kosi basin.

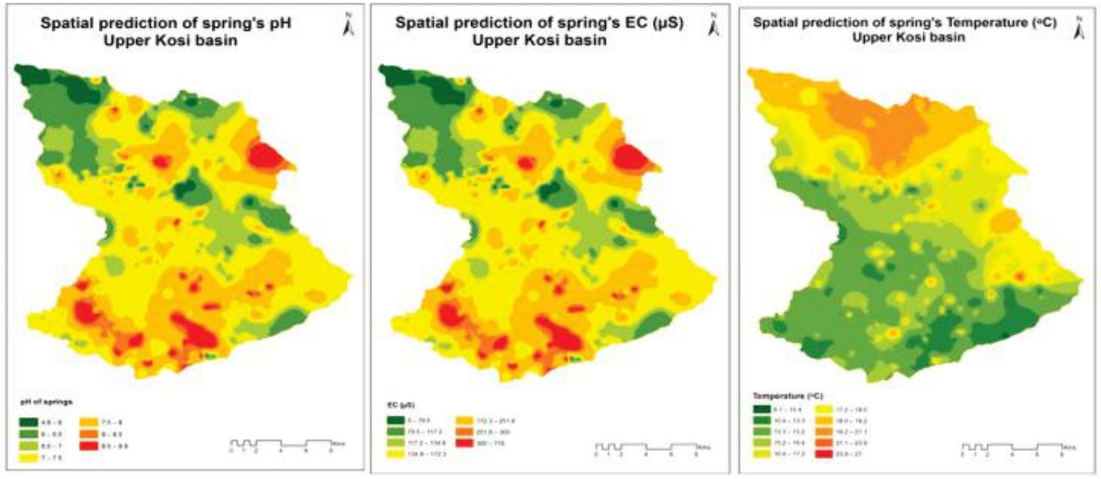


Figure 4 : Spatial variation in pH, electrical conductivity (EC) and temperature of spring water

Figure 4 is a depiction of pH, EC and temperature information of 931 springs. The maps indicate that water of springs located in upper left side of Kosi River (Menol Gad micro-watershed) and that of villages Galli Bassur, Barsimi, Nakot and Uskona is slightly acidic (lower than 6.5 pH), while that of the remaining springs is in normal range (6.5-8.50). The pH also shows an increasing trend from north to south in the entire basin (Figure 4a). The EC of springs was observed higher in southern side of basin and in Bholgaon hill range (Figure 4b). In some parts of basin, springs water had higher than permissible range of EC (300µS/cm) as per drinking water standards IS 10500:2012. Temperature of spring's water indicates declining trend from north to south as indicated in Figure 4c.

Chemical properties of spring water

Laboratory analysis of spring water indicated that water of most of the springs are under permissible limit for the analysed parameters (Table 3) however, the results for turbidity, EC and pH for few spring are out of acceptable or permissible limit. The min-max range and average value of analysed parameters have been compiled in Table 3.

Table 3 : Physico-chemical parameters for drinking water as per IS 10500:2012.

Parameters ↓	Acceptable limit	Permissible limit	Min	Max	Average	Description *
Turbidity (NTU) Max	1	5	0.04	180	12.50	Turbidity of 27 springs is higher than the suggested limit. High turbidity is due to sediments in spring water.
TH Max	200	600	24	254	69.28	All spring are within acceptable or permissible limit
Calcium (mg/L) Max	75	200	5.05	57.2	18.71	All spring are within acceptable or permissible limit
Magnesium (mg/L) Max	30	100	1.05	113	10.94	All spring are within acceptable or permissible limit.
Chloride (mg/L) Max	250	1000	1.42	7.1	2.95	All spring are within acceptable or permissible limit
Sulphate (mg/L) Max	200	400	0	24.21	0.98	All spring are within acceptable or permissible limit
Nitrate (mg/L) Max	45	None	0.29	11.43	2.26	All spring are within acceptable or permissible limit
Fluoride (mg/L) Max	1	1.5	0.03	0.08	0.05	All spring are within acceptable or permissible limit
Alkalinity (mg/L) Max	200	600	25	100	67.19	All spring are within acceptable or permissible limit
EC Max	300	None	19.9	574	103.79	5 springs have EC higher than permissible limit
pH Max	6.5-8.5	None	6.01	8.55	6.86	20 springs have p H lower than acceptable limits (< 6.5)

*** Detailed description is provided in Table 1.**

Apart from these parameters, Sodium (mg/L), Potassium (mg/L), and Calcium hardness (CaH, mg/L) were analysed in laboratory. The water of monitored springs was found to be in the range of 0 to 27.2 mg/L (average=7.2) for Na^+, 0.09 to 13.2 mg/L (average=3.1) for K^+, 12.6 to 149 mg/L (average=49.4) for calcium hardness during summer season.

Concluding remarks

The study provides a first- hand information of springs that currently exist in Upper Kosi basin. This information can be further used as a baseline for future R&D, and change in status studies. Prior to this study, the database on spring in Upper Kosi basin was not available. Geotagged springs information generated can be integrated with web to create applications with updating options to record/ analyze incorporating community, NGO, and government response. This way, it will provide a well managed spring database for conducting study of spring hydrology and open wider scope for hydrologists, policy makers and water resource managers for conservation of springs in Indian Himalayan Region.

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Annexure-II: Description of general, physical and chemical properties measured in field

The Data Element provides a description of different parameter mandatory or recommended for spring water inventory, characterization of springs and the technical specifications for the data to be collected. Three categories of spring data are recommended. The first category consists of mandatory data elements for general description about name, site, location and general identification of spring.

General Characteristics of springs: General characteristics must be collected and mandatory data element in order to provide a brief description and identification of spring. These data element are as below:

Spring Code: Spring Code is a unique identification number with initial digit indicating its type i.e. seasonal, perennial and dried followed by spring id with three digit (SP001= Spring Perennial 001, SS004= Spring Seasonal 004, SD001= Spring Dry 001).

Location (Latitude/Longitude): Location of spring in terms of latitude and longitude can be gathered using handheld GPS. The surveyor needs to be static for at least 2-5 minute to acquire accurate location with greater accuracy.

Elevation: Elevation (amsl) can be recorded using handheld GPS. If satellite signals are not acquired due to obstruction of forest, building etc, elevation information can be collected with the help of CartoSat-DEM.

Accuracy: Accuracy must be recorded using GPS in order to maintain correct location of spring. The surveyor needs to stop for 2-5 minutes for acquiring higher accuracy in hilly terrain.

Name of spring: Local name of the spring will help in identifying the spring for future monitoring and updating of records at proceeding level of inventory.

*Village/ Block/District/State***:** The information about administrative boundary of particular spring needs to be collected for further retrieving information about resource of a state.

Date/time of measurement: Date and time of measurement of all parameter must be recorded in standard format (dd/mm/yyyy) to analyse temporal and diurnal changes in temperature, discharge etc.

Physical Characteristics of springs: Physical and chemical features are dominant factors influencing water supply in a watershed. Physical and chemical characteristics of spring water depend upon the characteristics of recharge area, soil, and bedrock, depth of aquifer, precipitation and chemical composition etc. The second category of data elements recommended to collect spring physical and chemical characteristics are as follow :

Flow/Discharge: Discharge (l/min) is measured using measuring flask of known volume and a stop watch in case of '*Dharas*'. Discharge of '*Seep'* is very hard to measure due to unconfined flow. Discharge of seep/brook or run can be measured using notches (V or rectangular). Long-term discharge characteristics of a spring can't be quantified in a single measurement because discharge often changes throughout the day, seasonally, or annually. For this purpose discharge measurement during different hours of a day and seasons of a year needs to be averaged.

Electric conductivity: Conductivity is a measurement of the ability of an aqueous solution to carry an electrical current. This ability is dependent on the amount of dissolved ions, and is therefore an indicator of total dissolved solids in the solution. Conductivity provides insight into water sources and it is important to access the quality of water. The handheld EC meter can be used to record EC value (µS/cm). The meter should be kept clean, have fresh batteries, and calibrated daily following the manufacturer's recommendation.

pH: pH is the measure of hydrogen activity, which indicates the acid/basic qualities of water. It can be measured using a hand-held field meter. Waters may be classified as acidic, basic, or neutral, according to the balance of hydrogen in the water. Acidic waters are waters that measure below 7.0 on the pH scale. Neutral waters are waters that measure 7.0 on the pH scale. Basic/Alkaline waters are waters that measure above 7.0 on the pH scale. The pH meter should be kept clean and needs to be calibrated before starting survey following the manufacturer's recommendation.

Temperature: Water temperature is an important factor controlled by geology, and may give insight into depth of source waters. This measurement (record in ° C) is easily taken with a meter used to measure dissolved oxygen or conductivity, and it is necessary to calibrate some analytical meters (e.g. conductivity). Field measurements can be easily made using a high quality meter.

Type of spring: Spring types based on seasonality (Perennial, Seasonal); based on Temperature (Hot water springs. Thermal spring, Cold water spring) and based on origin of source (Depression spring, Contact spring, Fault spring, Joint/ Fracture spring, Karst spring) needs to be recorded during survey.

Geology: Spring hydrology is influenced by characteristics of regional and local geology, and how water moves through an aquifer. Information on Geology must be recorded by expert to know the aquifer type and rock during field survey or using geology survey of India map.

Brook length: Spring Brook Length measured in meters. Measuring tape must be used to measure distance from the spring source.

Other information- Any other information influencing the spring hydrology directly or indirectly may be collected based upon the objective of study and are not mandatory but recommended and put in third category of data elements. Although, these are not mandatory, still are helpful for management related aspect of spring and drafting water resource policy.

Associated Land use/land cover: Land use/land cover surroundings of spring must be recorded in the field or can be tabulated after survey using high resolution land use/land cover map if available.

Resource threat, if any: Resource threat considers various factors that can impact the health of springs, in terms of both water quality and discharge. Major threat in IHR may be drought, nutrient load, runoff, recreational activity and industrial development. A high threat usually means a spring will be more difficult to restore. Low threats suggest that land managers may wish to keep the spring in its existing condition.

Scouring/Gully erosion: Springs that are most susceptible to scour occur in the bottom of gullies where they are exposed to high flows during heavy rainfall due to erosion by moving water. Frequent scouring may have a lower recovery potential and resource value.

Conflicting issue: Conflicting Uses depict how present uses of spring clash with management options. The possible conflicting use may be channel diversion, grazing land, recreational activity etc. If a spring has high degree of confliction, then it will not be consider for rejuvenation, revival or any other management work.

Stressors: Primarily two types of stressor disturb springs in Himalayan region- Natural and Anthropogenic. Natural stressor includes drought, forest fire, erosion, landslide/avalanches. Anthropogenic stressors may be trampling, diversion, nutrient pollution, introduction of non-native plants and animals and over exploitation of water.

Ownership: Land ownership where spring is located in terms of government in case of forest, public if owned by municipality and personal if employed by a family or household.

Use: Either the spring water is used primarily for drinking, clothing, irrigation or other use must be included in Inventory Per-forma in order to know about the dependence of people and pressure on a spring.

Photograph: Photos should be taken using high resolution digital camera to show the spring and its associated landscape. Maintain a photo log with digital photograph number and description using the spring code.

Remarks: A brief description of spring including additional important information about religious or historical perspective of the spring

Annexure-I : Pro-forma for data collection on springs general information and physico-chemical Characteristics

A. General characteristics of springs/general spring information					
Spring Type					
Spring Code		Latitude*		Longitude*	
Name of spring		Elevation (amsl)		Accuracy	
Village/Block		District		State	
Surveyor Name		Date/Time			
*The surveyor needs to be static for at least 2-5 minute to acquire accurate location with greater accuracy using handheld GPS.					

B (1). Physical Characteristics of springs				
Parameters	Measured Value /type	Method/protocol	Rationale	Reference
Flow/Discharge: (L/s)		Using flask of known volume and a stop watch.	Physical characteristics of spring water depends upon the characteristics of recharge area, soil, and bedrock, depth of aquifer, precipitation etc. Physical characteristics are dominant factors influencing water supply in a watershed.	Valdiya, K. S. and Bartarya, S. K, 1989; Negi, G. C. S. and Joshi, V., 1996
Electrical Conductivity (µS/cm)		Using handheld EC and pH meter. The meter should be clean, have fresh batteries and calibrated.		Sada, Donald W. and Pohlmann, Karl F., 2002; White, W. E. and Kues, G. E., 1992
pH				
Temperature (° C)				
Brook length		Using measuring tape/High resolution satellite data		White, W. E. and Kues, G. E., 1992
Soil type		NBSS&LUP maps.		
Geology/ Rock type		Expert field interpretation/ Geological survey of India Map		Negi, G. C. S. and Joshi, V., 2004
Spring Type /(Depression springs, Contact springs, Fault springs, Joint/Fracture spring, Karst springs).		Expert observation in field		http://www.indiawaterportal.org

B (2). Chemical Characteristics of springs				
Turbidity (NTU)		Turbidity meter	Chemical characteristics of spring water provide	Kireet Kumar, Rawat, D. S.,1996; Joshi,
Na^+ (mg/L)		Flame Photometer		
K^+ (mg/L)		Flame Photometer		

TSS (mg/L)		Filtration	information about quality of water for drinking or irrigation purpose and its contamination level.	B. K. and Kothyari, B. P. 2003; Van Everdingen, R. O., 1991
Total Hardness		Titration		
Ca Hardness (mg/L)		Titration		
Alkalinity (mg/L)		Titration		
Calcium (mg/L)		Titration		
Magnesium (mg/L)		Titration		
F^- (mg/L)		Ion electrode		
Sulphate (mg/L)		Photometer		
Nitrate (mg/L)		Ion electrode		
Chloride (mg/L)		Titration		
Bicarbonate (mg/L)		Titration		
500 ml of sample is sufficient to determine the complete list of major ion parameters. Sample collection methods and laboratory analysis should follow standard procedure and protocol to prevent contamination and accuracy of measurement.				

C. Other information					
Associated Land use/land cover	Forest ☐	Agriculture ☐	Wasteland/scrubland ☐	Builtup/settlement ☐	Valdiya, K. S. and Bartarya, S. K, 1989, Negi, G. C. S. and Joshi, V., 1996
Resource threat	Drought ☐ Runoff ☐ Nutrient load ☐ Recreational activity ☐ Industrial Development ☐ others ☐				Sada, Donald W. and Pohlmann, Karl F., 2002
Degree of threat $	Low ☐ Moderate ☐ High ☐ None ☐				
Scouring/Gully erosion	Low ☐ Moderate ☐ High ☐ None ☐				
Conflicting issue	Yes ☐ No ☐				
Confliction type	Channel diversion ☐ Grazing ☐ Recreational activity ☐ Others ☐				
Stressors	Natural/Environmental (Drought, forest fire, erosion, landslide/avalanches)	Anthropogenic (Trampling, diversion, nutrient pollution, introduction of non native plants and animals, others)			
Ownership	Government ☐	Public ☐	Private ☐		Sada, Donald W. and Pohlmann, Karl F., 2002
Spring Use Primary=1 Secondary=2 Other=3	Drinking ☐	Clothing /Sanitation ☐	Agricultural ☐	Power/Industrial ☐	White, W. E. and Kues, G. E., 1992
Photograph	Attached photo labelled with id (i.e. spring code) of photograph.				
D. Remarks: Brief description of spring under this section provide complete details of all parameters of a spring.					

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