Protocols for Spring Water Quality Management as per BIS

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WATER RESEARCH

KSHITI JAL PAVAK GAGAN SAMEERA,
PANCH RACHIT ATI ADHAM SHAREERA

- Sant Tulsidas

AAPO DEVTA

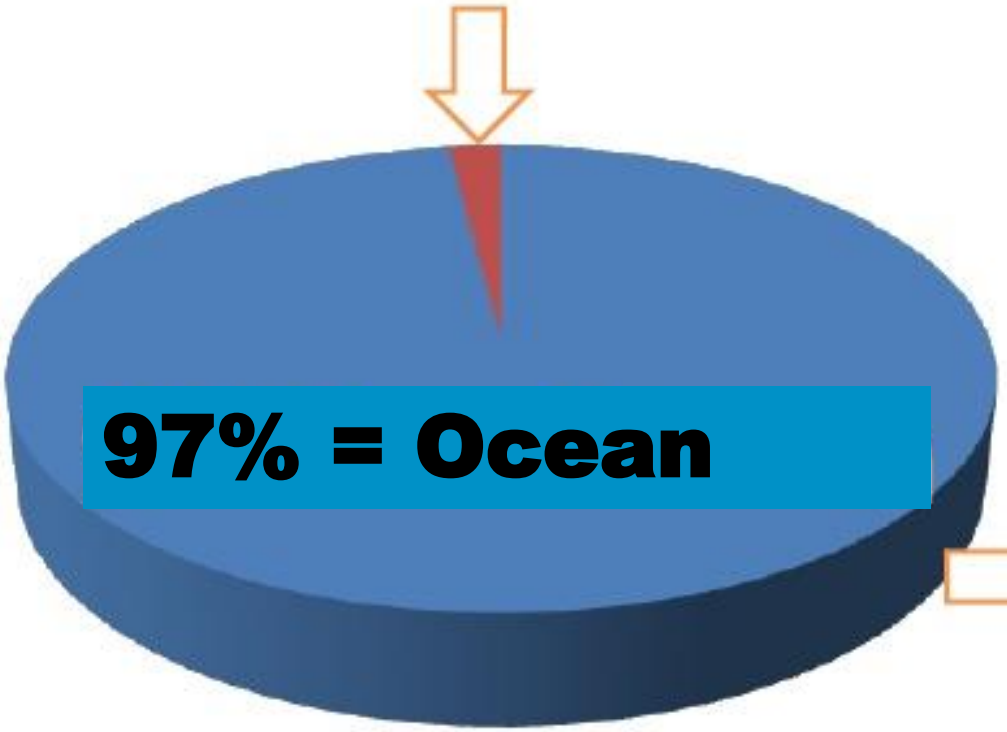
- Rigveda 10/129/1

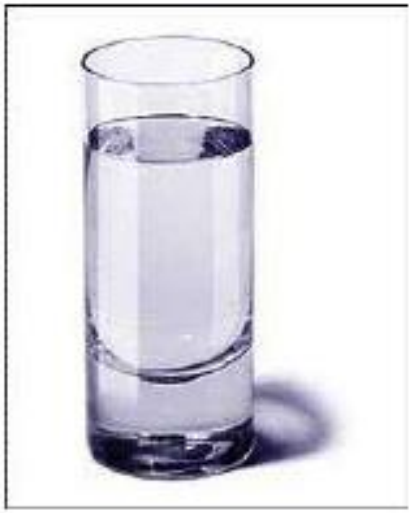
APSWANTARMRITAM ASTU BHESHJAM

- Rigveda 1/23/19

Water gives life to Earth

Only 3 % is fresh water !





HYDROLOGIC CYCLE

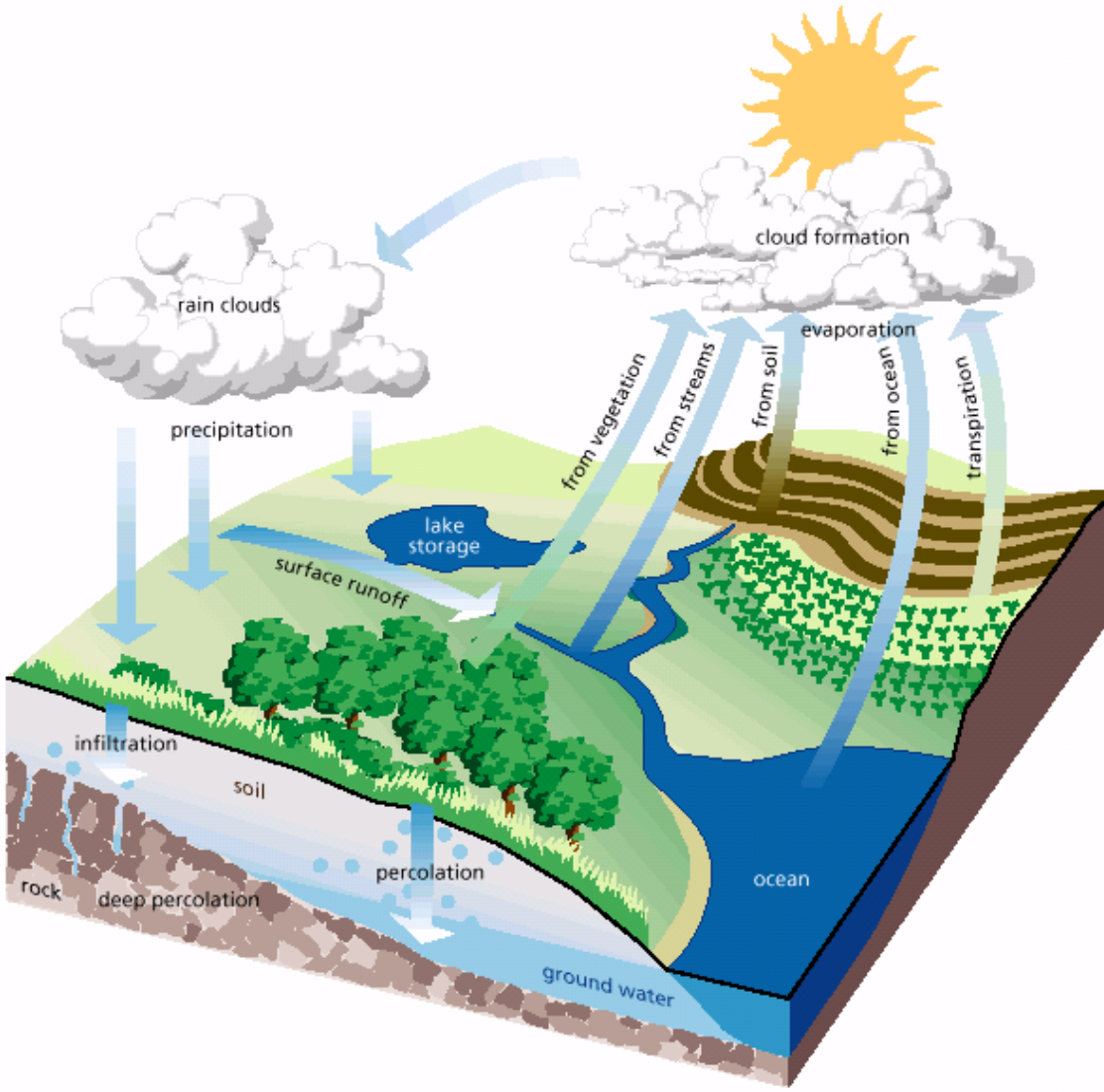
- Moisture is constantly circulating between the land, the ocean and the atmosphere.---Hydrologic Cycle

- Involves complex and interdependent processes
  - Precipitation
  - runoff
  - Infiltration
  - groundwater flow
  - Evaporation
  - transpiration etc.....

- During the hydrologic processes –soil acts as a reservoir and water is always in transitory storage in soil.

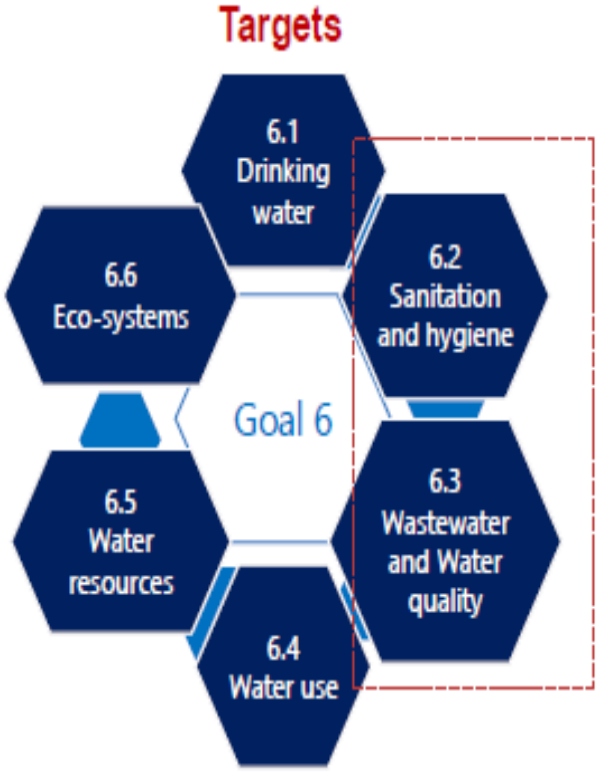
- Considerable time may elapse before this stored water flows either underground to a stream or returned to the atmosphere by evapotranspiration

During the process of precipitation and transitory soil water storages an opportunity exists to take advantage of hydrologic cycle in rainfed agriculture.



UN-Sustainable Development Goal SDG 6

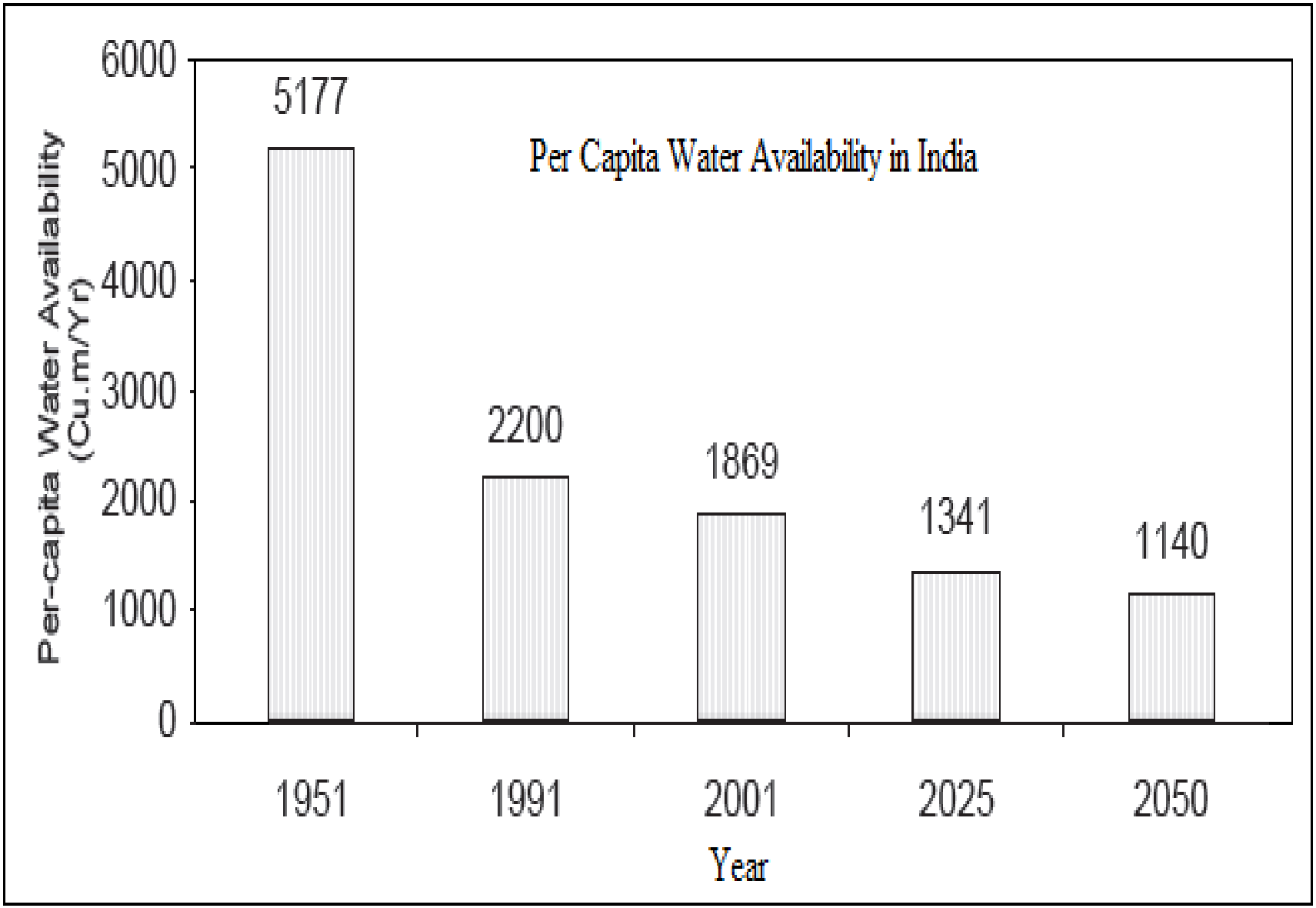
Ensure availability and sustainable management of water and sanitation for all



Global Situation

- Water is the life line for living beings on the earth.
- 3% of the total water on the earth is fresh water (97% is saline).
- 77% glaciers and ice caps of this fresh water
- 11% water upto 800 m depth below the ground is extractable and
- 11% ground water is available below 800 m depth.
- only 1% water is available in the form of lakes, rivers, streams etc.

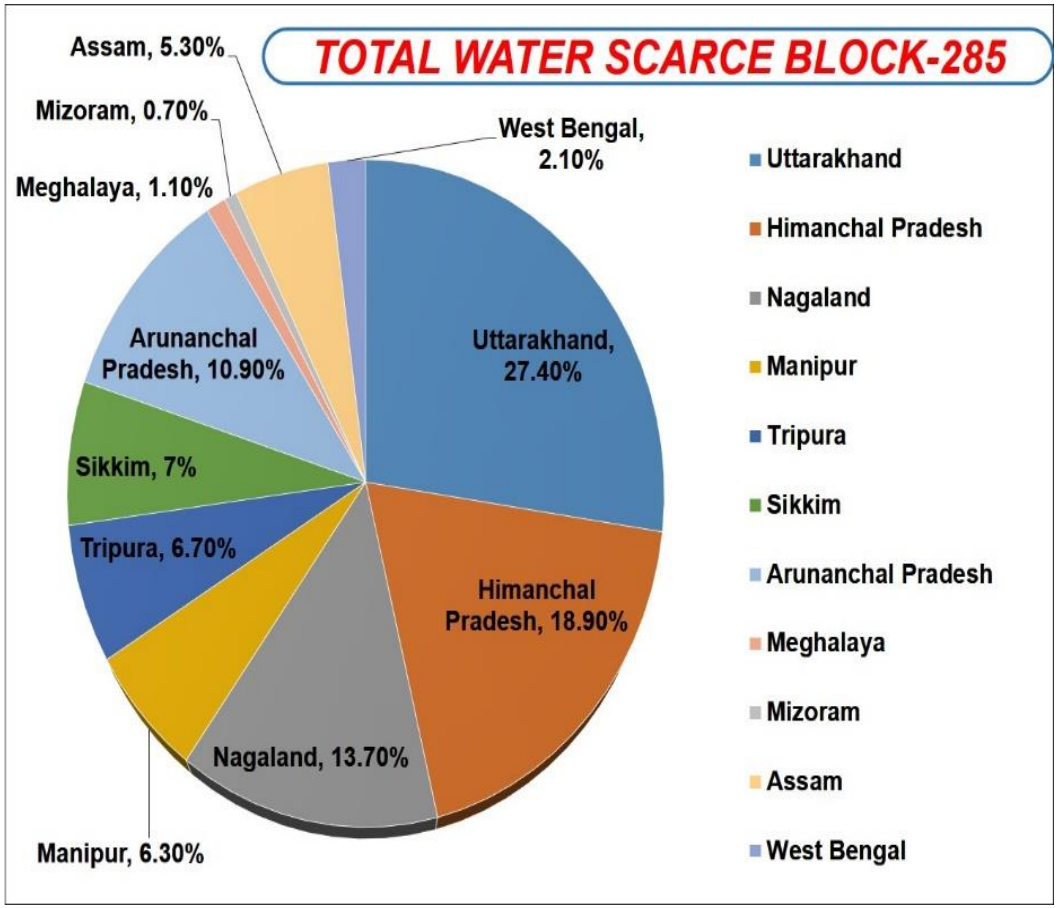
Water Availability in India



Per Capita Availability < 1700 Cubic Meter per year	**• Water Stressed**
Per Capita Availability < 1000 Cubic Meter per year	**• Water Scarce**

Water Scarcity in Himalayan States

- **285 blocks out of total 593 blocks are found to be water scarce in 11 states**
- Source: Kumar, 2020



- National Water Policy
- Jal Jewan Mission

Daily Water Requirement (As BIS)

Description	Minimum water requirement (lphd)
For communities with population upto 20,000 and without flushing system	
a. water supply through standpost	40 lphd
b. water supply through house service connection	70 – 100 lphd
For communities with population 20,000 – 100,000 with full flushing system	100 – 150 lphd
For communities with population above 100,000 with full flushing system	150 – 200 lphd

District-wise Water Bodies (Square Km) of Uttarakhand

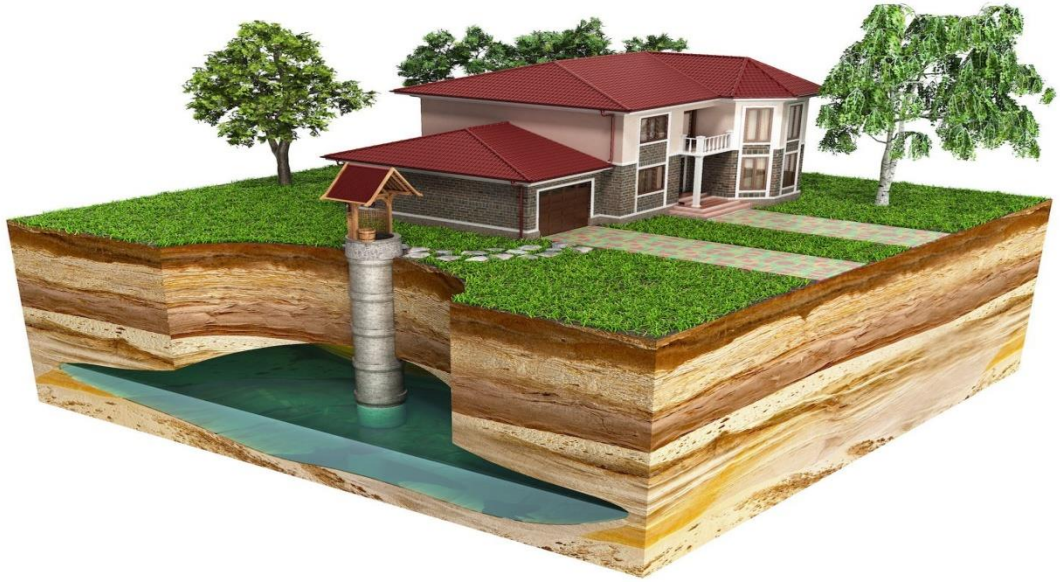
District	Area of Water Bodies	Area of Snow Cover
Uttarkashi	109.42	1232.42
Chamoli	47.38	1219.13
Rudraprayag	14.44	109.18
Tehri	61.83	139.89
Dehradun	135.35	-
Pauri	192.27	-
Pithoragarh	93.73	997.70
Bageshwar	25.75	138.31
Almora	30.30	-
Champawat	49.30	-
Nainital	191.94	-
Udham Singh Nagar	166.02	-
Haridwar	163.02	-

Some Imp Facts about Uttarakhand…

- According to Geological Survey of India, 9575 glaciers in Himalayan hilly states of India.
- Uttarakhand falls under Ganga Basin.
- Total 968 glaciers were reported in Ganga Basin with an area of 2483.91 km^2 and possess about 213.7 km^3 volume ice.
- Chal or Khal, Springs or gadheras, rivers, lakes, tube wells, dug wells, Bank Filtration wells, Uttaranchal Koops in Uttarakhand

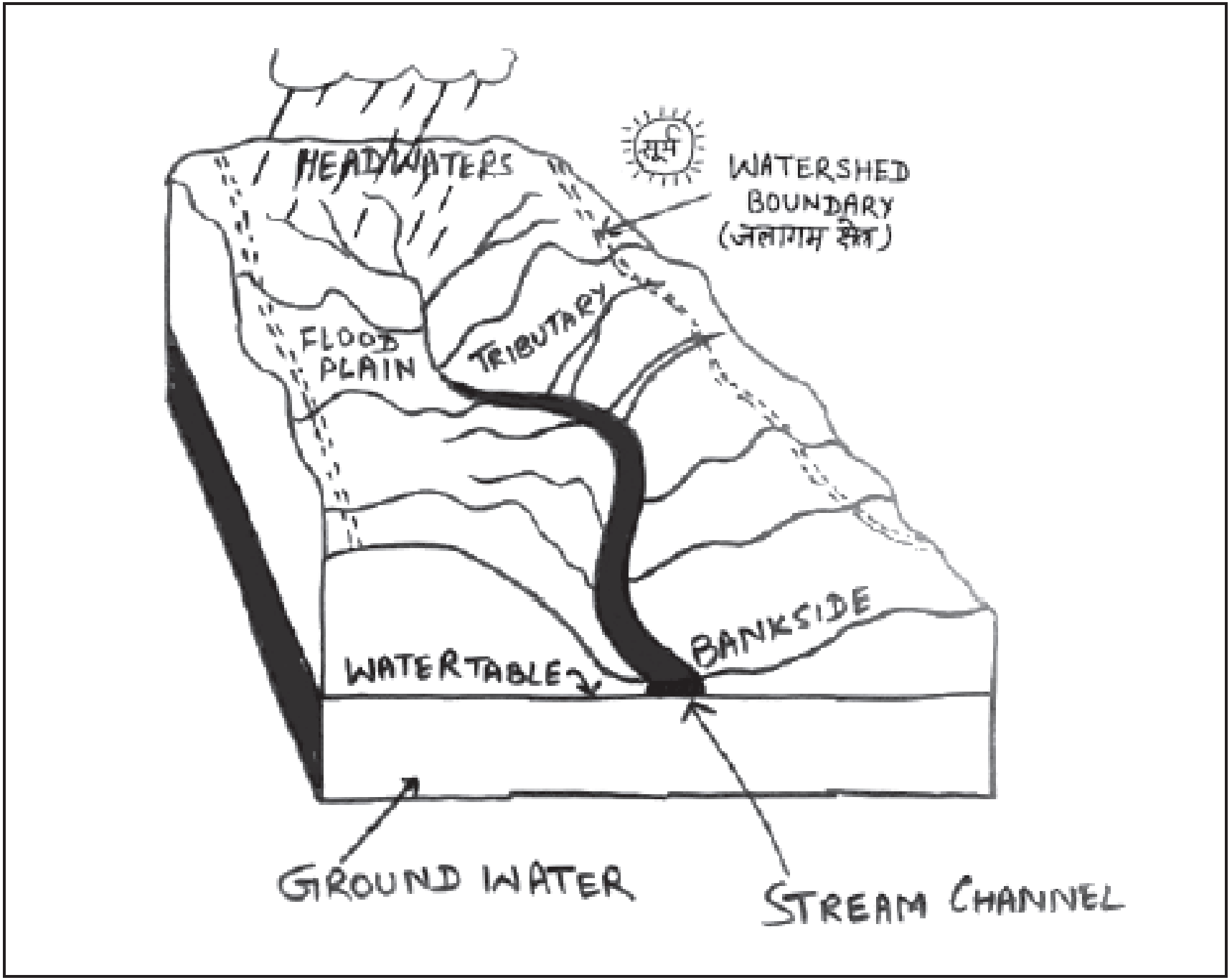
Aquifer

- A body of porous rock or sediment saturated with groundwater.
- Underground layer of water-bearing permeable rock, rock fractures or unconsolidated materials.



Spring

- **Spring**: In the mountain region groundwater naturally discharges in the form of springs, which occur where a water bearing layer (perched aquifer) intersects with a hill slope and groundwater seeps.


HEADWATERS
सूर्य
WATERSHED
BOUNDARY
(जलागम क्षेत्र)
FLOOD
PLAIN
TRIBUTARY
BANKSIDE
WATERTABLE
GROUND WATER
STREAM CHANNEL

Water Conservation/Water Management

- **Traditional Water Conservation Methods**

Traditional Water System

- Uttarakhand traditionally depended upon its *naula*s and *dhara*s (seepages and natural springs).
- The ancient people of this region evolved the hydraulic technology as per requirement.

Water and Sanitation related Diseases

- 1. **Water-borne diseases (transmitted by water)**: Cholera, Typhoid, Bacillary dysentery, infectious hepatitis etc.
- 2. **Water-washed diseases (caused by lack of water)**: Scabies, Skin sepsis and ulcers, leprosy, Trachoma etc.
- 3. **Water based diseases**: Schistomiasis, Dracunuliasis, Filariasis, Threadworm etc.
- Water related insect vector diseases: Yellow fever, dengue fever, malaria etc.

WATER QUALITY

Water Quality Parameters (BIS 10500; 2012)

Water Quality Monitoring of Water Resources

Sampling
Preservation
Analysis

SAMPLING


वन विभाग उत्तर
चुंगी धारा सौन्दर्यकरण
कैम्पा- वर्ष- 2020
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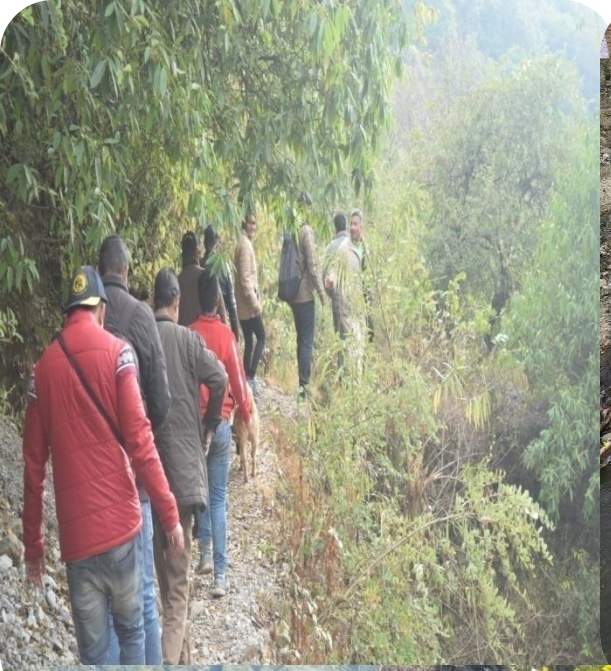
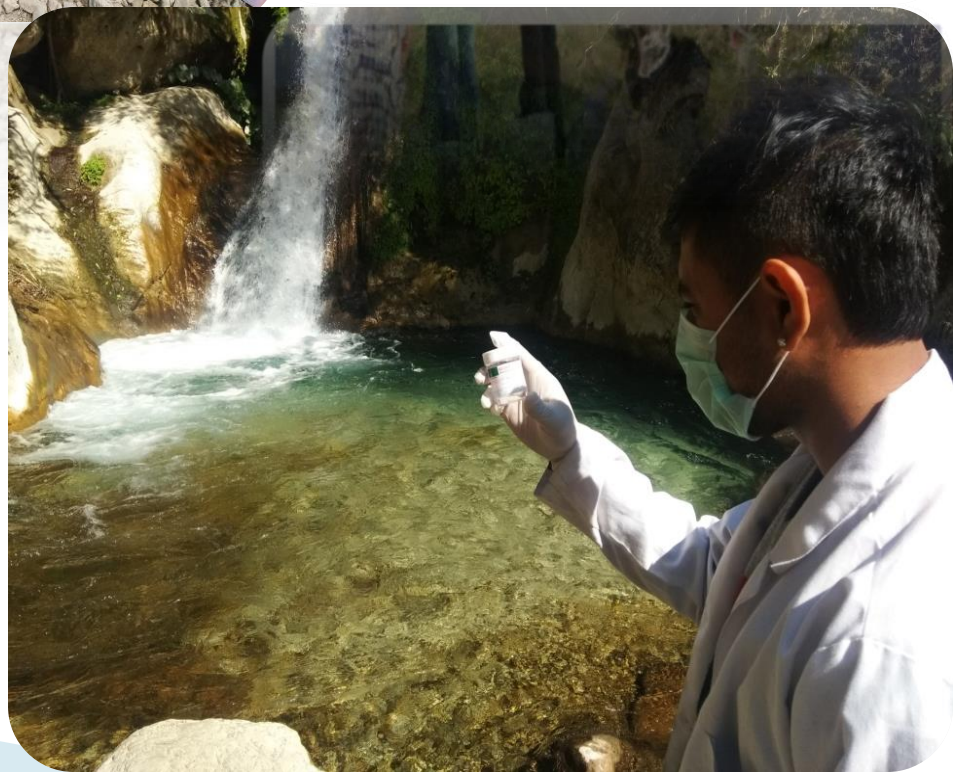



शिखर फाल से तलनी गढ़ पैदुल मार्ग
दूरी — किमी.
इस रिस्पना नदी के जल को स्वच्छ बनाये
रखने में आपका सहयोग वांछनीय है ।



- ANALYSIS
  - Physical
  - Chemical
  - Biological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GPS Map Camera
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नौगांव - पूरोला मार्ग, थाली, उत्तराखण्ड 249185, भारत
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Sikrut
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Dudhali


DO
Doadwala
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DO
Dudhli
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Analysis of Water Quality Parameters

S N	By Volumetric Method/Instrumental	By Instrumental Technique/ Manually	By UV-VIS Spectro-photometer	By Atomic Absorption Spectro-photometer	By Gas Chromatography
1.	Alkalinity	Odour	Anionic Detergents	Aluminium	Chlorinated Pesticides
2.	Total Hardness	Taste	Colour	Arsenic	
3.		Turbidity	Chloride	Calcium	
4.		Dissolved Solids	Res. Free Chlorine	Cadmium	
5.		pH value	Sulfate	Chromium	
6.		Coliform Bacteria	Phenolic compounds	Copper	
7.			Fluoride	Iron	
8.			Nitrate	Lead	
9.				Magnesium	
10.				Manganese	
11.				Mercury	
12.				Potassium	
13.				Selenium	
14.				Sodium	
15.				Zinc	

pH

- **Desired Limit**: 6.5-8.5
- **Permissible limit**: No Relaxation
- **Health Aspect**: Beyond the range, the water will affect the mucous membrane
- **Cause of Contamination**: Presence of acidic or basic compounds

RESIDUAL FREE CHLORINE

- **Desired Limit:** 0.2-1.0 mg/l
- **Permissible limit:** --
- **Health Aspect:** Chlorination may produce adverse effects, taste and odour characteristics of phenols may be intensified. **Potentially carcinogenic.**
- **Cause of Contamination**: Addition of chlorine in public water supply and industrial waste.

ALKALINITY

- **Desired Limit**: 200 mg/l
- **Permissible limit**: 600 mg/l
- **Health Aspect**: Beyond the limit the taste becomes unpleasant
- **Cause of Contamination**: Due to presence of salts of weak acids and strong bases.

HARDNESS

- **Desired Limit:** 200 mg/l
- **Permissible limit:** 600 mg/l
- **Health Aspect:**
  Kidney stones, Digestive health and constipation, Bone mineral density, Cardiovascular disease, Cancer, Malformations of central nervous system.

- **Cause of Contamination:** Presence of compounds of cations (Ca^{2+}, Mg^{2+}, Sr^{2+}, Fe^{2+}, Mn^{2+}) and anions (HCO_3^-, SO_4^{2-}, Cl^-, NO_3^-, SiO_3^-)

TURBIDITY

- **Desired Limit**: 1 NTU
- **Permissible limit**: 5 NTU
- **Cause of Contamination**: Presence of suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, plankton and other microscopic organisms.
- **Health Aspect**: Consumer acceptance decreases. If turbidity is caused by suspended solids or run off from animal feed lods, many of pathogenic organism may be covered with the particles and protected from the disinfection

FECAL COLIFORM

- **Desired Limit:** 0 MPN/ 100 ml
- **Permissible limit:** 0 MPN/ 100 ml
- **Health Aspect:** Fecal coliform bacteria may cause intestinal distress and in more severe cases nausea, vomiting and even death. Dysentery, typhoid fever, viral and bacterial gastroenteritis and hepatitis A.
- **Cause of Contamination:** Municipal waste.

Nitrate

- **Desired Limit:** 45 mg/l
- **Permissible limit:** No Relexation
- **Health Aspect:** Beyond the desirable limit **Blue Baby Syndrome (Methanemoglobinemia).**
  An illness that begins when large amounts of nitrates in water are ingested by an infant and converted to nitrite by the digestive system. The nitrite then reacts with oxyhemoglobin (the oxygen-carrying blood protein) to form methenoglobin, which cannot carry oxygen. **Heart Problem.**
- **Cause of Contamination:** Soil and industrial waste

TOTAL DISSOLVED SOLIDS

- **Desired Limit**: 500 mg/l
- **Permissible limit**: 2000 mg/l
- **Health Aspect**: Beyond 500 mg/l sweetness decreases and may cause gastrointestional irritation.
- **Cause of Contamination**: Earth crust, organic or inorganic compounds

FLUORIDE

- **Desired Limit:** 1.0–1.5 mg/l
- **Permissible limit: N**o Relaxation
- **Health Aspect:** Low fluoride in water causes damage due to cavity formation.

  High fluoride causes **dental Fluorosis** [Yellow spots on teeth], causes **skeleton Fluorosis** which deforms the skeleton.
- **Cause of Contamination**: Earth crust
- With the rising geological exploration & weathering of fluoride bearing rocks, excessive fluorides have started entering the GW. Excessive mining & discharge of GW leads to increase in F conc.
- Aluminium & Phosphate industries also contribute significant amounts of F into human environment.
- Large no of Fluorosis cases have been reported in **Rajasthan** due to GW contamination with F.

CALCIUM

- **Desired Limit:** 75 mg/l
- **Permissible limit:** 200 mg/l
- **Health Aspect:** No such health hazard but simultaneously encrustation in water supply structure and adverse effects on domestic use
- **Cause of Contamination:** Earth crust

IRON

- **Desired Limit:** 0.3 mg/l
- **Permissible limit**: No Relaxation
- **Helpful** in oxygen transport, DNA synthesis, oxidative phosphorylation etc.
- **Health Aspect:** Human suffers no harmful effects from drinking water containing iron but oxidation of iron can affect taste/ appearance, has adverse effect on domestic uses and water supply structure and promotes iron bacteria.
- **Cause of Contamination**: Earth crust & industrial waste

MAGNESIUM

- **Desired Limit**: 30 mg/l
- **Permissible limit**: 100 mg/l
- **Health Aspect**: Magnesium is an essential element in chlorophyll and in red blood cells. Higher conc. diuretic effect.
- **Cause of Contamination**: Earth crust and industrial waste

ARSENIC

- **Limit**: 0.01 mg/l
- **Permissible limit**: 0.05 mg/l
- **Health Aspect**: Arsenic in DW poses the greatest threat to public health, carcinogenic, Long term exposure through DW can cause Cancer of lung, bladder cancer, mutagen.
- **Cause of Contamination**: Mineral dissolution, industrial effluent or the application of pesticides.

LEAD

- **Desired Limit**: 0.01 mg/l
- **Permissible limit**: No Relaxation
- **Health Aspect**: Lead is non-essential element. High level exposure of Pb can impair with RBC maturation in **bone marrow,** can impair neurological & intellectual development. Prolonged exposure can lead severe **brain & kidney damage.**
- As per UNEP report, over 9 % children aged 1-5 year suffer from lead poisoning (in US).
- **Cause of Contamination**: Earth crust and industrial waste
- Everyday life exposure through paints, dyes, toys, newspapers, solders & batteries, lead pipe water and due to industrial waste of these industries including petroleum (Volatile TEL, antiknocking agent, greatest danger).

MERCURY

- **Limit:** 0.001 mg/l
- **Permissible limit:** No Relaxation
- **Health Aspect: Highly toxic** and **carcinogenic** in nature and responsible for **kidney damage**
- **Cause of Contamination:** From industrial, laboratory and domestic waste

  Human exposure to Hg may be from eating fish from water contaminated by mercury from industrial waste water discharge, from broken household thermometers, from salts of Hg used to treat & preserve food grains, fluorescent lights, paints, fungicides.

Minamata Disease:

Methylmercury poisoning in Japan (May 1956)

Occurred in humans who ingested fish and shellfish contaminated by MeHg discharged in waste water from a chemical plant (Chisso Co. Ltd.).

First officially "discovered" in Minamata City, The marine products in Minamata Bay displayed high levels of Hg contamination (5.61 to 35.7 ppm).

The Hg content in hair of patients, their family and inhabitants of the Sea coastline were also detected at high levels of Hg (max. 705 ppm).

Further, the fetus was poisoned by MeHg when their mothers ingested contaminated marine life (named congenital M. D.). The symptom of patients were serious, and extensive lesions of the brain were observed.

Treatment/Remedial Methods

Parameter	Remedial Method
Turbidity	Filtration, Coagulation
Odur	Areation Method, Filtration through Coal
Colour	Charcoal, Filtration through sand
Fluoride	Activated Alumina Method
Iron	Oxidation method
Hardness	Boil & Filter
Chloride	Reverse Osmosis Method
Total Dissolved Solid	Reverse Osmosis Method
Coliform Bacteria	Chlorination, Ozonation, UV-rays etc.

Major Issues on Water Quality Management

1. **Spring Water Quality Management**

   Issues : a. Deforestation & Agriculture
   b. Suspended Particles
   c. Bacteriological Contamination

2. **Ground Water Quality Management**

   Issues : a. Total Dissolved Solids
   b. Bacteriological Contamination
   c. Metals (depending upon Locations)

- Ecosystem
- Environmental Flow
- Water Discharge
- Population
- Society/Community

WATER ACT

- The Water (Prevention and Control of Pollution) Act, 1974

An act to provide for the prevention and control of water pollution and maintaining or restoring of wholesomeness of water.

Water Education Training to the Students


स्वास्थ्य स्वच्छता हेतु प्रशिक्षण कार्यक्रम"
आयोजक
उत्तराखण्ड विज्ञान शिक्षा एवं अनुसंधान केन्द्र (यूसर्क)
सूचना एवं विज्ञान प्रौद्योगिकी विभाग, उत्तराखण्ड शासन
वित्तीय सहयोग
गोविन्द बल्लभ पन्त राष्ट्रीय हिमालयी पर्यावरण एवं सतत् विकास संस्थान
(पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार), कोसी-कटारमल, अल्मोड़ा
सभागार गैरसैंण, चमोली
दिनांक : 26-27 फरवरी, 2021
डॉ भवतोष शर्मा


आयोजक :
जल गुणवत्ता एव


सभागार

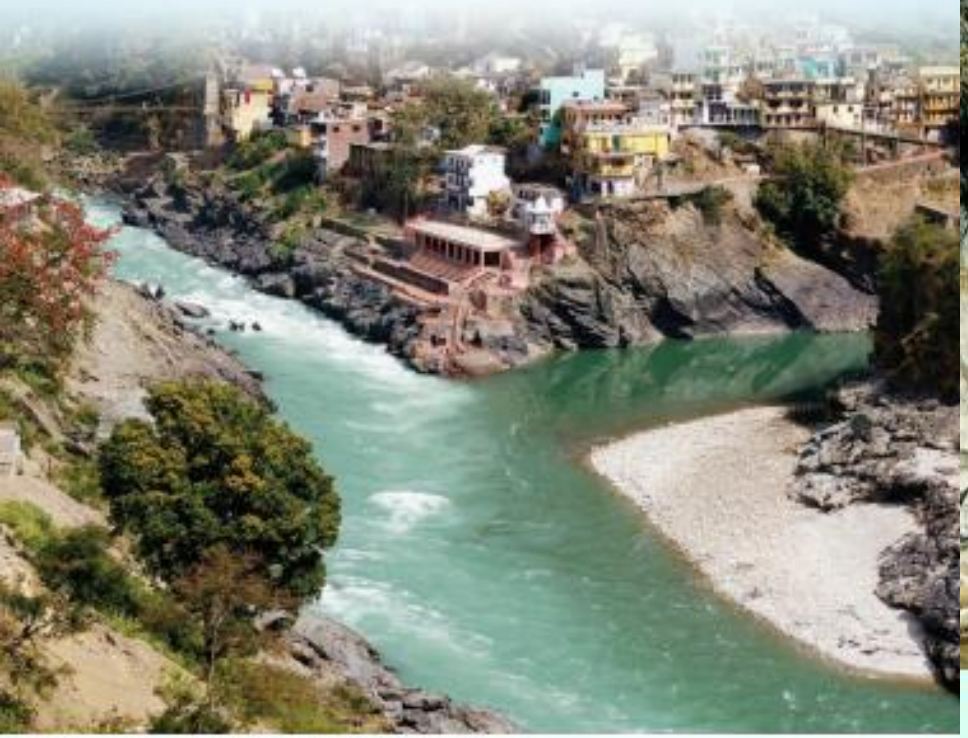

जल संरक्षण, जल गुणवत्ता एवं स्वास्थ्य स्वच्छता हेतु
प्रशिक्षण कार्यक्रम"
संयुक्त आयोजक :

02 Days 06 Training Programs on Water Education (Conservation, Quality & Health Hygiene)

S.N.	District	Place/District	Date	Participants
1	Pauri	HNBGU Campus Pauri	30-31 March 2019	90
2	Almora	Ranikhet, Almora	27-28 June 2019	71
3	Uttarkashi	PG College, Uttarkashi	13-14 August 2019	91
4	Chamoli	Block Office, Gairsen, Chamoli	26-27 Feb 2021	165
5	Champawat	PG College, Lohaghat	16-17 March 2021	95
6	Bageshwar	GIC Bageshwar	19-20 March 2021	80
			Total	592

उत्तराखण्ड शासन

``जल संरक्षण, जल गुणवत्ता एवं स्वास्थ्य स्वच्छता विषय पर शिक्षण हेतु`` प्रशिक्षण मैनुअल



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विज्ञान एवं प्रौद्योगिकी विभाग, उत्तराखण्ड शासन

परियोजना वित्तपोषण :
गोविंद बल्लभ पंत राष्ट्रीय हिमालयी पर्यावरण एवं सतत विकास संस्थान
(पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय, भारत सरकार)
कोसी – कटारमल, अल्मोड़ा

उत्तराखण्ड शासन

पर्वतीय जलस्रोतः संरक्षण एवं पुनर्जीवन

डॉ. भवतोष शर्मा एवं प्रो. दुर्गेश पंत

उत्तराखंड विज्ञान शिक्षा एवं अनुसंधान केन्द्र-यूसर्क
विज्ञान एवं प्रौद्योगिकी विभाग
उत्तराखण्ड शासन, देहरादून
2019

उत्तराखण्ड शासन

"जलस्रोत संरक्षण, संवर्धन व गुणवत्ता विषयक सूचना संचार पत्रिका"

प्रो० एम०पी०एस० बिष्ट, निदेशक

डॉ. भवतोष शर्मा, वैज्ञानिक

उत्तराखंड विज्ञान शिक्षा एवं अनुसंधान केन्द्र, (यूसर्क)

सूचना एवं विज्ञान प्रौद्योगिकी विभाग, उत्तराखण्ड शासन, देहरादून

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Education on Drinking Water Quality and Its Health Impacts among Students and Community People

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Abstract The health troubles due to poor drinking water quality are huge. The impact of increasing developmental activities, pollution and over-exploitation are altering the distribution of safe water. Besides this, the non-uniform distribution of rainfall due to changing climatic conditions aggravated the trouble. Both point and non-point sources of pollution affect the drinking water quality dominantly. The lack of education and awareness among community people and students about the drinking water quality are also key issues for health problems due to the consumption of contaminated water. Therefore, the knowledge of drinking water quality including health hygiene and sanitation aspects among students and community people is an urgent need. The present paper highlights the need of education about water quality, significant scientific information about the selected drinking water quality parameters, reasons of water quality deterioration, its health impacts etc.

Keywords: *education, students, community people, water quality, health impacts*

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1. Introduction

Water with safe quality is essential not only to survive the humans but for the proper development of ecosystem. Deterioration of drinking water quality has become a serious issue due to some anthropogenic behavior including increase in population, mismanaged agricultural and industrial activities. Besides this, some climatic factors also affect the hydrological cycle. Consequently, human interventions and natural processes affect the quality of ground water as well as surface water also. Domestic manners, mining, power generations, forestry practices etc. are also responsible to create the changes in physical, chemical and biological properties of water [1]. It has been reported that more than 80% untreated sewage in developing nations is discharged directly in water bodies [2]. People nearby contaminated sites and consumers of untreated drinking water are mainly affected with water borne diseases. Water with degraded quality may also impact the crop productivity and food security. According to United Nations, approximately 700 million people suffer today from water scarcity problem in 43 countries. It is estimated that 1.8 billion people will be affected with absolute water shortage by the year 2025 [3].

Human health is directly related with safe drinking water consumption. Ingestion of contaminated drinking water may create several health related problems. Sometimes, it may cause serious issues even death also. In this regard, the students and community people as the main part of society may play a key role in the better understanding of water quality issues. There are many parameters including physico-chemical and bacteriological parameters to judge the quality of drinking water for which certain guidelines has been issued by various authorities like World Health Organization [4], United Nations Environment Protection Agency (USEPA) [5], Bureau of Indian Standard [6] etc. Various water quality parameters can be analyzed in laboratory and also in fields. The knowledge of these water quality parameters has become indispensable to each people before its consumption [7-29]. Therefore, the present paper explains the knowledge of some important physico-chemical and bacteriological drinking water quality parameters and related health issues.

2. Education on Drinking Water Quality Parameters

The physico-chemical and biological characteristics of water define the overall quality of water and suitability for any specific application like drinking, irrigation etc. The knowledge of these water quality characteristics is essential before its consumption. The standard guideline values of these water quality parameters have been decided by certain authorities for different uses. In this paper various important drinking water quality characteristics such as pH, Total dissolved solids (TDS), Turbidity, Total hardness, Alkalinity, Chloride (Cl^-), Sulphate (SO_4^{--}), Nitrate (NO_3^-), Iron (Fe), Calcium (Ca),

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