WATER ACTIVITIES

How Much Water for Us?

The world's water resources seem enormous—nearly three-fourths of the Earth's surface is covered by water. But not all this water is available for our use. Ninety-seven per cent of this water resource is in the oceans and is salty. The glaciers and ice-caps lock away another two per cent. Less than one per cent is the fresh and usable water of lakes, ponds, rivers and groundwater. This activity will enable teachers to help students understand how much water is actually available for use, and to realize the need for conserving such precious resource.

Subject
Science, Social Science

Place
Classroom

Duration
45 minutes

Group size
8–10 students

Materials
Large container (2.5 litre volume), small transparent container, two small dishes, measuring cylinder, teaspoon, ink-dropper

Objective

To demonstrate the distribution of water on earth and how much water is actually available to us.

Activity

Divide the class into small groups. Ask each group to measure 2200 ml of water into a container. If a measuring cylinder is not available, an empty soft drink bottle of known capacity may be used.

Tell them to assume that 2200 ml represents the total water available on earth.

Ask them to take a teaspoon and measure out 12 spoons of water into a small transparent container. Tell them that this is the total amount of fresh water on earth, including the water found in lakes, rivers, ice-caps, and as groundwater. The water that remains in the large container represents salty water found in oceans and seas. From the container with 12 spoonfuls of water, let the students measure out two spoonfuls into a dish. This represents the groundwater. Let the students take another dish and remove into it half-a-spoon of water from the container which now has 10 spoonfuls of water. This represents the water found on the surface of the earth in freshwater lakes. From the remaining water in the smaller container, let the students remove one drop using an ink-dropper. This drop represents the amount of water found in rivers. The smaller container will now have about nine spoonfuls of water left in it. Tell the students that this represents the amount stored in ice-caps.

Distribution of Water on Earth (%)

Oceans	97.2
Ice-caps	02.0
Groundwater	00.62
Freshwater lakes	00.009
Inland seas and Salt lakes	00.008
Atmosphere	00.001
Rivers	00.0001
Total	99.8381

Ask the students to compare the quantities of water in the various containers.

Extension/Variation

Ask the students how the fresh water stored as ice becomes available to us.

Ask how people use sea water and whether it can be converted to fresh water for our use.

Explain problems caused by over-extraction of groundwater, for e.g. salt intrusion, land subsidence, etc.

Every Drop Counts

As human population increases, so does the demand for water. Change in lifesyles—for example, increasing use of gadgets like washing machines, as well as changes in agricultural and industrial activities, put enormous pressures. Pollution adds to the problem by effectively reducing the amount of usable water. However, the amount of water available on earth is constant. So it is important that we use this wisely.

Objective

To explain the importance of preventing water wastage, thus conserving water.

Activity

Ask students to gather around a water tap. Place a bucket under the tap and adjust the tap so that the water drips drop by drop. Let one student take charge of the stopwatch or minute glass and be the time keeper. Ask another student to hold a measuring cylinder under the dripping tap. As soon as the time keeper gives a signal at the end of one minute the cylinder should be removed from under the tap. The water collected in the cylinder should be measured. Based on the amount of water collected in one minute, ask the students to calculate the amount of water that would be wasted in one hour or in a day from the dripping tap.

Further discuss with students the most common causes on water wastage in our homes, schools, offices, etc. and on methods of preventing water wastage.

Extension/Variation

Information could be collected on how much water is used everyday for brushing, bathing, cleaning, washing clothes, etc. This could be compared to the amount of water wasted from a dripping tap in a day.

Subject
Science

Place
Home, School

Duration
10–15 minutes

Group size
8–10 students

Materials
Measuring cylinder or empty soft drink bottom of known volume, stop watch or ‘minute’ glass, a tap or a large bucket with an attached tap, a bucket.

We All Need Water

Subject
Science

Place
Outdoors

Duration
One hour for field visit and 30 minutes for discussion

Group size
Entire Class

Materials
Magnifying glass, writing material

All living things—plants or animals—need water to live. All organisms need to take in freshwater to replace metabolic losses and maintain life processes. Apart from this, some organisms may need it for living in, while still others might not be able to breed except in water. Though the amount of water required and the tolerance to lack of water are different for different organisms, none can do entirely without it.

Objective

To make students aware that a single water source is used by many living things.

Activity

Identify a common water source (small pond, tank or public water tap) near the school. Take the students to the site. Ask the students to observe the activities around the water source and note down all the activities such as washing, bathing, cleaning etc. They should consider not only human activity but also observe carefully how other living things—animals, birds, insects and plants—use the water source.

Ask students to dig out some soil from one or more places around the water source. Ask them to observe the various kinds of organisms that live in the soil—earthworms, insects, etc. They may use a magnifying glass for this.

Ask them to make a detailed list of the different ways in which water is used. A sample format is given below.

Activity Site — A Pond

Time	Who used	For what	Remarks
6.30 a.m.	7 women	Filling water pots	
11.30 a.m.	Some sparrows	Bathing in puddle	
All the time	Mosquito larvae	Observed in puddle	Something needs to be done.

This observation sheet should be put up in the classroom and discussed.

Discussion

Are there certain times of the day when the source is used more than at other times?

What are the activities that cause pollution of the source?

Which of the activities would be stopped if the source gets polluted?

Water Bulletin

Subject
Social Science, Language

Place
Classroom

Duration
15 minutes daily (for a week)

Group size
5–6 students

Materials
Chart papers, newspaper, glue, felt pens, markers, scissor, pins.

Newspapers are an integral part of our daily lives. Newspapers are current, they deal with real-life issues. They give news and information on varied subjects. One of them is environment. Articles and news related to the environment show how environmental issues and problems are linked to our lives. These issues or problems are not unidimensional, but have scientific, economic, social and political angles. Often there are many sides to a controversy and various points of view. To understand such issues, one needs to be thorough and regular in updating oneself. Also it is necessary to analyze things from a holistic perspective.

Objective

To help students analyze environment-related news in the newspaper, and make a bulletin board (collage) for their school.

Activity

Divide the students into groups of 5-6. Name the groups as Group A, Group B, and so on.

Depending on the number of groups, give them themes like Water, Wildlife, Climate, Agriculture, urban issues (for e.g. solid waste management, transportation).

After giving each group a theme, discuss with each group about the information they have to collect for their theme. Ask each group to follow the daily newspapers to clip out environment-related news pertaining to their theme. For e.g. if water is the theme, they have to look out for news related to water-scarcity, groundwater depletion, pollution of waterbodies, water distribution, diseases caused by contaminated water, etc.

Ask them to go through the newspapers daily and collect all the news and articles.

At the end of the week, give them a big chart paper and ask them to make a bulletin board.

Ask them to paste all the information collected and give catchy headings. They could also support their bulletin board with appropriate visuals to make it more attractive.

At the end of the week, display these on the school bulletin board, so that the whole school can come and read.

Extension/Variation

Instead of giving different themes to different groups, one group can be made responsible for preparing bulletin board for one week, other group for another week and so on. In such cases, theme could be same for a month.

You could also ask students to make posters highlighting the issue.

Collective Action

Subject
Social Science, Language

Place
Classroom

Duration
30 minutes

Group size
Entire Class

Materials
Writing materials

Traditionally, water use and management were governed by codes of conduct and traditional systems. Today these are being eroded. Keeping in view the water crises that is being faced today, efficient water management requires increased participation and decision-making at the community level. The case study described here is one of the well known Indian experiences and depicts a successful effort of a community-based micro-watershed development effort. The communities agreed to cooperate in the protection of the water catchment area in return for water for irrigation. This developed a new approach in terms of water catchment management and protection. Thus it emphasizes the fact that people need to be closely involved in management and decision-making process.

Objective

To help students understand the role of communities in water management.

Activity

Give the photocopy of the following case study or write it on the blackboard or chart paper.

Tell the students that not only are they going to read about a successful water management initiative, they are also going to learn techniques of comprehending information in a given text, by doing a few exercises.

Ask the students to read the paragraph carefully and answer the questions that follow:

Sukhomajri is a village in the Sivalik Hills near Chandigarh, in the foothills of the Himalayas. Some 70 families lived here. The village is one of the many that lie in within the catchment area of Sukhna Lake, a popular boating and picnic spot for the people living there. The lake began to get silted—the reason, cattle and goats grazing on the hillsides in the catchment had made the hills bare. The soil was running off into the streams and river that fed Sukhna Lake., causing the lake to fill up with silt. Large chunks of land were sliding into ravines around the deep gorge of the Sukhna River. The village itself was in danger of being swallowed up.

At the same time, villagers were suffering because of low water levels. The barren land could not hold water, and rainwater simply ran off the hills to the river below, carrying rocks, sand and soil with it. The problem was how to hold the water over the soil so that it could be used by Sukhomajri village, and at the same time stop it from carrying their soil away.

The Central Soil and Water Conservation Research and Training Institute (CSWCRTI) helped the villagers of Sukhomajri build three small reservoirs to collect rainwater for irrigating their land. The villagers, for their part, planted trees and grasses on the hillsides and stopped letting their cattle graze freely. As a result plants grew back to cover the slopes. The plant cover helped slow down the water so that it began to soak into the ground instead of just running off. Village wells and local springs benefited from the resulting higher ground water level.

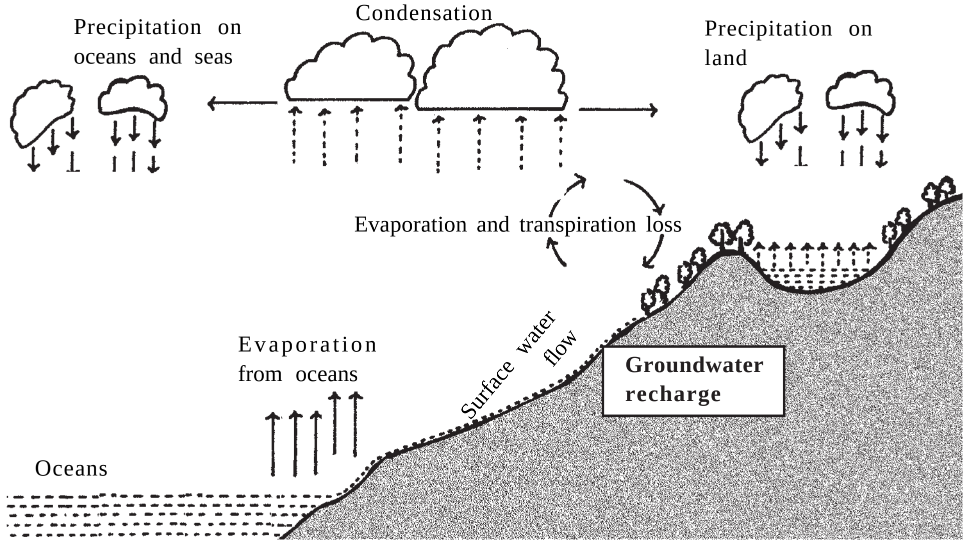
*The village formed a Hill Resource Management Society in which every villager was an equal member. The Society made sure that everyone shared in the profits of the water conservation project. The people also created a Water Users' Association. A water-sharing system was set up by the Association, whereby each family, whether it owned land in the village or not, was given a '**water coupon**". The family could use the coupon or sell it to someone else. Since there are no tubewells in the village, local farmers depended on the water from the reservoirs to irrigate their crops. With the water-sharing system, each farmer could get the water he needed.*

The result of the project was less soil erosion and a constant water supply for the village. The area around Sukhomajri is now covered with grasses, shrubs and trees. Local crop production is much higher with the use of the reservoir water for irrigation. Other villages in the region have started their own programmes like the one at Sukhomajri. And the villagers of Sukhomajri are profiting from a programme that they themselves helped to build.

Answer the following questions regarding the information presented in the above passage.

1. Why did Sukhna lake began to silt?
2. What was the problem in Sukhomajri village?
3. How did the CSWCRTI help solve the problem of villagers?
4. What did the villagers do on their part?
5. Which types of associations did the villagers form?
6. What type of water-sharing system was formed?
7. What was the result of the project?
8. Give an appropriate title for the passage.

More About Water



Life cannot exist without water. Water is an essential component of all living things. All animals and plants need water, and contain large amounts of it. Water plays a key role in determining the weather, helps to shape the land surface, and regulates the climate. Water has played a predominant role in governing the distribution of humans across the surface of the earth. In fact, the growth of many civilizations has been traced to areas near rivers.

About three-fourths of the earth's surface is covered by water. The Earth's water resource—hydrosphere—consists of oceans, ice and snow in the polar and other regions, mountain glaciers, lakes, streams, rivers, swamps, water in surface soil and in underground strata.

Hydrological Cycle

Water continuously circulates from the ocean, to the atmosphere, to the land, and back to the ocean. This never-ending movement from one stage to another is called the hydrological or water cycle.

Water in the oceans, lakes and streams is heated by the Sun and evaporates. Water also evaporates from plants. This is called transpiration. All this water vapour rises into the air. As it rises, it cools and condenses, and forms little droplets that make up the clouds.

Within clouds, tiny droplets of water come together to form larger and heavier clouds. When the air around the cloud cools, these fall as rain, or when the temperature is below freezing point, as snow. Water that falls from the clouds—in the form of rain or snow—is called precipitation.

Some of this rainwater seeps through the soil and is stored underground. This is called underground water. Plants absorb water from the soil and return it to the atmosphere during transpiration. Much of the remaining rainwater finds its way to rivers which transport it to the oceans. From the oceans it evaporates again. Thus a new cycle begins.

Sources of Water

The primary source of freshwater is precipitation in the form of rain, snow and hail. Rainfall is the most important of all these. After falling on the land, rainwater follows various pathways.

Freshwater Sources

Freshwater is available as part of the vast water cycle in which water evaporates from the ocean, falls as rain over land, and gathers in lakes, rivers, streams and other wetlands. It has a low salt concentration—usually less than one per cent (1000mg/L) of dissolved salts. Freshwater supplies are mainly stored either in the soil beneath the ground (as groundwater), or in lakes, rivers and streams on the earth's surface (as surface water).

Freshwater is found in ponds and lakes, streams and rivers, and wetlands. Water bodies are **flowing (*lotic*)** e.g. a river or stream, or relatively stationary i.e. **still waters (*lentic*)** e.g. pond or lake, which are often fed by rivers.

Freshwater habitats have different characteristics depending on whether water is still or moving.

Flowing water systems include creeks, rivulets, springs, streams and rivers. Flowing water usually concentrates into distinct water courses or channels. Small channels are called streams, and the larger ones rivers. Rivers play a vital role in the water cycle, because they drain water from land into seas and oceans. They flow rapidly downhill to the sea and hardly store any water. They are quick and pipe-like. During heavy rains, the increased inflow of water into the rivers may cause the low-lying areas adjacent to a river to be inundated by flood waters. These areas are known as flood plains.

Depending upon the duration of flow, streams or rivers are grouped into three types (*See box: Types of Rivers*).

A river supports different kinds of life forms. Factors determining the kind of flora and fauna a river can support include:

- Speed at which the river flows—for example, a river flows at a fast pace in the mountains, and as a result, the sediment at the bottom is not stable. It can therefore sustain very few species of animals and plants. The slower movement of this same river when it reaches the plains allows the development of a totally different set of plant and animal life.
- Transparency of the water—the amount of sunlight that percolates into the water directly affects the photosynthesis by the plants therein. The more turbid the water, or the deeper the water, the less light is available.
- Regular supply of oxygen—is essential for aquatic animals. Oxygen in water is in dissolved state. Much of it comes from the atmosphere. Algae and rooted plants add oxygen to water through photosynthesis. The oxygen content of natural water varies with temperature, salinity, turbulence, the photosynthetic activity of algae and higher plants, and the atmospheric pressure.
- Chemical composition of water—i.e. the different levels of mineral salts it contains also greatly influences its animal life largely.

Types of Rivers

Ephemeral Streams or Rivers

The stream flow occurs irregularly and the channel is dry for long periods. Rainfall is occasional and may come as a sudden downpour. Vegetation cover is sparse. When the rainfall intensity exceeds the infiltration capacity of the soil, the flow is increased, resulting in flashfloods.

(*See activity 'Soil Permeability' in 'Soil'*)

Intermittent Streams or Rivers

These are seasonal streams. There are distinct, well-defined wet and dry periods and seasonal contrasts in the water balance. During rainy season, there is surplus water which results in high flows. Even after the rainy season, the stream flow is sustained by the groundwater stores, till the early part of the dry season.

Perennial Streams or Rivers

These have permanent flows. They flow throughout the year. During dry seasons, the store of groundwater is sufficient to sustain a minimum flow.

Still water systems include lakes, ponds, and swamps. Lakes are stratified with respect to temperature, oxygen and nutrients. The top layer of the lake is warmer, with plenty of oxygen and light. Photosynthesis by plants occurs in this layer. The bottom layer of the lake is colder and denser. Between these two is the middle layer which is a narrow transition zone. The water temperature decreases abruptly here.

Water bodies like ponds and lakes consist of four distinct ecological zones, providing habitats and niches for different species. The *littoral zone* includes the shore and the shallow, nutrient-rich waters near the shore. A variety of phytoplanktons, rooted vegetation such as water lilies and cattails are commonly found in this region. Snakes, snails, frogs, clams and aquatic insects are some of the animal species found here. The *limnetic zone* is the open-water surface layer that gets enough sunlight for photosynthesis. It contains varying amounts of phytoplankton, zooplankton and fish, depending on the nutrients available. The *profundal zone* is the deep, open water where it is too dark for photosynthesis. These are inhabited by fish adapted to cooler and darker water. The *benthic zone* at the bottom is inhabited by decomposers (bacteria and fungi), detritus-feeding clams, and wormlike insect larvae.

Groundwater

Much of the freshwater on land is not in rivers and lakes. It is hidden underground as groundwater in vast reservoirs. Groundwater is the accumulation of water below the surface of the ground.

How does water gets accumulated beneath the ground? When rain falls on the ground, some of it flows along the land surface to streams or lakes, some seeps into the ground which is utilized by plants and some evaporates and returns to the atmosphere. As water seeps into the ground, some of it clings to particles of soil or to roots of plants just below the land surface. This moisture provides

Some Threats to the Water Cycle

Dams which block the flow of a river and therefore have a negative impact on the area downstream the dam, which no longer receives a flow of water.

Tubewells and borewells which are being dug deeper and deeper to extract groundwater.

Pollution of water sources which is caused by municipal sewage, industrial effluent, agricultural runoff etc. Municipal water pollution consists of wastewater from homes and commercial establishments. Industries use water to generate electricity, to cool or clean equipment or in various processes. They return water that is often polluted and at a warmer temperature than the intake. **Acid rain** caused by emissions of sulphur dioxide and nitrogen oxides from industries and motor car exhausts affects the entire water cycle by making rainwater acidic. The use of fertilizers and pesticides in agriculture produces agricultural wastes and runoffs which reaches rivers and streams, thus causing pollution. All these activities severely affect the ecological balance of the water bodies and plant and aquatic life. *(See chapter 'Pollution' for more information on various types of pollution)*

Deforestation which affects the amount of water percolating into the soil and the moisture that can be retained in an area. Forests are like sponges, absorbing rainwater and releasing it gradually into streams. The soil's water holding ability is related to the amount of organic material and its penetration by roots. The roots of trees help to retain the soil and retard siltation at bank stream. Removal of vegetation exposes the soil to more rapid erosion. Denuded land allows water to run off, rather than sink into it. Soil particles are washed into streams where they cause siltation. In the absence of vegetation and forest, the heavy downpour batters the soil, resulting in erosion of soil.

plants the water they need to grow. Water not used by plants moves deeper into the ground. The water moves downward through empty spaces or cracks in the soil, sand, or rocks until it reaches a layer of rock through which water cannot easily move. The water then fills the empty spaces and cracks above that layer. This water that fills the empty spaces and cracks is the groundwater. The process of water seeping down from the land surface and adding to the groundwater is called recharging of water.

Groundwater is recharged from rain water and snowmelt or from water that leaks through the bottom of some lakes and rivers. Groundwater also can be recharged when water supply systems (pipelines and canals) leak and when crops are irrigated with more water than they require.

Water table

The top of the water surface below the layer of soil, sand, or rocks is called the water table. The water table may be deep or shallow. The rise or fall of the water table depends on several factors. Heavy rains or melting snow may increase recharge and cause the water table to rise. An extended period of dry weather may decrease the recharge and cause the water table to fall. Increased withdrawal through wells and tubewells for human use, also leads to a fall in the water table.

Aquifer

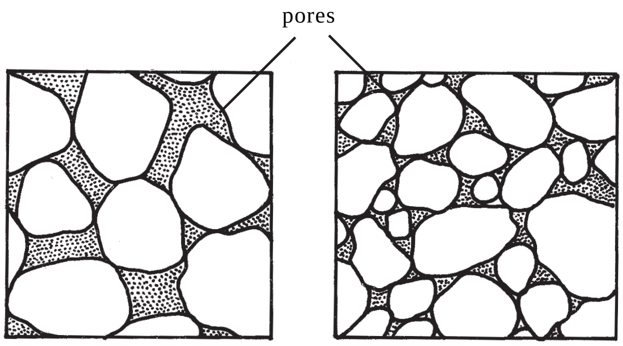
Water that is not absorbed by the plant roots enters the soil. It moves slowly downward through the spaces in the soil and subsurface material until it reaches an impervious layer of rock. The porous layer which becomes saturated with water is called an aquifer.

The amount of groundwater that can flow through soil or rock depends on the size of the spaces in the soil or rock and how well the spaces are connected. Permeability indicates the relative ease of movement of water i.e. the characteristics that determine how fast air and water move through the soil.

Infiltration refers to the downward movement of water into the soil surface.

Aquifers come in all sizes. They may be small, only a few hectares in area, or very large, underlying thousands of square kilometers of the earth's surface. They may be only a few meters thick, or they may measure hundreds of meters from top to bottom.

Aquifers typically consist of gravel, sand, sandstone, or fractured rock such as limestone. These types of materials are permeable because they have large connected spaces that allow water to flow through. The spaces in a gravel aquifer are called pores. The spaces in a fractured rock aquifer are called fractures.



If a material contains pores that are not connected, groundwater cannot move from one space to another. These materials are said to be impermeable. Materials such as clay or shale have many small pores, but the pores are not well connected. Therefore, clay or shale usually restrict the flow of groundwater.

Most usable groundwater occurs at a depth of 750 m. Groundwater supplies water to wells, springs and even to rivers and streams. Groundwater has a number of advantages when compared to surface water. These reservoirs do not suffer seepage losses like surface reservoirs like streams, lakes.

Water Resources in India

India has one of the richest water resources in Asia, with about 14 per cent of Asia's renewable freshwater resource. It receives an average annual rainfall of 1150 mm. However, rainfall distribution varies widely across the land, both spatially and temporally. Some areas like the Thar desert receive less than

200 mm annually, while 10 km from Cherrapunji stands the village of Mawsynram, which has snatched the heaviest rainfall record, with 12,163 millimeters of rainfall.

India has a network of rivers comprising of 12 major river basins, having a combined catchment of about 256 million hectares (m.ha). Besides, there are 46 medium river basins of sizes varying between 2000 to 20,000 sq.km. covering a total area of about 25 m.ha.

In a 'record-making' month in 1861, Cherrapunji received 22,987 mm of rainfall.

There are some large natural lakes like Dal and Wullar in Jammu and Kashmir, Kolleru and Pulicat in Andhra Pradesh, Chilika in Orissa.

There are about 1500 glaciers in the Himalayan region.

Rivers in India

The Ganga, India's largest river basin, is bounded by the Himalayas in the north and the Vindhya Range to the south. The Ganga has its source in the glaciers of the Greater Himalayas, which form the frontier between India and Tibet in northwestern Uttar Pradesh.

The Brahmaputra rising in Tibet, flows south into Arunachal Pradesh after breaking through the Great Himalayan Range. It continues to fall through gorges in Arunachal Pradesh until finally entering the Assam Valley where it meanders westward on its way to joining the Ganga in Bangladesh. The Brahmaputra has the greatest volume of water of all the rivers in India because of heavy annual rainfall levels in its catchment basin

The Mahanadi, rising in the state of Madhya Pradesh, is an important river in the state of Orissa. The upper drainage basin of the Mahanadi, is centered on the Chhattisgarh Plain.

The source of the Godavari is northeast of Mumbai in the state of Maharashtra, and the river follows a southeasterly course for 1,400 kilometers to its mouth on the Andhra Pradesh coast. The Godavari River basin area is second in size only to the Ganga; its delta on the east coast is also one of the country's main rice-growing areas. It is known as the "Ganga of the South," but its discharge, despite the large catchment area, is moderate because of the medium levels of annual rainfall, for example, about 700 millimeters at Nasik and 1,000 millimeters at Nizamabad.

The Krishna rises in the Western Ghats and flows east into the Bay of Bengal. It has a poor flow because of low levels of rainfall in its catchment area—660 millimeters annually at Pune. Despite its low discharge, the Krishna is the third longest river in India.

Cauvery originates from the Bhramagiri Hills in the Western Ghats and flows through the states of Karnataka and Tamil Nadu, in the southeastern direction. In the early 1990s, an estimated 95 per cent of the Cauvery was diverted for agricultural use before emptying into the Bay of Bengal.

The Narmada and the Tapti are the only major rivers that flow into the Arabian Sea. The Narmada rises in Madhya Pradesh and crosses the state, passing swiftly through a narrow valley between the Vindhya Range and the Satpura Range. It flows into the Gulf of Khambhat. The shorter Tapti follows a generally parallel course, between eighty kilometers and 160 kilometers to the south of the Narmada, flowing through the states of Maharashtra and Gujarat on its way into the Gulf of Khambhat.

But sadly this perennial source of water is disturbed and damaged. The trees that guaranteed the river water their life are destroyed along with development projects, the banks are led waste.

Watershed and Catchment Area

A watershed is a system. It is a drainage basin, which guides all precipitation and runoff (water, sediments, dissolved minerals, pollutants and trash) to a common water course or body of water. It is an area of land that catches rain, and drains or seeps it into a stream, river, lake or groundwater. The entire area from which drainage is received by a river system is called the **catchment area**.

Watersheds are found in all shapes and sizes. Our homes, farms, villages, forests, small towns, big cities and more, can all be a part of watersheds. They can vary in size from thousands of acres—like the land that drains into the Ganges—to a few acres that drain into a local pond.

A watershed may be open or closed, depending on where the water drains. In a closed system, like in some ponds, there are no outlets for the water, so it leaves the system naturally by evaporation or by seeping into the ground (becoming groundwater). In an open watershed system, water eventually flows into outlet rivers or a gulf and ultimately, the sea.

Watersheds have many features that make each one unique. These include: size, geographic boundary, topography and soil.

Size: Some like the Ganga river basin, are very large and include many smaller river basins or watersheds.

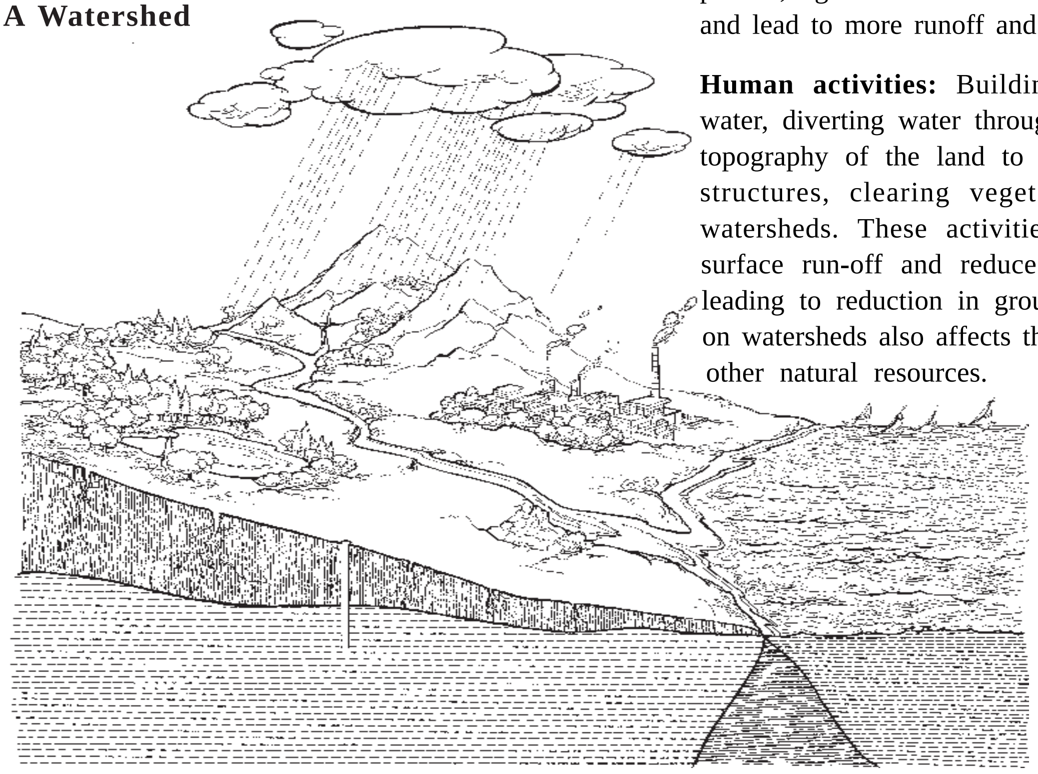
Geographic boundary: The high areas from which water drains towards a watershed form its geographic boundary.

Topography: The terrain of the watershed—how flat or steep the land is—impacts how fast water drains. The faster the drainage, the higher the potential for flooding and soil erosion.

Soil type: This is an important feature, which determines whether the water seeps inside the soil or runs off. Sandy soils, for example, allow the ground to soak up water fast and reduce surface runoff. Clayey soils, on the other hand, are closely packed, tight and do not allow as much infiltration and lead to more runoff and soil erosion.

Human activities: Building dams to impound water, diverting water through canals, or changing topography of the land to build roads and other structures, clearing vegetation, etc. can alter watersheds. These activities could increase the surface run-off and reduce infiltration of water, leading to reduction in groundwater. What we do on watersheds also affects the quality of water and other natural resources.

A Watershed



Uses of Water

The total amount of fresh, usable water is limited. But few of us are conscious of the number of demands on this limited amount of water. We may not even be conscious of the various things for which we use water, how many times in a day we use water, or how much water we need.

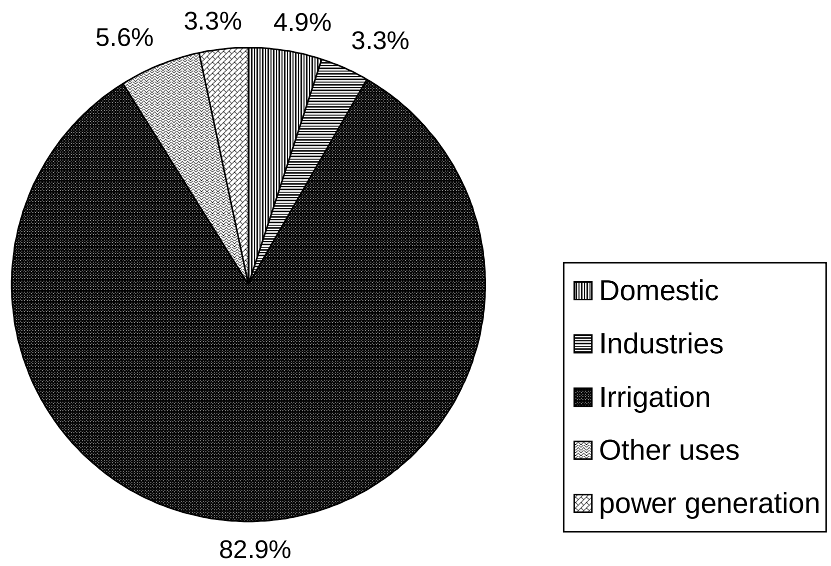
Water uses can be broadly categorized as follows:

Water for Life: Life began in water and water is a basic component of every living cell. It acts as a medium for important life-processes and chemical reactions, and transports food and waste products.

Agriculture: Food cannot be produced without water. Crops, livestock, all need water.

Industry: Almost all industrial processes need water. It is needed for the manufacturing or processing of ores, textiles, chemicals, paper, food, etc. Water is needed as a solvent, as a medium, as a cooling agent, as a cleaning agent.

Utilization of Total Water Resources in India (1997)



Power: Almost all modes of power generation require water—from hydel power, where falling water turns turbines to produce power to nuclear power, where usually water is used as a coolant.

Domestic Use: Cleaning, cooking, washing, bathing, sanitation—all these require water.

Waste Disposal: Whether it is domestic sewage or industrial effluents, water is vital for waste disposal.

Medium of transport: Boats, ships and sail boats carry men and materials from one place to another.

Water Problems

Water problems fall into three categories: too much; too little; and threats to water bodies.

Too Much Water

Flooding occurs as a result of too much freshwater entering a particular area. Flood damage is made more acute by deforestation and by the development of flood plains. Flood plains are the areas bordering a river that are subject to flooding. Human activities, such as the removal of water-absorbing plant cover from the soil and the construction of buildings on flood plains, increases the likelihood of both floods and flood damage. Forests provide some protection from floods by trapping and absorbing precipitation. When these are cut down or clear cut, the area cannot hold water and heavy rainfall then results in rapid runoff and causes soil erosion. This also puts the nearby area at extreme risk of flooding.

Waterlogging is another serious problem. It occurs where the water table rises close to the surface due to saturation of soil with irrigation water or excessive precipitation. This generally happens in agricultural lands where there is excessive irrigation on poorly drained soils. Water cannot penetrate deeply in poorly drained soils, for example, where there is an impermeable clay layer below the soil. It also occurs on areas that are poorly drained topographically. The irrigation water (and/or seepage from canals) eventually raises the water table in the ground. Farmers do not generally realize that waterlogging is happening until it is too late. The raised water table results in the soils becoming waterlogged. When soils are water logged, air spaces in the soil are filled with water, and plant roots essentially suffocate, i.e. lack oxygen. Waterlogging also damages soil structure. (*See chapter 'Soil' for more information on soil structure*)

Too Little Water

Water becomes scarce when there is no precipitation, and continuous drought follows. Human activities such as overdrawal of surface water, extraction of groundwater at a pace faster than it can be recharged through the water cycle, pollution of water sources— all decrease the availability of water.

Overdrawing surface water: Removing too much water from a river or lake can have disastrous consequences on the local ecosystem. Rivers become shallower and regulated flow does not match natural conditions to which plants and animals have evolved. Often, overdrawing leads to shrinkage of lakes and rivers. When the rate of overdrawing exceeds the rate of replenishment, they dry up.

Groundwater extraction: Groundwater is generally extracted through wells. Wells may be either open wells or borewells. Once the water extraction starts, groundwater structures start emptying out. If they are not filled/recharged again, there is a depletion of the groundwater level.

Over-exploitation of groundwater results in long term decline in water levels, and may lead to consequences such as aquifer depletion, land subsidence (sinking of land when groundwater is withdrawn), saltwater intrusion, and accelerated movement of pollutant, thereby deteriorating ground water quality.

Drought

Scarcity of water which occurs due to inadequate rains, late arrival of rains and excessive withdrawal of groundwater, is referred to as drought. It is a period of unusually dry weather which persists long enough to produce a serious hydrologic imbalance, for example, crop damage, water supply shortage, etc. The severity of the drought depends upon the degree of moisture deficiency, the duration and the size of the affected area.

Droughts are classified into six different types. They are:

Meteorological drought, is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) and the duration of the dry period. Meteorological drought must be considered region specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region. According to India Meterological Department, meteorological drought occurs when the total amount of rainfall received in an area is less than 90 per cent of the normal rainfall.

Hydrological drought, which occurs when there is insufficient water in the streams and rivers and reservoirs, and groundwater levels drop to seriously low levels.

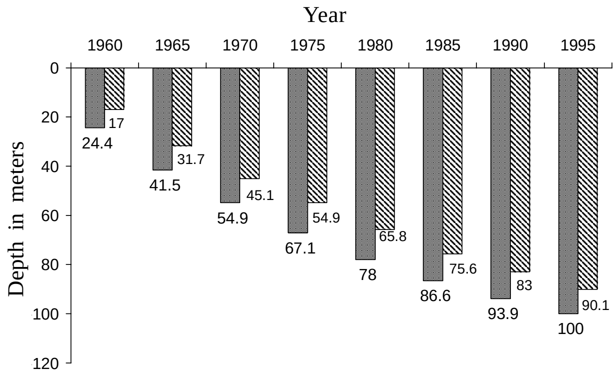
Agricultural drought, which occurs when the crops start wilting due to lack of soil moisture.

Socio-economic drought, which occurs due to reduction of availability of food and social security of the people in the affected areas.

Famine, which occurs when large-scale collapse of access to food occurs, which without intervention can lead to mass starvation.

Ecological drought, which occurs when the productivity of a natural ecosystem fails significantly as a consequnce of distress-induced environmental damage.

Water Table in Ahmedabad City



Source: A report, "Reviving an Ancient Wisdom—Tanka: Traditional Rooftop Rainwater Harvesting System in the Walled City of Ahmedabad" prepared by Heritage Cell of Ahmedabad Municipal Corporation in association with Sarbjit Singh Sahota.

Impact of over-extraction of groundwater

Aquifer depletion: Aquifers produce useful quantities of water when tapped by a well. The extraction of more groundwater from aquifers by humans than can be recharged by precipitation is called aquifer depletion. Prolonged aquifer depletion drains an aquifer dry, and then it is no more a water resource. If the annual withdrawal from an aquifer regularly exceeds the recharge, the water stores in it will be depleted. Aquifer depletion may lead to serious shortage of water for drinking, domestic and irrigation purposes. The movement of salt water into a freshwater aquifer (saltwater intrusion) can occur if an aquifer along coastal areas is depleted faster than it can be replenished; this may result in the infiltration of seawater into it, thereby making the groundwater saline.

Land subsidence: Land subsidence occurs by human activities like underground mining, and excessive withdrawal of groundwater. Land subsidence varies from small local collapses to broad regional lowering of the earth's surface. In the last two decades, groundwater use as a percentage of total water use has increased drastically because surface water supplies are already used and/or are contaminated and hence more groundwater is being pumped than ever before, to meet the ever increasing demand. Groundwater exploitation increases manifold during dry periods or droughts. This often leads to land subsidence, and causes many problems like:

- damage to structures like buildings, storm drains, sewage canals, roads, railway tracks, canals, bridges, etc.
- in coastal areas, subsidence has also resulted in sea water encroaching into the lowlands during high tides.
- changes in ground levels of rivers, streams, drains and other water transporting facilities.

Threats to Water Bodies

Pollution: The main sources of water pollution are waste disposed from human settlements, industries and agricultural run-off. There are also natural sources of pollution—for e.g. addition of soil, plant and animal debris to water bodies after a heavy [redacted]r. When too much organic matter, toxic [redacted] or other undesirable substances are [redacted] in water, the water becomes polluted. Plant and animal life suffer and the water may become impossible to treat for consumption. Another kind of pollution associated with water is thermal pollution. Hot water is used in many industries to cool machinery. This water is removed via a discharge pipe into the river. Due to this temperature change, life in that ecosystem is affected. The increase in temperature affects the level of oxygen that was otherwise freely available to aquatic organisms. This in turn affects their respiration and their way of life.

Water pollution is not restricted to surface water alone. Groundwater also gets contaminated. Dumping of solid waste is one of the reasons for groundwater pollution. Various kinds of harmful material (chemicals, metals, etc.) present in the solid waste may get dissolved or leached out into water. Once groundwater is contaminated, it is very difficult to clean up.

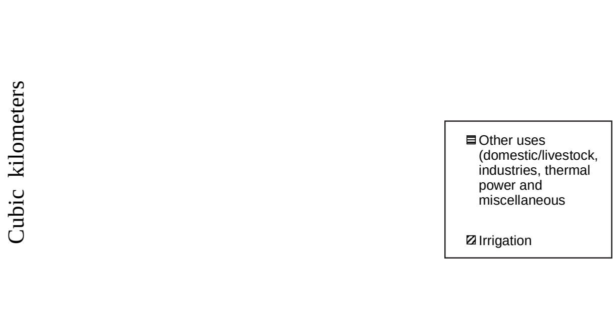
Changes in river hydrology: Major modifications to river systems include making changes in depth and width for navigation, construction of reservoirs for drinking water supply, damming for hydroelectric power generation, etc. This action can directly or indirectly lead to modifications of the river and the associated valley, which can lead to changes in the aquatic environment. Modification of a river valley is also caused by encroachments of the flood plains by agricultural land and urban centres. These actions could lead to a loss of flora and fauna found in the aquatic ecosystems.

Sand quarrying: Removal of sand from river beds is a common phenomenon in our country. This can cause serious ecological problems such as changes in the water flow velocity particularly in monsoons, resulting in violent river flow. This can cause erosion of the banks, damage to flora found there and occasional change in river course direction. Quarrying stops only when all the sand has been removed and this destroys niches and habitats of most organisms irreversibly.

Reclamation of land and conversion of landuse: This is the most common cause of wetland loss worldwide. Swamps, marshes and lakes are reclaimed by draining the water for agricultural crops, building apartments and townships.

Depletion of forest cover and intensive agricultural practices in the watershed area results in soil erosion that fills up the wetland downstream, thereby reducing its area.

Increase in Annual Groundwater Demand in India



Source: The Citizens' Fifth Report, Part II Statistical Database, CSE

Introduction of new species to water bodies: Exotic species (non-native plant or animal species deliberately or accidentally introduced into a new habitat) such as water hyacinth, hydrilla and Salvinia take over native vegetation. Such species have many negative impacts on the environment. When exotic species are introduced into an area, they may cause increased predation and competition, disease, habitat destruction, genetic stock alterations, and even extinction.

Wetlands: Uses and Threats

Wetlands are water bodies—both fresh and saline. They are the areas where water is the primary factor controlling the environment and the associated plant and animal life. Wetlands occupy the transitional zone between permanently wet and generally dry environments. Shallow lakes, ponds, abandoned quarries, estuaries, lagoons, coral reefs, mangrove swamps, etc., are some of wetlands.

Wetlands are among the world's most productive environments. Th[illegible]ovide a wide array of be[illegible] to human [illegible]gs, and [illegible] great di[illegible] of life for [illegible]e direct [illegible]ood pr[illegible] that can [illegible]sumed, [illegible]tus, ag[illegible]r (an algae [illegible]r makin[illegible]tion — [illegible]ample bir[illegible]hing an[illegible]ber, etc. [illegible] control, [illegible] purifi[illegible] as habitat for fish, birds and other [illegible] are the indirect uses of wetlands.

Many wetlands are being drained for agriculture, industry, urban expansions, and other such purposes. Also, a large number of these are subjected to inflow of domestic sewage, industrial pollutants and agricultural run-off. Deforestation and several unplanned human activities in the catchment area of many wetlands have caused increased sedimentation and resultant shrinkage in the wetland. Weed infestations is another problem posing a great threat to wetlands' ecological functions. Wetlands are also mined for sand, gravel and other materials.

A non-native species may survive better than a native one, not only because it has no natural enemies in the new environment, but because it grows more quickly or in less favorable conditions than natives. This causes increased competition for resources by native species. Exotic plants grow quickly, thus they block sunlight to other species. When they decay, they consume more oxygen, thus leading to oxygen depletion in water. Lack of oxygen in water results in fish loss. Fishes even die due to suffocation. The overgrowth also crowds out navigation channels and clogs machinery.

Exotic animals consume food sources that native species would eat, leaving insufficient food; they occupy safe or supportive habitat, leaving a reduced amount of habitat for natives; they may serve as food for native species but may lack certain essential nutrients, leading to death of native offspring; and consume eggs, young, and adults of native species.

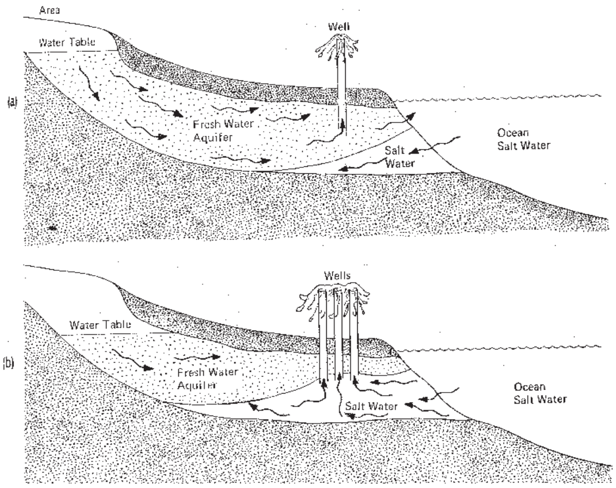
Water Crisis in India

Over one billion people worldwide lack safe water, 80 per cent of infectious diseases are water borne, killing millions of children each year. Several parts of India are facing an immense challenge to meet the basic needs of water. People have to walk long distances to collect even a few pots of drinking water. Thus, there is an urgent need for understanding the status of drinking water quantity and quality, the related problems and also the reasons for the problems.

The crisis of water in India has aggravated as there is increase in demand of water. At the same time, water resources are continuously declining, despite there often being a good amount of rainfall. The water sources are continuously degrading due to factors like pollution, salinization etc.

The minimum requirement of water per person per day is about 90 litres to 120 litres as per World Health Organization. There is a huge disparity in quantity of drinking water supplied in the cities of India. Of the 299 Class I cities, only 77 cities have cent per cent water supply. The per capita water supply also

Salt Water Intrusion



ranges from as low as 9 litres per capita per day (lpcd) in Tuticorin, to as high as 584 lpcd in Triuvannamalai. Similarly, of the 345 Class II towns, 203 have low per capita supplies i.e. less than 100 lpcd. Besides there is an inequitable distribution of water in a given city, and the supplies are erratic, with water quality degrading continuously over time.

The reasons for the water crisis include:

Over-extraction: Groundwater levels have fallen in many areas due to over extraction in many parts of India. The fall in groundwater levels has caused acute shortage of drinking water. Over-extraction has also affected the quality of groundwater. This has led to seawater intrusion along shorelines, causing salinization of coastal agricultural lands. In Chennai, salt water intrusion has moved 10 km inland, rendering many irrigation wells useless (UNEP 1996b). Salt water intrusion is of particular concern in small island states, where the limited groundwater supply is surrounded by salt water.

Pollution and contamination: The pollution of air, water, and land has an effect on the pollution and contamination of groundwater. The solid, liquid, and the gaseous waste that is generated, if not treated properly, results in pollution of the environment. This affects groundwater too due to the hydraulic connectivity in the hydrological cycle. For example, when the air is polluted, rainfall will settle many pollutants on the ground, which can then seep into and contaminate the groundwater resources. Water extraction without proper recharge and leaching of pollutants from pesticides and fertilizers into the aquifers has polluted groundwater supplies. In addition, leachates from agriculture, industrial waste, and the municipal solid waste have also polluted surface and groundwater. Groundwater supplies are often contaminated by arsenic, fluoride, iron and salt. Some 45 million people the world over are affected by water pollution marked by excess fluoride, arsenic, iron, or the ingress of salt water.

Arsenic in Drinking Water

Arsenic may be found in water which has flowed through arsenic-rich rocks. Severe health effects have been observed in populations drinking arsenic-rich water over long periods in countries world-wide. Arsenic in drinking-water poses the greatest threat to public health. Exposure at work, mining and industrial emissions may also be significant locally.

Arsenic is widely distributed throughout the earth's crust. It is introduced into water through the dissolution of minerals and ores, and concentrations in groundwater in some areas are elevated as a result of erosion from local rocks. Industrial effluents also contribute arsenic to water in some areas. Arsenic is also used commercially e.g. in alloying agents and wood preservatives.

Long-term exposure to arsenic via drinking-water causes cancer of the skin, lungs, urinary bladder, and kidney, as well as other skin changes such as pigmentation changes and thickening (hyperkeratosis).

Increased risks of lung and bladder cancer and of arsenic-associated skin lesions have been observed at drinking-water arsenic concentrations of less than 0.05 mg/L.

Absorption of arsenic through the skin is minimal and thus hand-washing, bathing, laundry, etc. with water containing arsenic do not pose human health risk.

Following long-term exposure, the first changes are usually observed in the skin: pigmentation changes, and then hyperkeratosis. Cancer is a late phenomenon, and usually takes more than 10 years to develop.

Flouride in Drinking Water

Fluorides occur naturally in the earth's crust, in many materials, in volcanoes and the oceans. The largest natural source in soil and water is from the breakdown of rocks. All water naturally contains some fluoride. Fluoride leaches into the water from fluoride-containing rock formations.

Although it is necessary to humans in small amounts, fluoride can be harmful in large amounts.

Prolonged exposure to levels of fluoride exceeding this maximum contamination level (MCL)can cause skeletal fluorosis, a serious and crippling bone disorder.

In addition, children exposed to levels of fluoride over 2.0 mg/L for an extended period of time may develop dental fluorosis, a brown staining or pitting of their permanent teeth. Dental fluorosis can only occur if developing teeth (teeth that have not yet erupted from the gums) are exposed to high levels of fluoride.

Too much fluoride ingested while teeth are developing, can cause mottling and this occurs in children at levels of 2.0 mg/litre of water.

Statewise details of contamination of groundwater in some areas of the districts due to various contaminants

State	Salinity	Iron	Flouride	Nitrate	Arsenic	Heavy Metals
Andhra Pradesh	East Godavari, West Godavari, Krishna, Guntur , Prakasam	—	Prakasam, Nellore, Anantapur, Nalgonda, Rangareddy, Adilabad	Vishakhapatnam, East Godavari, Krishna, Prakasam, Nellore, Chittoor, Anantapur, Cuddapah, Kurnool, Mehboobnagar, Rangareddy, Medak, Adilabad, Nalgonda, Khammam.	—	Anantapur, Mehboobnagar, Prakasam, Visakhapatnam, Cuddapah, Nalgonda.
Assam	—	Northern Bank of Brahmaputra	—	—	—	Digboi
Bihar	Begusarai	Champaran, Muzaffarpur, Gaya, Munger, Deoghar, Madhubani, Patna, Palamau, Nalanda, Nawada, Banka	Giridih, Jamui, Dhanbad Palamau, Gaya,	Patna, Nalanda, Nawada, Bhagalpur, Sahebgunj, Banka	—	Dhanbad, Muzaffarpur, Begusarai
Gujarat	Banaskantha, Junagarh, Bharauch, Surat, Mehsana, Ahmedabad, Surendranagar, Kheda, Jamnagar, Bhavnagar	—	Kachch, Surendranagar, Rajkot, Ahmedabad, Mehsana, Banaskantha, Sabarkantha, Amreli	—	—	—

State	Salinity	Iron	Flouride	Nitrate	Arsenic	Heavy Metals
Haryana	Sonepat, Rohtak, Hissar, Sirsa, Faridabad, Jind, Gurgaon, Bhiwani, Mahendragarh	—	Rohtak, Jind, Hissar, Bhiwani, Mahendragarh, Faridabad	Ambala, Sonepat, Jind, Gurgaon, Faridabad, Hissar, Sirsa, Karnal, Kurukshetra, Rohtak, Bhiwani, Mahendragarh	—	Faridabad
Himachal Pradesh	—	—	—	Kulu, Solan, Una	—	Purwanoo, Kalaamb
Karnataka	Bijapur, Belgaum, Raichur, Bellary, Dharwar	—	Tumkur, Kolar, Bangalore, Gulbarga, Bellary, Raichur	—	—	Bhadrawati
Kerala	Ernakulam, Trichur, Alleppey	—	Palghat	—	—	—
Madhya Pradesh	Gwalior, Bhind, Morena, Jhabua, Khargaon, Dhar, Shivpuri, Shajapur, Guna, Mandsor, Ujjain	—	Bhind, Moerana, Guna, Jhabua, Chhindwara, Seoni, Mandla, Raipur, Vidisha	Sehore	—	Bastar, Korba, Ratlam, Nagda
Maharashtra	Amaravati, Akola.	—	Bhandara, Chandrapur, Nanded, Aurangabad	Thane, Jalna, Beed, Nanded, Latur, Osmanabad, Solapur, Satara, Sangli, Kolhapur, Dhule, Jalgaon, Aurangabad, Ahmednagar, Pune, Buldana, Amravati, Akola, Nagpur, Wardha, Bhandara, Chandrapur, Gadchiroli	—	—

State	Salinity	Iron	Flouride	Nitrate	Arsenic	Heavy Metals
Orissa	Cuttack, Baleswar, Puri	Parts of Coastal Orissa	Bolangir	—	—	Angul, Talcher
Punjab	Bhatinda, Sangrur, Faridkot, Firozpur.	—	Ludhiana, Faridkot, Bhatinda, Sangrur, Jalandhar, Amritsar.	Patiala, Faridkot, Firozpur, Sangrur, Bhatinda.	—	Ludhiana, Mandi, Gobindgarh.
Rajasthan	Bharatpur, Jaipur, Nagaur, Jalore, Sirohi, Jodhpur	Bikaner, Alwar, Dungarpur	Barmer, Bikaner, Ganganagar, Jalore, Nagaur, Pali, Sirohi.	Jaipur, Churu, Ganganagar, Bikaner, Jalore, Barmer, Bundi, Swai Madhopur.	—	Pali, Udaipur, Khetri.
Tamil Nadu	Karaikal, Pondicherry, Nagapattanam, Quide-Millet, Pudukottai, Ramananthapuram, North Arcot - Ambedkar, Dharampuri, Salem, Trichy, Coimbatore.	—	Dharampuri, Salem, North Arcot-Ambedkar, Villipuram-Padayatchi, Muthuramalingam, Tiruchirapalli, Pudukottai.	Coimbatore, Periyar, Salem.	—	Manali, North Arcot.
Tripura	—	Dharamnagar, Kauleshaher, Khowai, Ambasa, Amapur and Parts of Agartala Valley	—	—	—	—

State	Salinity	Iron	Flouride	Nitrate	Arsenic	Heavy Metals
Uttar Pradesh	Agra, Mathura, Mainpuri, Banmda.	—	Bulandshahar, Aligarh, Agra, Unnao, Rae-Bareli	Orai, Jhansi, Lalitpur, Faizabad, Sultanpur, Maharajganj, Gorakhapur, Deoria	—	Singrauli, Basti, Kanpur, Jaunpur, Allahabad, Saharanpur, Aligarh.
West Bengal	—	Midnapore, Howrah, Hooghli, Bankura	Birbhum	Uttar Dinajpur, Malada, Birbhum, Nadia, Midnapur, Howrah, Murshidabad, Purulia	Malda, South-24 Paraganas, Nadia, Hoogly, Murshidabad, Bardhaman, Howrah	Durgapur, Howrah, Murshidabad, Nadia.
NCT of Delhi	Najafgarh, Kanjhawala, and Mehrauli Blocks.	—	—	City Shahdara and Mehrauli Blocks.	—	Alipur, Kanjhawala, Najafgarh, Mehrauli City and Shahdara Blocks.

Source: http://wrmin.nic.in/resource/cont_gw.htm

Rainfall Pattern

The annual rainfall and the total water resource availability in the country varies from basin to basin. The long-term average rainfall is around 85 cm for the whole country. The problem is that the heavy spells of rain are not uniformly distributed over the four months of monsoon (i.e June to September) across the land. There are hardly 100 rainy days at any place. In the drought-prone areas the number of rainy days are even less—40, 20, etc. Some regions receives heavy downpour whereas at some places there is deficiency of rainfall for two or three consecutive years. The springs, lakes and wells dry out due to scarcity of water because of inadequate rains, late arrivals of rains or no rains. Further, over-extraction of groundwater leads to severe droughts.

Conservation and Management of Water

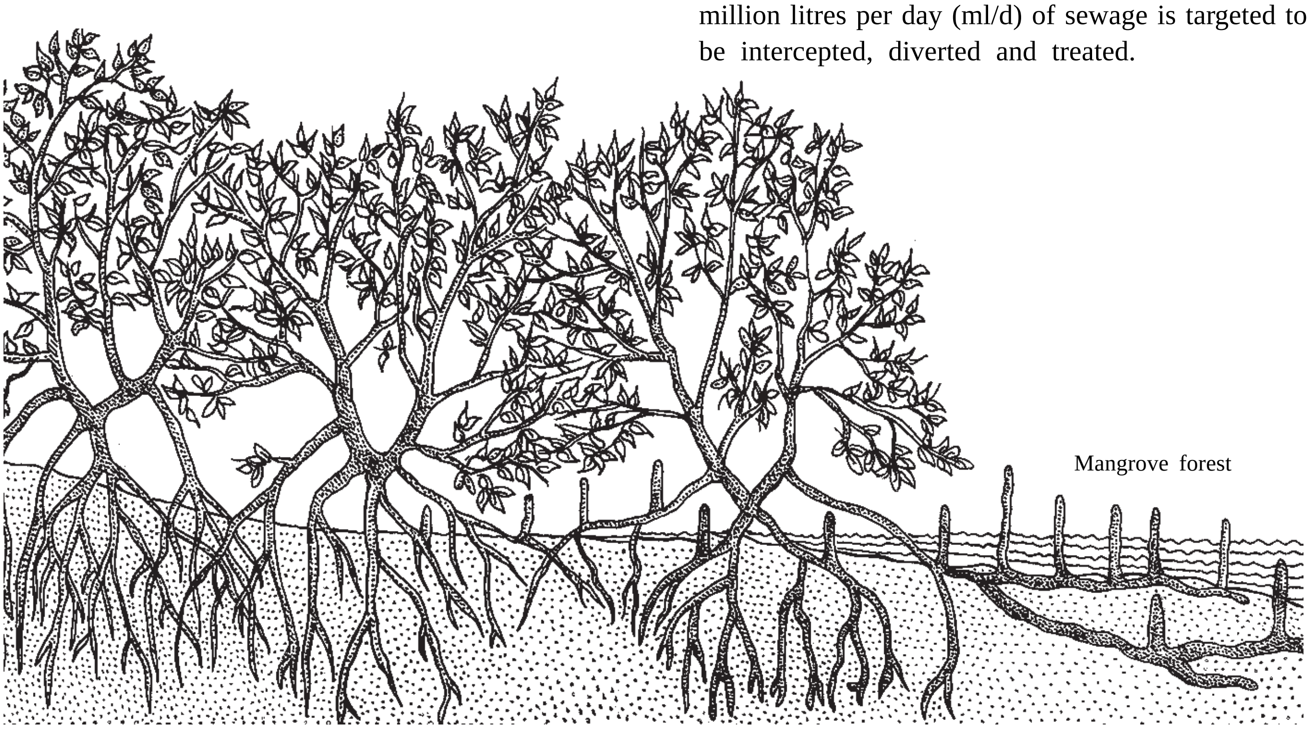
Every sector and every individual has a responsibility towards conservation and proper management of water.

India receives an average annual rainfall equivalent of about 4000 billion cubic meters (bcm). Of 4000 bcm of available water, the mean flow in the country's rivers is about 1900 bcm. Out of this, only 690 bcm is utilizable as surface water whereas the replenishable ground water resource is about 431.9 bcm.

Some Government Conservation Programmes

The Government has initiated a number of programmes to conserve water and to prevent and monitor water pollution and safeguard water bodies from being polluted.

National River Conservation Plan (NRCP): The National River Conservation Plan was launched in 1995 to cover 18 major rivers in 10 states of the country. Under this action plan for pollution abatement, works are being taken up in 46 towns in the states of Andhra Pradesh, Bihar, Gujarat, Karnataka, Maharashtra, Madhya Pradesh, Orissa, Punjab, Rajasthan and Tamil Nadu. About 1928 million litres per day (ml/d) of sewage is targeted to be intercepted, diverted and treated.



Mangrove forest

National Lake Conservation Plan (NLCP): On the recommendation of the National Committee of Wetlands, Mangroves and Coral Reefs, a programme for conservation of 21 urban lakes was formulated. Large scale conservation activities have been taken up in selected urban lakes which are highly degraded due to pollution, encroachments and habitat degradation. Apart from these programmes, wetland conservation and watershed management have also been given priority by the government.

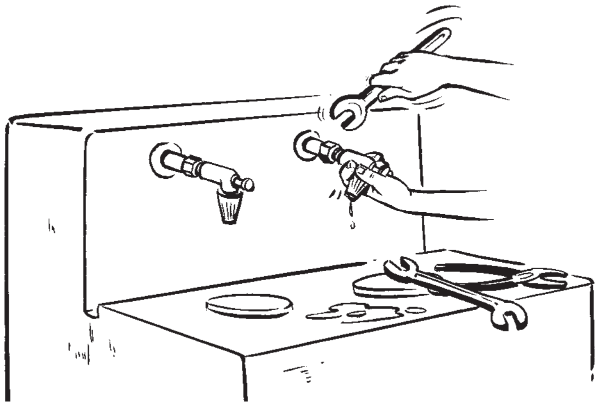
Monitoring programmes: The Central Pollution Control Board (CPCB) along with the State Pollution Control Boards has set up a water quality monitoring network having 480 sampling stations throughout India.

Accelerated Rural water Supply Programme (ARWSP): Under the Rajiv Gandhi National Drinking Water Mission the ARWSP attempts to assist the States/UTs in providing safe drinking water, free from chemical and bacteriological contamination at 40 liters per capita per day (70 lpcd in desert areas to cover requirement of cattle), to under-covered and partially covered villages/ habitations identified through surveys, within 1.6 kilometers in plains and 100 metres elevation in hills.

What Can I Do?

Conserving water does not mean changing your lifestyle. To reduce the amount of water usage, there are simple ways to eliminate the water wastage and use it efficiently. Here's what you can do:

- When you turn on the tap, don't turn it the whole way— maintain a slow flow.
- While you brush your teeth or wash your face, turn the tap off.
- Ensure that the tap is closed when clothes are being washed or vessels cleaned.
- When you fill a glass of water, take only as much you need.



- Get the leaking taps fixed.
- For a cool bath during summer, don't let the water run until the flow is cold; fill a bucket of water and let it stand for a few hours.
- If you store water in the house, utilize the unused stored water for soaking clothes, watering the garden, mopping the floors, etc.
- Wash vegetables, fruits, etc. in a pan of water, rather than under running water.
- Keep a large bucket in the kitchen and pour water used for washing food items or rinsing vessels into this. This could be used for watering plants/
- Collect and store as much rain-water as possible during the rainy season. Rainwater is pure and apart from washing and bathing you could use it for watering delicate plants. Brass vessels washed with rain water stay sparkling for a long time.
- Water the garden early in the morning or late in the evening. These reduce water loss due to evaporation. Avoid the temptation to over water the garden and water only until the soil becomes moist, not soggy.
- Use defrost water from the refrigerator for watering delicate plants, after it has warmed to room temperature.

Traditional Wisdom

Ancient civilizations flourished in proximity of perennial water sources. As the population grew, people moved slowly away from rivers and a culture of storing rainwater emerged. For centuries, people have relied on rainwater harvesting to supply water for household, livestock, and agricultural uses. Rainwater harvesting has been practiced in Indian villages from time immemorial. Evidence of this tradition has been found in ancient texts, inscriptions and archaeological remains. The *Kuhals* of Jammu, *Kuls* of Himachal Pradesh, *Guls* of Uttarakhand, *Pats* of Maharashtra, *Zings* of Ladakh, *Zabos* of Nagaland, *Eris* of Tamil Nadu, *Keres* of Karnataka, *Tankas, Kundis, Bawdis, Jhalaras*, etc. of Rajasthan are some of the traditional rain harvesting systems, which existed in India but now, dying a slow death. The traditional practice involves conserving rain-water at the place where it falls. In this process, groundwater is also recharged. How it is done depends on local conditions and needs, and the nature of the land. These traditions, especially those that are community based, are strongest in the areas of low rainfall and undulating land surfaces.

The traditional rainwater harvesting system of Gujarat and Rajasthan involves collecting rainwater falling on the terrace of the house, in an underground container called *tanka* or a vertical shaft from which water is drawn and the surrounding inclined subterranean passageways, chambers and steps which provide access to the well called *vav* or *baoli*.

Tankas are based on the principle of collection of rainwater as close as possible to the location where it falls. The rainwater falling on the terrace of houses is channelized through a pipe down to an underground tank. The terrace is swept and cleaned before the monsoon by the house owners. A copper pipe carries the rainwater from the terrace to a chamber. This chamber has two outlets, one to the *Tanka*, and another to the drain outside. The water from the first few showers is allowed to flow to the outside as it could contain some impurities and also as it cleans the pipes. The outlet is then plugged and the water from the following showers go to the *Tanka*, through the other outlet, which has a copper mesh at its mouth. The *Tanka* has two manholes, one to access water and other for ventilation. It also has an outlet to drain out excess water.

The *vav* or *baoli* (stepwell) is a distinctive form of underground well architecture found all over Gujarat and Rajasthan. Stepwells reflect the development of architectural and sculptural styles in the chronology of temple architecture of the western region. A long-stepped corridor leading down five or six storeys to the well at the far end is an essential feature of a stepwell.

Stepwells combine a utilitarian function as a source of water, and a meeting and resting place for men and women while drawing water. In the arid climate of north Gujarat, where rivers and natural depressions retain water only for a few months after the rainy season, a stepwell is often the only source of water, with freshwater being supplied by underground springs throughout the year. Built underground, stepwells were ideal places of social interaction and communication. Stepwells situated outside villages along major trade route were built as resting places for business men who carried goods from important ports along the coast of Gujarat to northern India.

In addition, stepwells are regarded to be abodes of various spirits with life giving powers. Traditional water harvesting systems have passed the test of time and are suited to the specific environments for which they have been evolved.

Oceans and Seas

Oceans cover more than seventy per cent of the earth's surface. This is why earth is also called the blue planet. These oceans play key roles in the survival of life forms on earth. They serve as a gigantic reservoir for carbon dioxide, thus helping in regulating the temperature of the troposphere. The winds that blow and the rains that fall, have their origin in the oceans. Oceans provide habitats for about 250,000 species of marine plants and animals which are food for many organisms, including human beings. They also serve as a source of iron, sand, gravel, phosphates, magnesium, oil, natural gas and many other valuable resources. Because of the its size and currents, the oceans mix and dilute many human produced wastes flowing or dumped into them to less harmful or even harmless levels, as long as they are not overloaded.

Life Evolved Here!

The long and complex process of evolution of life began below the surface of the sea. A variety of living things inhabit every part of the oceans—from the surface waters to the deepest depths. The inhabitants range from the billions of microscopic creatures that thrive in the surface waters, to the gigantic blue whales. Oceans provide these life forms the water they need for survival and growth. All forms of life, including those living on land, need water—most of which comes ultimately from the oceans.

Oceans are a vast resource of marine wealth. Oceans are a huge and complex living ecological machine in which every part interplays with every other part. They play a vital role in our lives, directly or indirectly. Oceans are a vital economic resource providing livelihood to millions of people world-wide. Oceans are a reservoir of food. People have been depending on fishing for their livelihood. Every year, almost 100 million tons of fish are captured globally that provide work to 36 million people in the primary capture fisheries and aquaculture production alone. The bulk of all international trade, approximately 90 per cent, is transported by sea and over 29 per cent of the total world production of oil comes from the oceans. Coastal recreational activities and the cruise industry, are a major, if not the most important, source of revenue for a number of countries, in particular small island developing States. Increasingly, scientists are also looking to the deep sea as the source of future scientific discoveries and resources. About one-fifth of the world's total supply of oil and natural gas comes from under the seas.

What Oceans Do for Us

Oceans plays a vital role in water cycle. They supply us with rain, food, and help regulate our climate. Oceans help regulate the greenhouse effect—billions of its tiny plants called phytoplankton absorb the greenhouse gas carbon dioxide and release oxygen, thus helps in balancing the carbon dioxide and oxygen.

But these oceans are threatened by human activities directly or indirectly, by activities that take place on the land and in the water.

Threats to Oceans

Industries coming up in the coastal area discharge their untreated effluents into the sea through waste water, canals, drains, creeks etc. Pesticides and herbicides used in the fields contain persistent organic pollutants. These toxic chemicals find way through the washed away silt and irrigation water, finally into ocean. Sewage contains heavy metals, man-made chemicals and organic wastes, also ultimately finds its way into the ocean. The toxic chemicals released through all these lead to the problem of biomagnifications and subsequently the creatures in the food chain are affected.

The heat generated in the industrial processes leads to thermal pollution. Even a slight variation in temperature affects the marine ecosystem in many ways. Nuclear reactors discharge radioactive waste into coastal waters.

The hot water released from power plants poses danger to the flora and fauna in the warm tropical waters as they cannot adapt to the rise in water temperature.

Oceans are polluted by oil through various sources and oil-spills have a long-term effects. Oil spills from tankers at sea or leaks from underground storage tanks on land are very difficult to control as oil tends to spread very fast, affecting a large area in a very short time. Oil spills at sea decrease the oxygen level in the water and cause grave harm to the creatures living in the sea.

Port development activities such as dredging of harbours and deepening of navigation channels also contribute to increasing siltation, making the water turbid, and choking the living creatures that inhabit the coastal waters. The dredging activity churns up the toxic pollutants which may have settled on the sea bed and brings them up, where they once again mix with water. There is also less loss of water due to evaporation.