WATER SECURITY

Standard Nine

The Constitution of India

Chapter IV A

Fundamental Duties

ARTICLE 51A

Fundamental Duties- It shall be the duty of every citizen of India–

(a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;

(b) to cherish and follow the noble ideals which inspired our national struggle for freedom;

(c) to uphold and protect the sovereignty, unity and integrity of India;

(d) to defend the country and render national service when called upon to do so;

(e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities, to renounce practices derogatory to the dignity of women;

(f) to value and preserve the rich heritage of our composite culture;

(g) to protect and improve the natural environment including forests, lakes, rivers and wild life and to have compassion for living creatures;

(h) to develop the scientific temper, humanism and the spirit of inquiry and reform;

(i) to safeguard public property and to abjure violence;

(j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement;

(k) who is a parent or guardian to provide opportunities for education to his child or, as the case may be, ward between the age of six and fourteen years.

Govt. Resolution No.: Study - 2116 (Q. No. 43/16) SD-4 dated 25.04.2016 in the meeting of the Coordinating Committee dated 30.01.2020 has approved this textbook from the academic year 2020-21 .

Water Security

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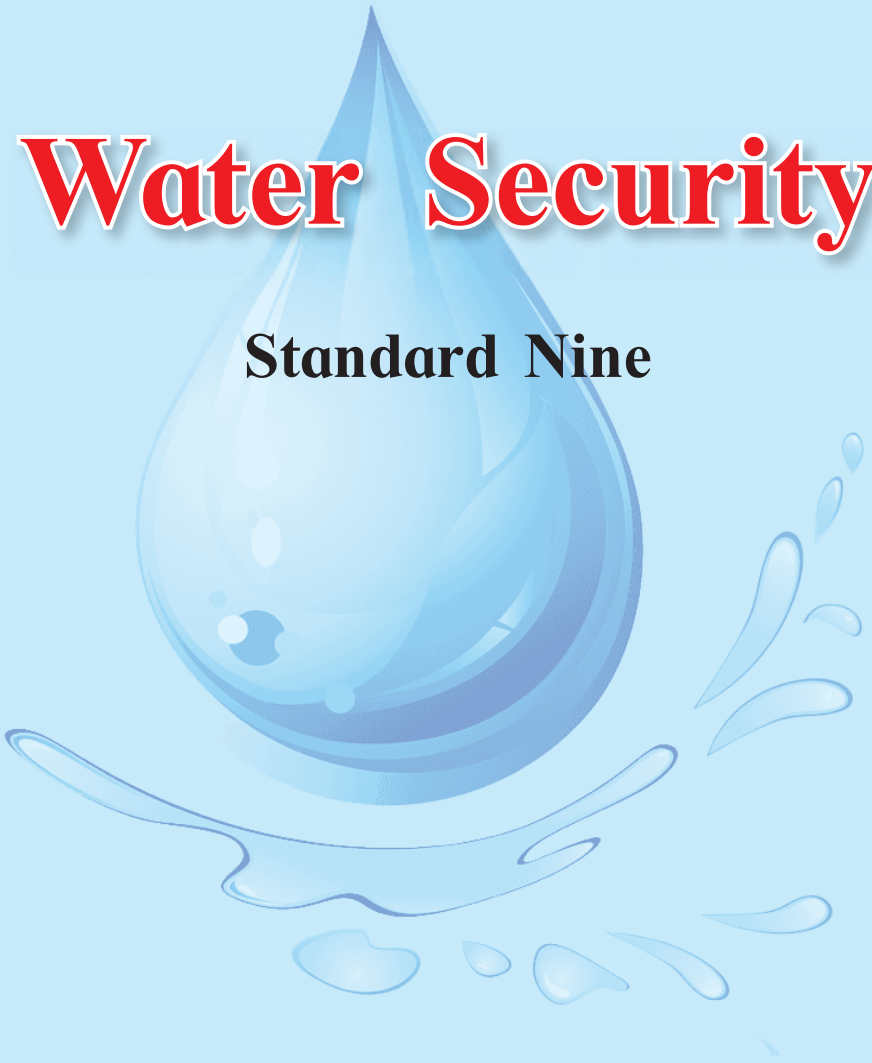

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The Constitution of India

Preamble

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC and to secure to all its citizens:

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the unity and integrity of the Nation;

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949, do HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.

NATIONAL ANTHEM

Jana-gana-mana-adhināyaka jaya hē
Bhārata-bhāgya-vidhātā,

Panjāba-Sindhu-Gujarāta-Marāthā
Drāvida-Utkala-Banga

Vindhya-Himāchala-Yamunā-Gangā
uchchala-jaladhi-taranga

Tava subha nāmē jāgē, tava subha āsisa māgē,
gāhē tava jaya-gāthā,

Jana-gana-mangala-dāyaka jaya hē
Bhārata-bhāgya-vidhātā,

Jaya hē, Jaya hē, Jaya hē,
Jaya jaya jaya, jaya hē.

PLEDGE

India is my country. All Indians are my brothers and sisters.

I love my country, and I am proud of its rich and varied heritage. I shall always strive to be worthy of it.

I shall give my parents, teachers and all elders respect, and treat everyone with courtesy.

To my country and my people, I pledge my devotion. In their well-being and prosperity alone lies my happiness.

Preface

Dear students,

Welcome to Class IX. You are studying various subjects as per National Curriculum Framework 2005, State Curriculum Framework 2010, State Secondary Education Curriculum 2012 and Restructured Secondary Education Curriculum 2016. As per Govt. misc. 2019 / S.No. (243/19)SD4, dated 8th August 2019, Water security is a compulsory grade subject for secondary education level from the academic year 2020-21. We are very happy to handover you the 9th grade textbook on water security. Studying various subjects from primary level till now has developed various abilities in your personality.

You all know that there are different kinds of problems in the environment. They are based on various factors. At the school level, the main objective of the curriculum is that, the student should study the environment problems/issues, suggest solutions and behave accordingly. The issue of water security has been framed with the same objective in mind. While studying the subject of water security, you have to carefully observe (analyse) the situation and the relevant factors around you. Understand the various concepts, principles, theories in this subject and relate them to daily practice. The major components of water education, water conservation, water management and water quality are covered in this textbook. The textbook has been deliberately based on information and activities while designing the topic of water security. You must apply the complete information of the subject through activities and projects.

The main purpose of this textbook is to understand and apply the knowledge of water security related to our daily life and explain its application to others. In the textbook, various concepts, theories are explained through figures and actions. Exercises are also given along with it. Try all these activities, experiments yourself to understand the subject properly. Seek the help of your teachers, parents, society and classmates as you practice. Connect the knowledge you have learned with your daily life.

In today's fast paced world of technology, you are familiar with computers and smartphones. Therefore, make proper use of information communication technology tools while studying this water security textbook. Be careful while handling various apparatus, important materials while doing activities and experiments and tell others to be careful too. Also try environmental conservation while doing activities and observations. Take care that plants and animals are not harmed. While reading, studying and understanding this textbook, please let us know your favourite part of it as well as the difficulties encountered.

Best wishes to you for your academic progress.

(Vivek Gosavi)
Director
Maharashtra State Bureau of Textbook
Production and Curriculum Research, Pune 4

Pune
Date : 21 February 2020
Indian Solar: 2 Phalguna 1941

Standard 9th Water Security

Unit	Competency Statements / Learning Outcomes
Water Education	1. To be able to name the different steps in the water cycle. 2. Be able to describe the processes that take place in each step of the water cycle. 3. To be able to explain the scientific causation of the water cycle. 4. Identify the type of clouds in the area. 5. Be able to describe the process of rainfall. 6. Identify the type of rainfall in one's own region. 7. To be able to tell the difference between seepage and run-off. 8. Be able to tell the type of rivers in the area. 9. To be able to describe the type of landforms formed by the river. 10. To be able to explain the involvement of components in the river ecosystem. 11. Be able to map the river system in the district. 12. Explain the use of the river. 13. To be able to classify the various religious rituals, various types of actions taking place along the river as right and wrong. 14. To be able to take care of the river by explaining the measures for river protection. 15. To be able to classify the watershed/catchment area. 16. Describe the type of watershed/catchment area in the area. 17. To be able to explain the properties of rain. 18. To be able to explain the distribution of water and type of ground water. 19. Identify the aquifers of your district by understanding the types and characteristics of aquifers. 20. To identify the types of soil and rocks in district / taluka through observation.
Water Conservation	1. Understand the work of the Water Conservation Department and be able to review the work of this department in the area. 2. To be able to suggest various water conservation methods that are suitable for the area. 3. To be able to take measures considering the benefits of rain water conservation. 4. Understand the relationship between groundwater recharge and structure of underground and choose recharge method accordingly. 5. To be able to use roof water for recharge. 6. To be able to calculate the rainfall in the area. 7. Explain the importance of soak pits in the groundwater recharge process. 8. Explain the care to be taken while refilling wells and borewells.

Water Management	1. To be able to calculate the water usage and calculate the water requirement for the family, village, city. 2. To be able to explain the importance of water required for business. 3. To create awareness in the society to stop water leakage considering the importance of water conservation. 4. Understand and adopt different methods of saving water. 5. To be able to get information about the water saving efforts being implemented by the government. 6. To create awareness in the society about habits to avoid wastage of water. 7. Convincing others about the importance of water. 8. Explain the water journey from different water sources to the house. 9. To be able to describe the process of water purification.
Water Quality	1. To be able to state the factors that affect water quality. 2. To be able to name the components required for water quality. 3. To be able to suggest necessary measures for sewage management. 4. To be able to state the properties of drinking water / water quality criteria. 5. To be able to describe suitable water storage methods as well as water disinfection methods to maintain water quality at household level. 6. Understanding the causes of water pollution and reviewing the pollution of water resources in the area. 7. To be able to suggest necessary measures to stop water pollution in the area.

For teachers and students

Through the subject of class IX water security, the necessary information in daily life has been introduced. Attempts have been made to create awareness and develop a positive attitude towards the various situations around us, some important issues and measures to be taken to avoid adverse effects on their daily lives. It is necessary to strive for the development of personality, inquisitiveness, efficiency and a sense of leadership. While studying and teaching the subject of water security, the steps will have to be taken not only for the purpose of knowing the subject matter but also for the purpose of observation, reasoning through comparison, conclusion and inference.

It is important to understand the subject and the actions taken to explain it to others, to experience it for oneself and to make proper application of the information gained. While formulating the subject, the main topics of water security include water education, water conservation, water management and water quality.

The arrangement of these chapters has been done not only in the form of information but also with various figures and photographs. The information given is rich in various activities and experiments. Discussion, Observation, Tell, See are the titles given to give impetus to the thought process. 'Did you know ?' is the title for extra important information. Through this subject, we want to make our role, actions and behavior useful to the society on many issues such as the water crisis, water scarcity that we find around us and in fact we personally feel. It will help to mould oneself and society.

Water Security

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Unit 1: Water Education

Chapter 1: Water cycle

About 71 % of the earth's surface is covered by water. This mass of water is found in various forms such as glacial, freshwater, ocean salt water and atmospheric vapor. This water supply is constantly changing from one form to another. That is, it evaporates from rivers into the ocean and back into the atmosphere through the process of evaporation from the ocean. This cycle is indestructible and continues uninterrupted.

Let us understand the water cycle.

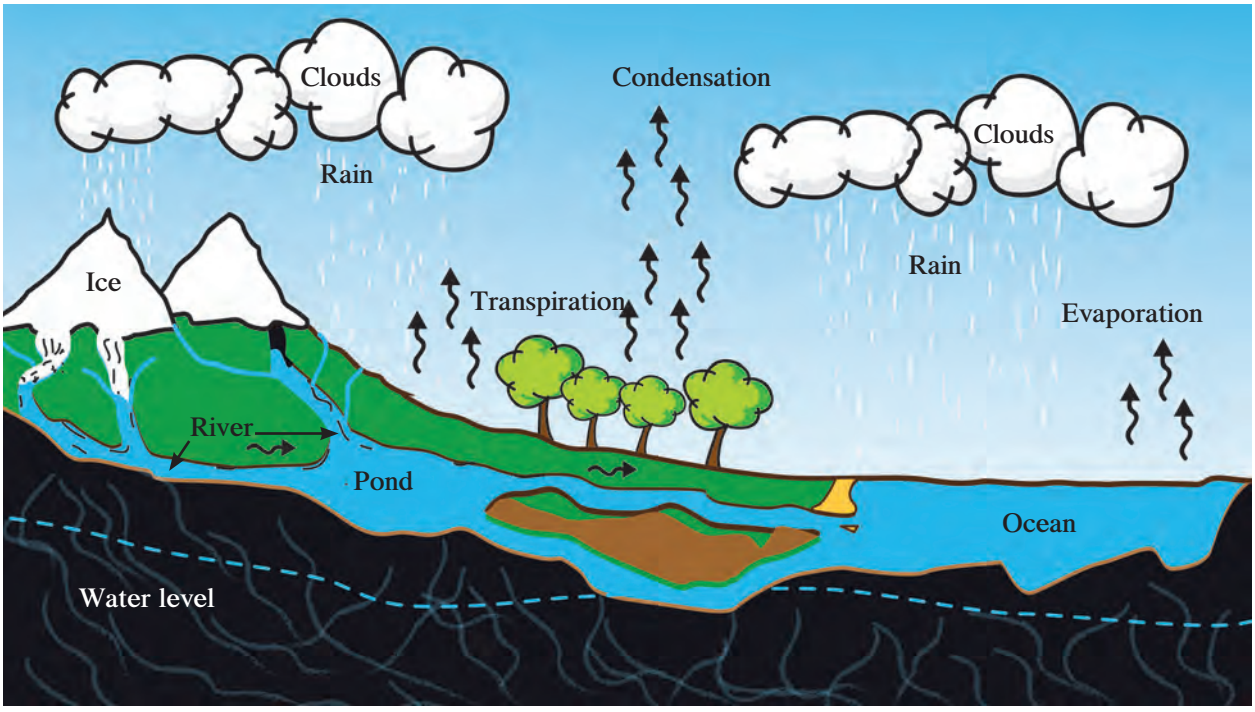
"Severe heat causes the water in the oceans to evaporate. As it is lighter, it rises to the sky, it forms clouds together, it becomes heavier because of the water in it. Due to cold air, water from clouds that falls on ground in the form of rain, this water flows through river brook and returns to the sea. In this way, the water travels through different conditions and returns to the sea. That is, a cycle is completed, this is called the water cycle."

This journey from sea to sea is due to the constant movement of water in the earth's underground, evaporation, transpiration from the leaves of plants, liquefaction, precipitation, seepage from the soil, run-off water from the surface and subsoil, etc. While this is happening, water goes through various stages such as liquid, gaseous and solid.

The sun, which primarily evaporates ocean water, is the major component or driver of the water cycle. Evaporation in the water cycle is the process of purifying water and recharging it on the ground. The water cycle is essential for the survival of life on earth.

Evaporation:

The process by which water gets converted into vapors due to heat is called evaporation. Evaporation is an essential part of the water cycle.



1.1.1 Water Cycle

The heat of the sun (solar energy) causes water to evaporate from the sea, lakes, soil moisture and other sources of water.

The higher the temperature, the higher the evaporation rate. At lower temperatures there is less evaporation. The larger the surface area of the liquid, the higher the rate of evaporation of the liquid. Water in the form of gas (water steam) is called vapor.

Try this :

Take water in a glass jar and cover it with a lid. Place jar in Sunlight. After 30 minutes, observe the inside of the jar. Record what you see.

Condensation :

As the vapor rises higher, the air pressure naturally decreases and the temperature begins to decrease. As the temperature drops, the vapor begins to liquify. As long as a tiny drop of water is light in weight, it is weighed in the air. As these tiny droplets come together to form larger droplets, they transform into clouds that appear over a large area of the sky. This vapor is also seen as a mist near the ground. This vapor is carried by the wind. The tiny droplets of water in the clouds increase in size and weight, collide with each other, and fall as rain on the earth under favorable conditions. There are different types of rainfall. Water, a mixture of water and hail, only hail and snow, depending on the situation.

What exactly is a cloud?

Clouds that form in the sky are also a form of water. The warmth of the sun causes water to evaporate from the surface of the earth as well as from the surface of the ocean. As it is light it goes up into the atmosphere. Cold air in high altitudes slows down the movement of vapor molecules. This slowdown causes these vapor molecules to come together and freeze. During this time, fine dust from the air begins to accumulate around it. These particles are called condensation nuclei. Many such particles combine to form vapors that form droplets. That is, they transform into clouds.

Cloud types:

There are two types of clouds in the sky.

1. A giant or huge cloud (Cumulonimbus)-

As water vapor freezes, a large amount of energy is generated. It accumulates in these giant clouds. The result is thunder and lightning. Sometimes they fall on the earth in the form of large fireballs. Occasionally there may be a major storm or hurricane.

2. Crazy black curved or gray black cloud (Nimbostratus) -

This type of very large cloud can cause heavy rainfall at any time. Sometimes it can snowfall.

How do clouds float in the air?

The solar heat causes the earth's surface to heat up. As a result, the surface air becomes lighter and superficial. Due to the hot air going up, clouds keep the particles in the air without falling on the ground. Similarly, due to storms, the warm air on the ground helps to keep the clouds afloat.

As water vapor condenses on the dust in the air, a very fine nucleus is formed. These particles cannot be seen with the naked eye. But clouds are formed by the millions of vapor dust that live in such centers. While the vapor on the dust freezes, it helps to keep the clouds floating with itself.

Condensation/compression:

Condensation is the process by which the vapor in the air or atmosphere decreases and is converted back into water particles. Unsaturated air or air with a relative humidity of less than 100% , cools as the temperature decreases. As a result, its evaporation capacity decreases. Eventually this air becomes vaporized which means its relative humidity is 100%.

The temperature or temperature level at which unsaturated air evaporates at a certain temperature is called **the dew point**.

The action of condensation in the atmosphere depends on two factors. It is the relative humidity and temperature of the air. As the temperature of humid air decreases, it evaporates and a greater condensation occurs. During condensation, vapor is converted into water particles or ice. The dust that is required for the formation of these water particles or ice particles is called waterborne dust. If the temperature level (dew point) is above the freezing point during condensation, then the conversion of vapor (into water particles) is seen in different forms like dew, fog, clouds or rain. And if, during the condensation process, the dew point is below freezing point (0 ^{0}C), then the vapor is converted into ice and there is dew, hail or snowfall.

The overall condensation action requires a lot of humidity in the air. And the temperature of that air also has to go down.

Do you know ?

1. When the ambient temperature is very cold, the vapor cools and comes together in the form of small droplets in the cloud. This temperature is called the hydrocephalus temperature.
2. Dust is required for clouds to form.
3. In the same way that hot water vapor freezes on a mirror glass in the bathroom, air vapor accumulates around the dust at cold temperatures.
4. There is only a difference in size between water droplets and raindrops in a cloud.
5. Not all raindrops falling from the clouds reach the ground. Such drops are called "Vibra".

Rain:

Due to the inability of large water particles to float in the air due to their big size, the water particles fall in the form of rain. Water falling from clouds to the ground in liquid or solid form is called rainfall.

The forms of rain are as follows.

1. Snowfall: When the air temperature goes below freezing point, the precipitation that takes place when steam is directly converted into snow is called snowfall.

2. Hail: Pallets of frozen rain which fall in showers are called hail.

How does it rain?

Rainfall in the Indian subcontinent is called 'Monsoon'. Monsoon is a slang of the Arabic word 'Mausam'. It means season.

When the clouds are joined by the wind, the clusters of clouds begin to come down in the form of drops due to the weight of the water. Some vanish in between, but most of the drops reach the earth from the atmosphere. This is what we call rain. During this time the size of the vapor dust increases. When they cannot carry their own weight, they separate from the clouds and fall to the ground in the form of rain.

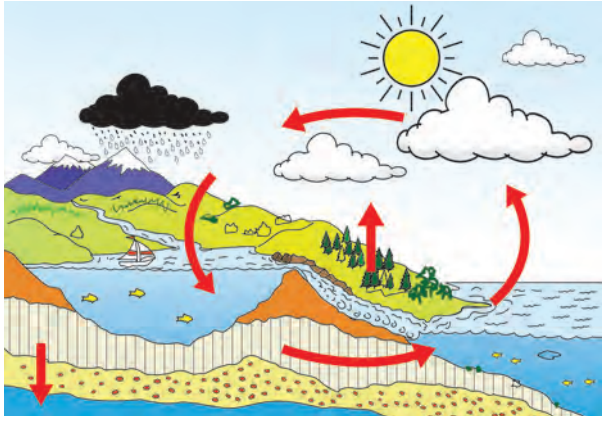
1.1.2 Rain

When large amounts of evaporated clusters come together, dense black or gray clouds form. Even the sun rays cannot penetrate them and reach the earth. At such times, there is no appearance of sun during the day. These black clouds together can go very high. Very large and black clouds can reach heights upto 15 km in the tropics. These types of clouds can cause very heavy or torrential rain. Sometimes there is cloudburst and the area becomes waterlogged.

The journey of water : Water is available everywhere on earth in the form of vapor, liquid or ice. Due to the heat of the sun, high temperatures, the transition of water to vapor continues uninterrupted. This process continues uninterrupted in any type of open water reservoirs such as lakes, rivers, seas. Similarly, the evaporation of water in animal and plant bodies continues. The vapor created by this evaporation becomes lighter and goes up in the air. All this vapor forms clouds, they rise up and up in the atmosphere.

Clouds formed by the mixture of fine dust particles freeze due to the cold air in the upper atmosphere, forming water droplets. When these clouds are blowing with the wind, they get blocked by mountains or high mountain ranges and move higher. The size of such clouds also increases. At the same time, water droplets made up of tiny particles become larger and heavier in size and eventually fall back to the ground in the form of rain.

This rainwater flows back down the hillside and takes the form of small streams, brook and then forms itself into a river or flows into the river. Sometimes it can accumulate in the form of lakes. Meanwhile, this water quenches the thirst of plants, other animals and human beings. All plants absorb ground water according to their needs and release it into the atmosphere through the leaves due to transpiration. This indestructible cycle continues year after year.



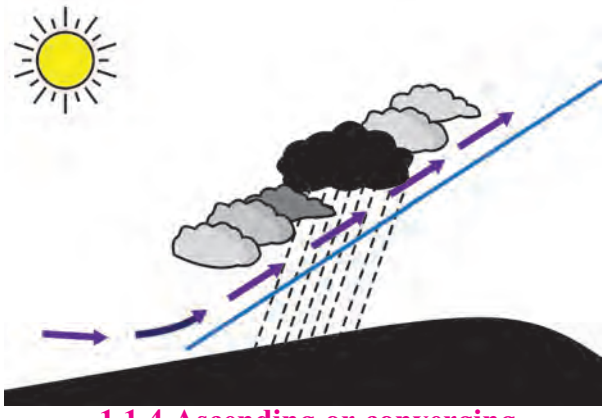
1.1.3 Water Cycle

The continuous circulation of water on the Earth, the convection of water from the oceans to the atmosphere, from the atmosphere to the land and from the land back to the ocean is called the water transition cycle or water cycle. Although the level of water on the Earth is almost constant, water molecules are coming in or out of the atmosphere. Water flows from one reservoir to another through physical processes such as evaporation, condensation, precipitation, run-off and groundwater flow. Like the water of rivers gets to the sea or the water of the sea mixes with the atmosphere in the form of vapor.

While this is happening, water is transformed into solid, liquid, and gaseous forms. One-third of the water that falls to the ground goes back to the ocean through surface or subsurface water flows. The remaining two-thirds of the water re-enters the atmosphere due to evaporation and transpiration of plants. Thus a gross water transition cycle is continued.

Types of rainfall

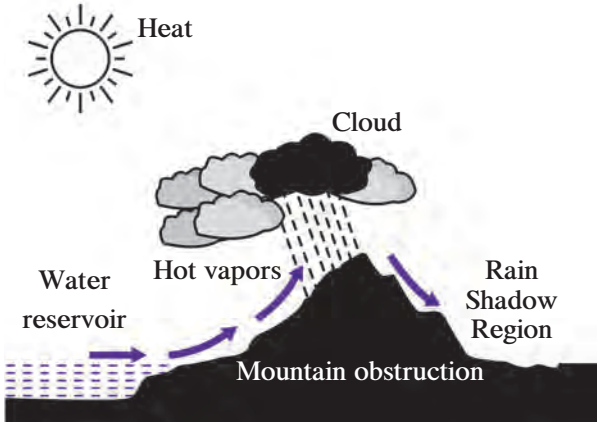
1. Ascending or converging precipitation/ rainfall : The air cools after reaching a certain height. The process by which air moves upwards is called 'ascent'. Cold air has low evaporation capacity, so it condenses and converts into water particles and rains. This type of rainfall occurs in regions where there is a large upward movement of air, as well as in areas where it is not much in the horizontal line. In the equatorial region, such rain usually falls every afternoon.



1.1.4 Ascending or converging precipitation/ rainfall

2. Resistance Rainfall:

Winds containing vapor from the sea or large reservoirs are blocked by high mountain ranges in the path and begin to follow the mountains. Due to the low temperature at the altitude, the vapor in this air condenses and it rains. This rain is called resistance rain as it falls due to obstruction.

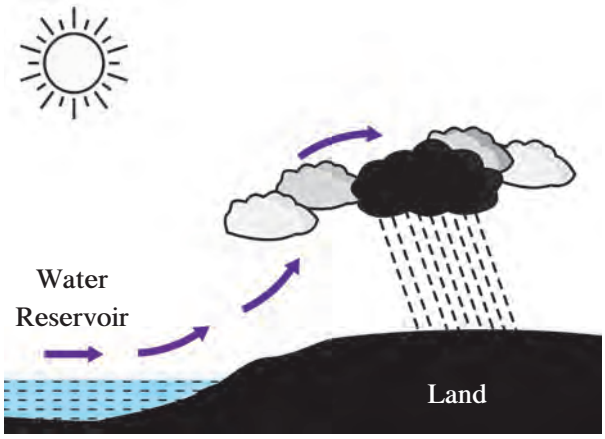


1.1.5 Resistance Rainfall

Rainfall is heavier on the slopes in the direction in which the winds follow the mountains, while in the areas where the winds cross the mountain, the amount of rainfall decreases as the amount of air vapor decreases and the vapor holding capacity of the air increases. Such a region with low rainfall is called a 'rain shadow region'.

3. Periodic Rainfall:

A low pressure belt is formed at a specific place in the air, so that the winds from the adjacent region are attracted in that direction. These winds move in a circular direction and at a tremendous speed. This is called a cyclone or periodic. When a cyclone is formed in a region, the air in the cyclone starts to go up. As the air rises, its temperature decreases and the vapor in the air condenses and rain falls. Such precipitation is called cyclonic precipitation or cyclone precipitation. The cyclones move from one place to another and rain falls wherever they pass. This type of rain falls more in temperate belts. Also in the tropics there is some cyclonic/periodic rainfall which is stormy.



1.1.6 Periodic Rainfall

Out of all the above three types of rainfall, resistance type rain falls in most parts of the world. There is such certainty in ascending type rains but there is also uncertainty in resistance and periodic precipitation. Therefore, in these cases, sometimes we have to face disasters like heavy rains, floods and sometimes droughts. Considering Maharashtra, there is resistance rainfall in the Western Ghats, drought prone areas in the Marathwada region as a rain shadow region and a lot of certainty in Vidarbha.

Rainwater seeps into groundwater or it is carried to the ocean in the form of runoff.

Seepage :

Not all surface water flows into rivers. Some water seeps into the soil. Groundwater is the water that seeps into the soil. The period of surface water flow depends on the porosity of the soil, the type of soil, the slope of the groundwater, etc. Depending on the factors, water seeps first into the subsoil and then deeper into the ground. Groundwater recharge occurs. To some extent this water can come to the surface as a source of living water. Deep-seated water can be stored in the soil for a long time.

Run-off :

A watershed is an area of land on which all the rainwater that falls is collected in a specific source of water. Watershed size, length, width, rainfall, soil texture and other properties are related to each other. They

determine the limit of water accumulation or stagnation of the catchment area. Run-off is an integral part of the water cycle. Its regulation and management is intended for watershed development. This water flows from the surface to the ocean through brooklets (Odhe), runnels (Nale), rivulets (Ohol) and rivers.

Surface water and groundwater are also stored in lakes naturally created due to topography. In the river basins, surface water and groundwater are constantly circulating. Over time, water enters the ocean and changes its position in the water cycle.

Exercise

1. What is the water cycle?
2. What are the main components of the water cycle?
3. Write the names of different steps in the water cycle.
4. Find out the information about places in India regarding heavy rainfall.
   i) Mawsynram ii) Cherrapunji iii) Agumbe iv) Amboli v) Tamhini
5. Describe the main processes in the water cycle.
6. Make a model of the water cycle and present it to the class.
7. Briefly describe the journey of rain.
8. What are the factors that affect seepage and run-off ?
9. State the types of rainfall.
10. Visit an organization that keeps track of rainfall and other factors in the water cycle.
11. Observe landforms related with runoff and groundwater.

Unit 1 : Water Education

Chapter 2 : River System

We have all understood the water cycle in the previous chapter.

Let's recall.

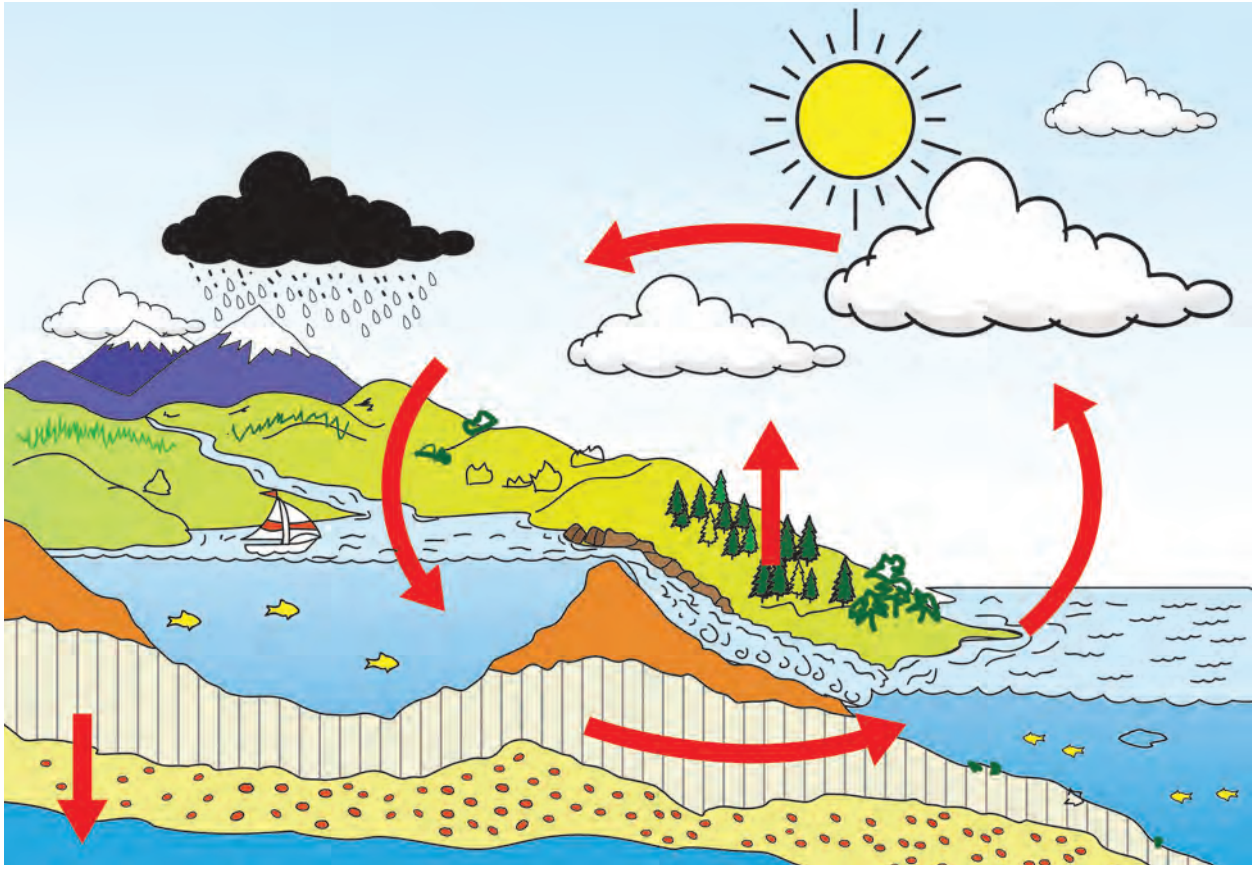
In the water cycle, water travels through which stages? Observe the diagram and write the name of each step.

This water cycle runs uninterrupted in nature. The river is a part of this water cycle.

Origin of the River :

When it rains, the water does not flow away from the ground immediately. Just as it falls on plane land, it also falls on reservoirs like mountain slopes, lakes and the sea. Some parts of the water evaporate immediately as the soil warms, some parts are absorbed by the plants and some parts of the water seep into the rocks and go underground. When more rain falls in a short period of time, it exceeds the limit of seepage or accumulation in one place, this water is seen flowing from the ground for some time, it is called runoff or flow of water. Such a stream of water then flows continuously downhill. In some places it is obstructed, water can accumulate in low lying areas and water seeping into the soil continues to flow through cracks and crevices. This natural flow of water is seen in various forms like brooklets (Odhe), runnels (nale), rivulets (Ohol), tributary (upnadi) and rivers etc.

A river is a natural body of water that flows over a large area of land. These different types of streams are collectively called "River Systems".



1.2.1 Water Cycle

The shape of the River:

The river is also a natural wide stream but such a river does not form at once. The small amount of rain water that flows from the ground is called Brooklet (Ohol). Many such brooklets come together and flow through the low lying areas on the ground, they form Rivulets (Odhe). The "River" is the one that is formed due to combining of many such rivulets. Near the origin the river basin is narrow and the slope is steep. Where it meets the sea, its width increases and its slope decreases.

Rivers and Landforms :

The upper reaches of the river are near the origin of the river. The flow of water in a certain direction from a low-lying area to a certain width is called a river basin. The river basin can be deep, shallow, wide, narrow. Usually it is single but sometimes the river basin is divided. In some places, islands are also formed in the river basin.

Types of River :

Natural flow of water also depends on the topography of the place, climate change, human barriers for water use. Accordingly the types of river, are-

Noisy River :

Usually immediately after origin, if the water flows rapidly from the steep mountain slope and the river basin in that area is narrow and deep, then such a river is called a noisy river or a fiery river. This river is constantly eroding its bed. Such rivers are found in the highlands.

1.2.2 Noisy river

Slow River :

Where the slope of the land surface decreases and the basin widens, the river water starts flowing slowly, hence it is called slow river. The river basin can be deep in this place so the water level in the river basin is also high. Such rivers are found in the plateau region.

1.2.3 Slow river

Old Rivers :

Rivers which have a very low slope and have no weathering capacity fall into old river category. Such rivers are most likely found near the sea.

Revived River :

A river that dries up due to various reasons and starts flowing again when the surface is lifted due to topographical movements is called revived river.

Living River :

River basin gets water in different ways. Due to direct rains, streams and groundwater from other places flow into the river basin in the form of springs. But this is not always the case. When the rains stop, some rivers stop flowing and some can flow for twelve months. A river that flows into a river basin in the form of springs even in the absence of rain is called a living river. A river that stops flowing when the rains stop is called a dead river.

Do you know ?

The velocity of a river is determined by its flowing volume in cusecs - how many cubic meters of water flowed in a second. (Cusec = 1 ft^3 of water = 28.31 Litre/sec) Also sometimes measured in gallons.

The edges built at the river banks are useful to control the speed of the river. Such wide stone banks are called ghats. All the major rivers considered sacred in India have ghats.

Landforms created by the River :

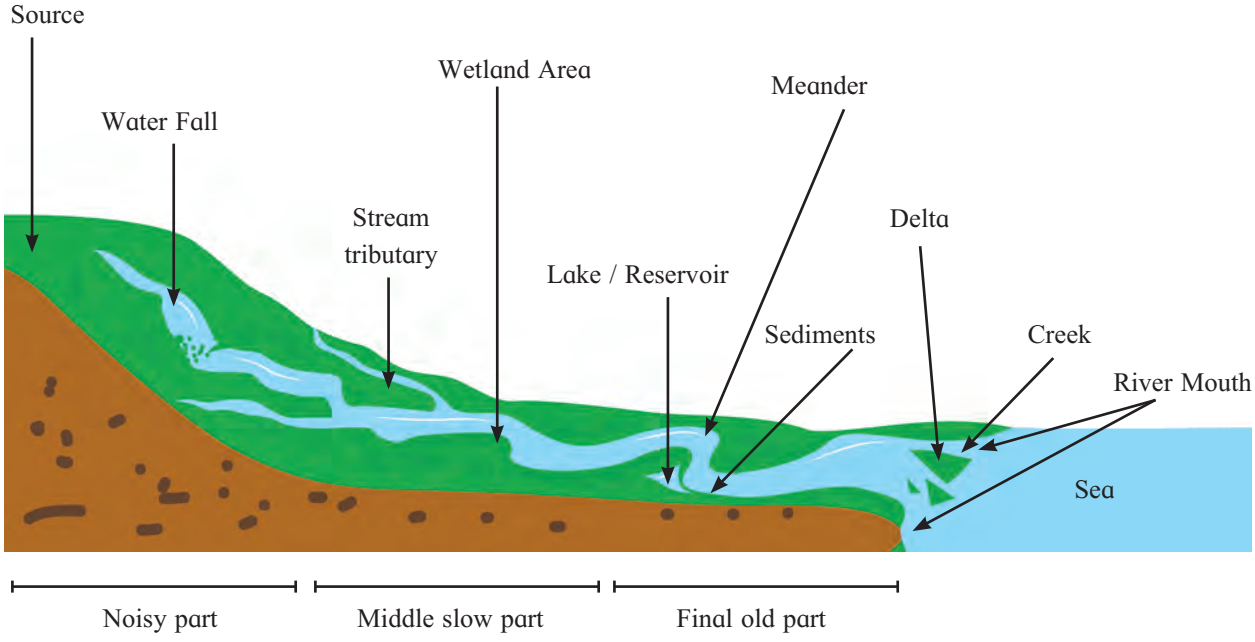
Mining of the river creates landforms like V-shaped valleys (ghalai), furrow or trenches (ghals), waterfalls, Pot-holes (ranjan khalge).

Due to the accumulation of river, flood plains, flood banks, triangular regions, winged plains, serpentine turns, horseshoe shaped lakes are formed.

The rapid flow of water in the highlands can also cause erosion of hard rocks. This creates sand having fine pieces of rock. The river basin becomes deeper. In some places, a flow that falls from a height (waterfall) is formed.

Sometimes the strength of the flow in the plateau changes the course of the river and makes the path shorter. Sometimes the rivers pull the silt from the banks into the stream, sometimes the river releases the silt from its basins to the banks. This silt accumulates in the middle of the stream and forms an island. Parts made of such silt are very fertile for agriculture. Such islands are also found in Maharashtra in the river basins of Godavari, Bhima and Krishna.

Triangular regions are the areas of fertile silt formed near the mouth of a river. E.g. Many such triangular regions have been formed in the river Ganga and the river Brahmaputra.



1.2.4 Landforms created by the river

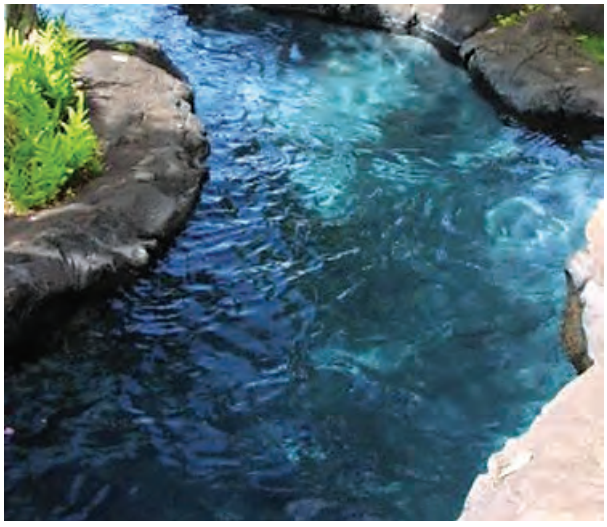
In a river basin, if there is a sudden downpour or a cliff, the water picks up speed or gets a circular motion. This is called a river vortex.

1.2.5 River Vortex.

The water stored in certain rocky areas of the river basin for a long time is called river pond / pool.

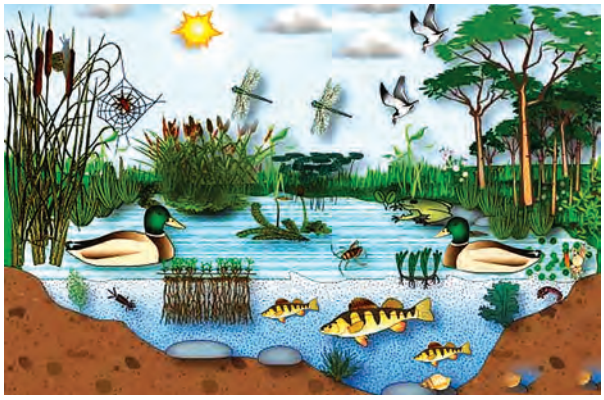
In the rainy season, when a large amount of water enters the river basin, it extends to a certain distance that exceeds the width of the basin. Almost all rivers flow on the surface. But some rivers flow through caves below the surface. Many caves are enlarged by such rivers. Often such rivers erode salt rocks and form caves.

Many miraculous shapes formed due to this are found.



1.2.6 Salt rocks and Formed caves

River Ecosystems : The organisms, plants and animals living in the river water use only the naturally occurring resources and habitat of the river. The existence of an independent cycle of life that depends on the river, is called the river ecosystem. It consists of many plants, animals and parasites. Most of the living things in the river are freshwater, but some can live in brackish water also.



1.2.7 River Ecosystems

Uses of River :

Basic uses :

Rivers are the main source of water for living things. Man uses river water for drinking, for industry, for transportation, for power generation, and for running large machinery. The river is also used as a border between the country and the state, ensuring territorial boundaries.

The river has been used as a means of transportation and direction for centuries. The first evidence of river navigation has been found in Indus culture since 3300 BC. River basin transportation is very cheap. Today such transport is carried on the most important and largest rivers in the world. Rivers are also used to transport of cut trees (wood) in forest areas.

Rivers have been used for food since eternal time. There is a cycle of life in rivers. It produces many kinds of fish. River water is being used not only for fishing but also for agriculture and food production.

Most of the rivers in India have ghats for recreation and access to the river.

River sand is used for construction. The beautified riverbanks attract more tourists, and give the local community the opportunity to serve cruises. Sometimes rivers flowing in mountainous areas form waterfalls.

Such places become the center of travel. Sometimes a fast sailing boat called 'kayaking' is used in the rushing waters.

1.2.8 Rafting

1.2.9 Bhambavli-Vajrai Water fall, Satara : A favourite destination

Religious significance of the river :

The life of the whole village/city takes place on the banks of the river. Culture is developed on the banks of the river. Therefore, the daily activities of the people are more related to the contact of the river. Therefore, religious activities (Dharmacharan) such as daily bathing, prayers (sandhya), chanting (japa), tarpan, etc., started on the banks of the river from ancient times. Therefore, the river is considered to be the major social and religious center of the village/city. So various festivals are held along the river banks to express the gratitude one feels for the river.

1.2.10 Religious significance of the river

Exercise

1. Which main river flows through your taluka?
2. What is the type of this river? What will be the average length, width, depth of its basin ?
3. What landforms are created by the river in your area?
4. How many tributaries or springs-brooklets-rivulets meet that river?
5. Which river flows next to that river? OR This river meets which major river ?
6. What are the major check dams, lakes, dams on the river?

   (Seek the help of your parents.)
7. What are the uses of river?
8. Identify the factors that harm the river.
9. If you find any type of river pollution, what will you do ? bring it to the notice of adults.
10. Present the information of the nearest river that you have visited or studied.
11. Discuss whether it is right or wrong to perform religious activities on the river bank.
12. Visit the nearest river and observe the ecosystem there. See which plants and animals are found there, make notes and explain to others.
13. What are the main types of rivers?
14. What landforms are formed by rivers?
15. Explain the difference between a living river and a dead river.
16. Make a chart of the names of rivers and tributaries in Maharashtra.
17. Get a map of the river system in your district.

Unit 1 : Water Education

Chapter 3 : Watershed area and water types

The area in which rainwater naturally flows from one place (rivulets, river, etc.) according to the geographical conditions, the whole area from which the rainwater flows in, assuming a water stream (rivulets, tributary, river, etc.) as a measure, is called the catchment area/watershed area.

Types and sizes of watersheds :

Each surface reservoir and each body of water has its own catchment area. When many such small watersheds come together, they form large watersheds, and when many such streams come together, they form a river valley.

Watershed classification by area :

Micro Watershed	Upto 10 hectares
Mini Watershed	Upto 200 hectares
Sub Watershed	Upto 4000 hectares
River Valley	No area limit

Watershed properties :

Before preparing a watershed development plan, it is necessary to check all the properties of that watershed. Watersheds are divided into three types- geographical, rainfed/rainy and geophysical.

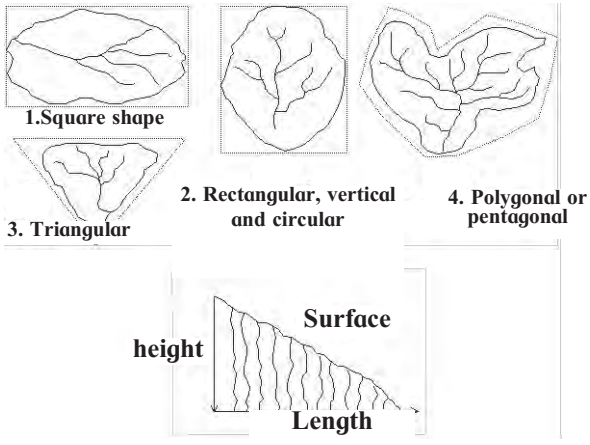
Let us know the properties on which the characteristics of the catchment area/ watershed area depend.

1. Dimensions :

How much watershed is to be managed in the catchment area depends on the size of the catchment area. Similarly, a large catchment area is beneficial for drainage. However, as the catchment area expands, so does the variation in its geological composition, soil type, slope, etc. Therefore, the right way is to study each watershed area separately and come up with the right solution.

2. Size :

The size of the catchment area affects the source flowing through that area. The proportion of watershed coming from the catchment area is related to the ratio of its length and width, it is inversely proportional to the length and directly proportional to the width. If the length of the catchment area is greater than its width, it takes longer for water to come out of the catchment area. This allows water to accumulate and seep into the soil and less water is released. If the same situation is reversed, that is, if the width is greater than the length, then the water in the entire catchment area falls into the source early. Therefore, it is less blocked and less seeped in the soil.



1.3.1 Watershed size

3. Slope :

The average slope of a watershed is determined by the height of the highest point in the catchment area and the maximum length of the slope. The time it takes for a drop of water flowing from the farthest point to reach the source to get out of the catchment area is inversely proportional to the height along the horizontal distance from that route. This means that it takes less time to carry water in a steeply sloping catchment area than in a flat catchment area. If it takes longer for the catchment to be carried away, more water seeps into the soil and the catchment is reduced. The watershed at the source of the steep slope catchment area is always higher than the watershed in the flat catchment of the same area.

4. Ground cover :

Ground cover is the surface vegetation, which affects both the surface watershed and the soil erosion. If there is grass everywhere on the ground, it keeps the soil particles tight and reduces soil erosion. If there is dense vegetation on the ground, the intensity of the rain falling on the ground is reduced by getting stuck in it and hence the soil particles will be less blown and the erosion will be reduced. But if the land is cultivated and crops are taken, then there is a lot of erosion as the soil particles are free in such land. This will allow you to decide which type of soil to treat. Also the roots of the plants increase the porosity of the soil. As a result, more and more water seeps into the soil, reducing the catchment area.

5. Flow density:

It is also necessary to study the number of watercurrents (brooklets, runnels, rivulets, streams etc.) flowing in the catchment area. Because it also depends on the amount of watershed in the catchment area, soil erosion and flood problem. Similarly, the division of the watershed and the direction of departure from the area make it easier to plan the management of the watershed and the measures to reduce soil erosion.

6. Land use :

To study how the land in the catchment area is being used now and how to use it in the future according to the usability of the land? It is very important to plan this. Watershed use, infiltration and drainage in the catchment area depend on the land use, the crops grown on it and the cultivation method adopted. It also determines the intensity of soil erosion to some extent.

7. Water infiltration :

The water holding capacity and drainage capacity of the soil depends on the amount of water infiltration in the soil. If the water holding capacity of the soil is high, it will absorb a large portion of rain water. However, due to lack of natural drainage of water in such soils, there is a risk of infertility due to water. Conversely, in lands with high drainage capacity, maximum water will be absorbed and surface runoff will be reduced. Watersheds from lands with low water holding and drainage capacity will be more.

8. Soil :

This is a very important factor. The water holding capacity, drainage and inflow of soil depends on it. This means that the amount of watershed and erosion also depends on it to a large extent. For this, the type of soil has to be decided by studying the composition, texture, color etc. of the soil. This work is done through a soil survey system. The amount of soil erosion depends on the type of soil.

9. Geological componants :

The type of soil depends on the subsoil and the rock. Therefore, it is important to study this from the point of view of watershed management.

10. Soil depth :

Soil depth is also a factor affecting soil erosion, watersheds, etc. This is also studied in soil surveys.

Rain (Precipitation) and its properties :

Rainfall is the largest and most important factor determining the amount of watershed and soil erosion. So it is simply impossible to plan watershed management without studying the rainfall in the catchment area. Many of the properties of rainfall affect the extent of the watershed and the erosion of the soil in different ways.

Rainfall :

Rainfall is rainwater falling on the surface. It is measured in millimeters. The amount of rainwater that falls on a given surface area over a period of time is considered to be the rainfall over that area over a period of time. The water measured in this way up to a given date throughout the year is the accumulated rainfall up to that date and the total rainfall of such measured rain throughout the year is considered as the annual rainfall of the area. Thus the average annual rainfall of an area is determined by averaging the rainfall over the last few years (e.g. 10, 25, 50). This rainfall determines the total watershed of a catchment area.

Rainy Season :

Rain does not usually fall continuously, but sometimes stops falling and then starts falling again after some time. The period of time when rain falls at one time is called the rainy season. If the rainfall in this season is short, maximum water is absorbed into the soil and the amount of surface runoff decreases. Conversely, if the rainfall in this season is high, the land becomes saturated and its water absorption capacity decreases.

Rainfall Density :

Rainfall density is the amount of rain that falls over a period of time. This is usually calculated as millimeters per hour. The total rainfall in a given hour is the density of rainfall in that hour. Automatic drawing type rain gauges have to be used to determine the rainfall density. From this graph, the rainfall density of each day, every hour is calculated. The hour in which the maximum rainfall density is thus found throughout the year is considered to be the maximum rainfall density of that catchment area for that year. Considering the rainfall density of the last few years (e.g. 10, 25, 50) which is the highest, it is considered to be the reversible peak density of those periods. Reversible peak rainfall density of a period of 10 to 25 years is generally considered to determine the pattern of soil conservation measures.

Frequency :

Considering the total annual rainfall, the maximum rainfall in the last few years (e.g. 10, 25, 50) is the frequency of that rainfall. E.g. 1250 mm of an area. The frequency of rainfall is a maximum of 1250 mm of rainfall which falls once in 10 years in that area

Distribution :

Rain does not fall uniformly throughout the region. Or it does not fall every time, so its distribution depends on the area in which it falls and the period in which it falls.

The above properties of rainfall are generally related to each other. For this, it will be useful to remember some key points.

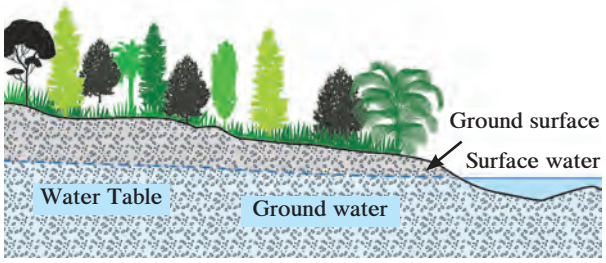
- The frequency of high rainfall is low and the density is high. Also its duration is short.
- The high density rainfall has low duration and frequency.

Let's Recall?

What are the two main components of the earth's surface?

Groundwater:

Ground water is the water beneath the land. It can be in porous soil, in rocky crevices, or in a cavity.



1.3.2 Ground Water

1. The chemical composition of this water is simple, easy and plain. Also, since the water is trapped in rocks and sometimes very deep in the ground, it is free from turbidity, offensive colors or harmful microorganisms. So it doesn't need much processing to use it properly.
2. This water is relatively much safer than surface water, as it is free from any chemical, radioactive or biological pollution.
3. Since this water is underground, it is not affected much by any kind of climate change, even drought.
4. Since this water is generally available locally, the means of supply may be available at cheaper rates. So this water is also economically beneficial.

Groundwater sources:

1. Rainfall :

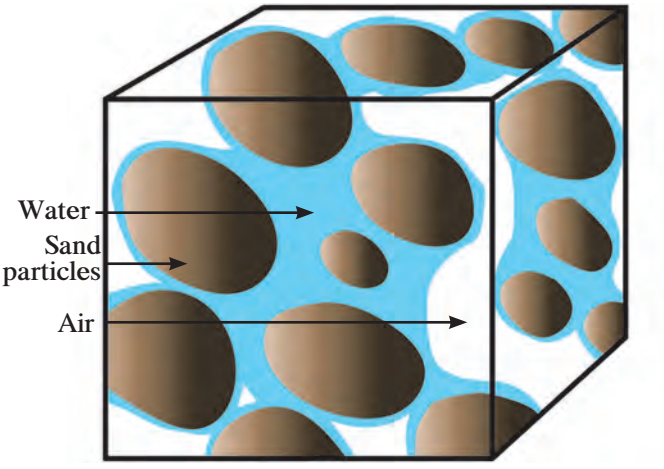
This is the source of water. Rain, snow, or water seeps underground from the earth's surface. The amount of water that will accumulate in an area depends on the type of rocks in that area and their characteristics. Normally, where there are sedimentary rocks, the infiltration rate is higher. This is because these rocks have the most cavities.

Along with rain and snow, rivers and lakes can also be sources of this water.

If the porosity of soil and rocks is high, then the groundwater table is above a water current. For example, suppose two water currents are at more and less height from each other. If the porosity of the rocks is high, then water will seep from the higher current into the lower current.

2. Connate Water :

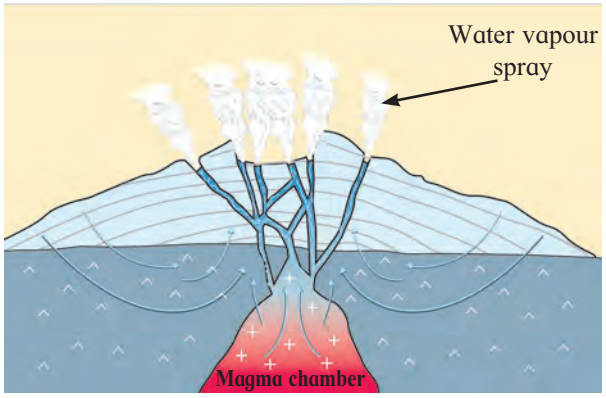
This water does not seep into the soil from the surface. The water that gets stuck in the sedimentary rock is called connate water.



1.3.3 Connate Water

3. Magma / Volcanic Water :

When water vapor in molten rocks is formed due to underground magma, it tries to rise through the available notches. If it does not find a place to rise, it eventually condenses and transforms into water. This is 'magma/ volcanic water'.



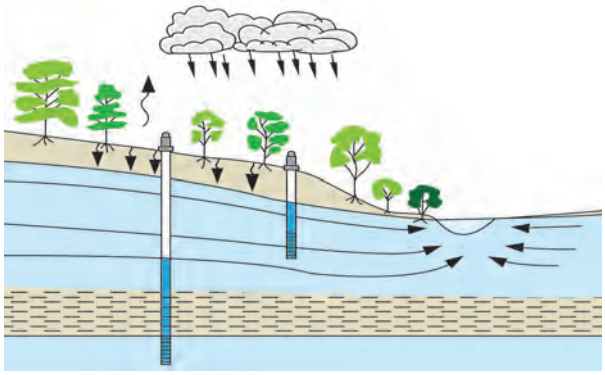
1.3.4 Magma water formation

Groundwater again returns to the surface in the following way.

1. Water in a nearby reservoir e.g. Rivers, Springs, Ponds, Lakes etc.
2. As the groundwater travels downhill according to the law of gravity, it is found to flow out in the form of springs in mountainous areas where it penetrates the surface.
3. Extracted for use from wells.

Can you tell?

What differences can you see among the terrane layers in the picture?

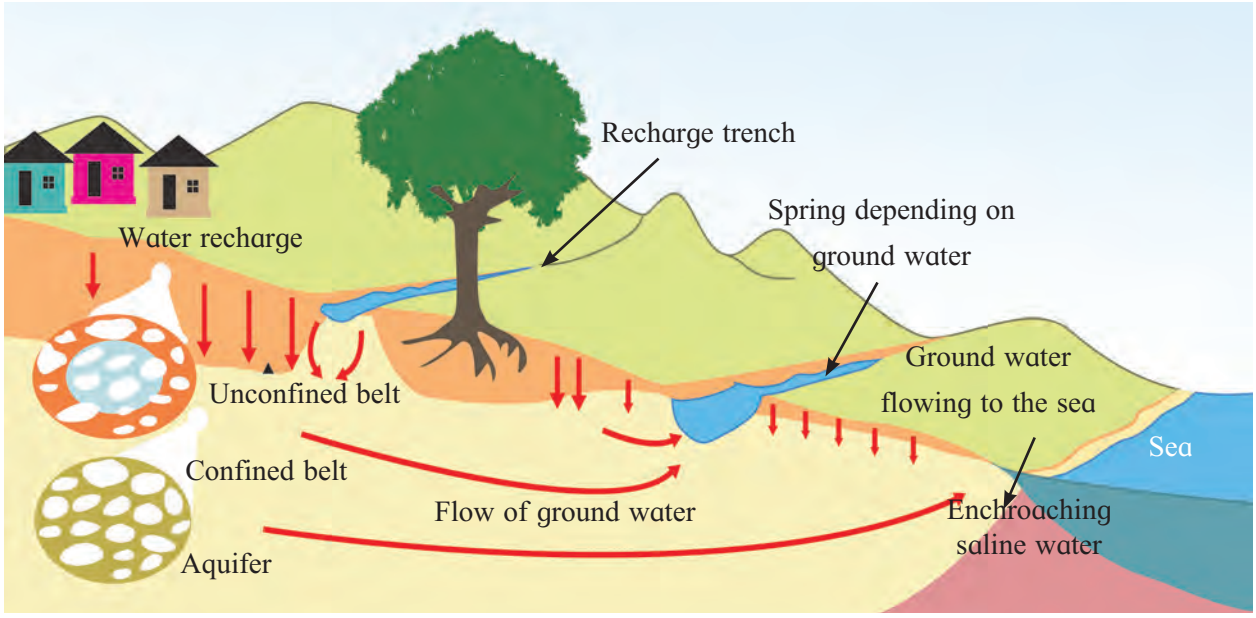


1.3.5 Terrane layers

Briefly :

The journey of rainwater falling on the earth is as follows:

1. Water falls into the reservoir.
2. It flows from the ground to the nearby reservoir.
3. Groundwater reserves increase by seeping into the soil.

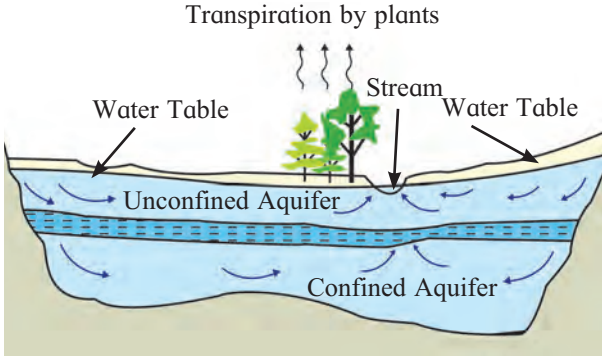


1.3.6 Flow of ground water

On the basis of geographical formation groundwater is classified as follows :

1. Aquifer : Aquifer is made up of soil, sandy soil, muddy, cracked rock, limestone etc. These areas have hollow spaces that can be connected to each other, through which water can seep. The velocity of groundwater seeping through depends on the size of the cavities in the soil or rocks and how they are connected to each other. Its main feature is that the reservoir can store water as well as supply water due to its permeability.

They have two types depending on their location on the ground



1.3.7 Aquifer

(A) Unconfined aquifer : The soil and rock pores in this area contain air as well as water. Being close to the surface, it is affected by atmospheric pressure. Where there is a lake as well as a swamp, this part does not exist, but in the desert region it covers hundreds of meters.

Groundwater plays an important role in providing water and nutrients to living creatures.

Characteristics :

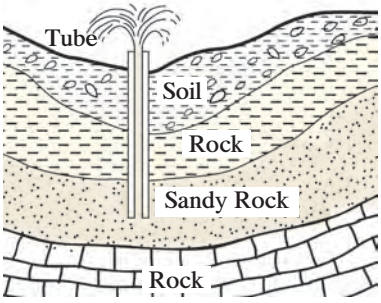
- This unsaturated aquifer controls the flow of water from the surface to the saturated aquifer.
- This affects the recharge of the aquifer.
- It is crucial in groundwater use and management.
- This helps in removing unwanted substances.

(B) Confined aquifer : The layer of saturated aquifer is below the unsaturated layer. Similarly gaps between these cracked rocks and all other gaps are fill with water.

Since there are many layers on the saturated layer, this layer is detached from the surface or atmosphere.

Can you tell ?

What happens if there is a huge pressure on the saturated water table?

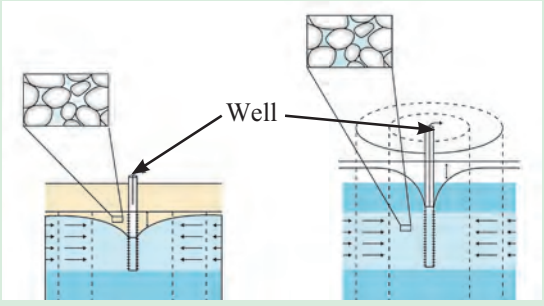


1.3.8 Fountain well and its internal structure

Fountain well : If water comes to the surface due to natural pressure after digging a well, then that well is called a fountain well.

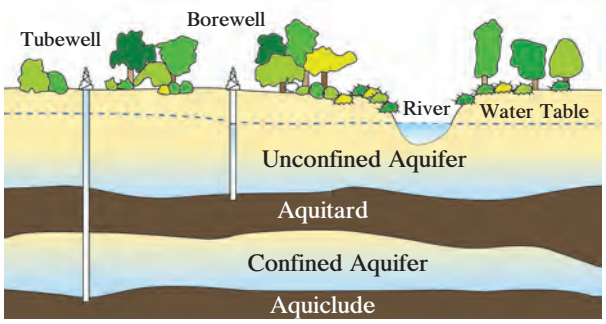
Can you tell?

What happens if water is pumped out of the well from different water holding layers?



- When water is pumped out of unsaturated aquifers, the water level decreases and the water in the empty spaces decreases.
- When water is pumped out of saturated reservoirs, the water pressure decreases, but the spaces remain filled with water.

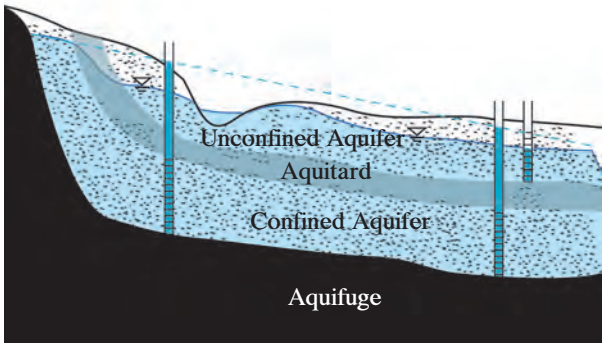
2. Aquitard : Water is not readily available due to low permeability of this layer. But if there is a reservoir below this layer, the water in it seeps into the reservoir. Sandy soil is an example of this layer.



1.3.9 Aquiclude

3. Aquiclude : As this layer is porous, it has good water holding capacity, but it does not seep water. Therefore, water is not available from it. Soil is an example of this.

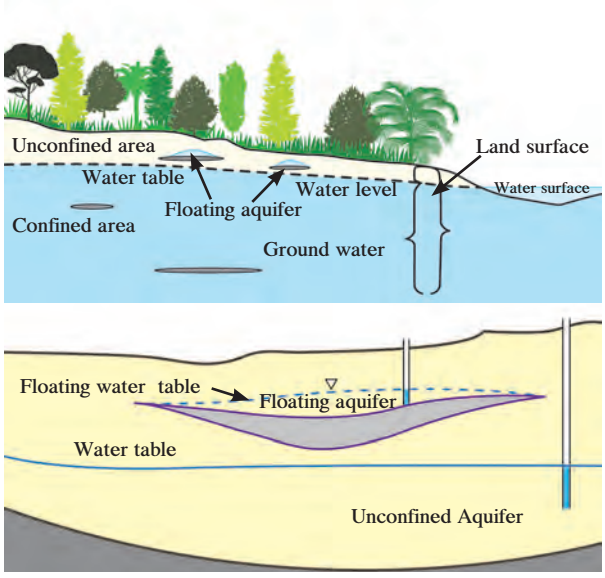
4. Aquifuge : This layer is impermeable and not porous. Therefore, it cannot hold water and water does not seep through it. Hard rock is an example of this.



1.3.10 Aquifuge

Geographical Formation / Characteristics	Aquifer	Aquitard	Aquiclude	Aquifuge
Water holding capacity	Yes	Yes	Yes	No
Permeability	Permeable	Semi-permeable	Im-permeable	Im-permeable
Ability to provide water	Yes	Yes, but slower	No	No
Example	Sand, gravel.	Sandy soil	Soil	Hard rocks e.g. Granite, basalt

5. Hanging aquifer : This layer is on top of unsaturated aquifer. Its size is generally small. The amount of water in it depends on the weather conditions.



1.3.11 Hanging aquifer and its Cross section

Surface water :

Surface water is water found on the surface. These include rivers, lakes, springs, reservoirs, ponds, creeks. Although seawater is salty/ brackish, it is still surface water.

There are three types of surface water.

1. Perennial: It has water all year round. If the rainfall is low, it is recharged by

groundwater.

1.3.12 Surfacewater

2. Temporary: It contains water only for a few months of the year. These include small creeks, coastal creeks.

3. Man-made: Water from dams as well as constructed catchment areas, in short, artificially stored water.

Maharashtra State Water Reserves :

Dams: Total 1821 large dams

Region	Capacity (Million liters)	Status in 2019 (Million liters) Approx
Amaravati	4131000	2531000
Konkan	3511000	2661000
Marathwada	7259000	4544000
Nagpur	4604000	2996000
Nashik	5823000	4848000
Pune	15199000	11942000

Reservoir in Maharashtra State :

Type of Reservoir	Total number	Water lifting (BCM)
Wells	21 Lakhs	> 14. 85
Tubewells	1.91 Lakhs	1.29

(BCM =Billion Cubic Meters)

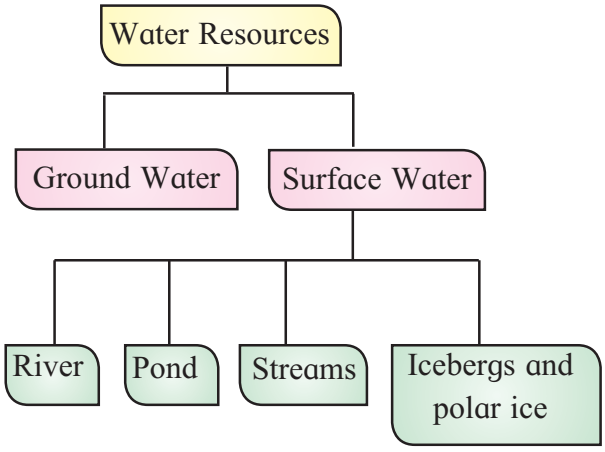
Observe and discuss.

1.3.13 Hand pump

What is common in these two pictures? Where does the water from the borewell in the picture come from? Think about it. Where did this groundwater come from?

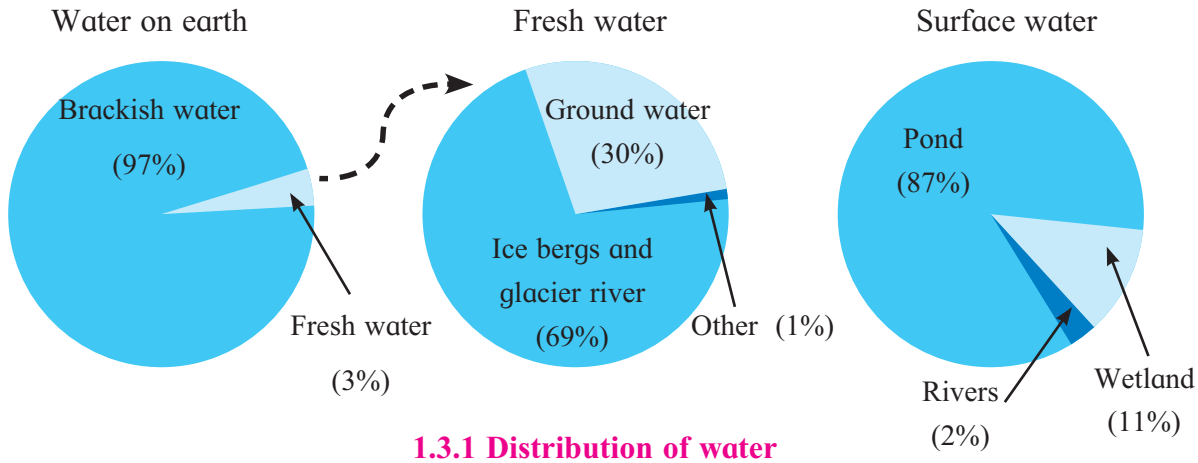
There are two main types of water resources :

1. Groundwater 2. Surface water



Observe and discuss.

How is the distribution of water on earth?



1.3.1 Distribution of water

The figure shows that,

- Most of the water on Earth is in the oceans, which is brackish.
- Much of the freshwater is in the form of snow and ice, while the rest consists of rivers, lakes, groundwater, and air vapor.
- This means that even though the amount of water on Earth is high, the usable water is much less than 1%.

Let's recall.

How many types of water resources are there on earth?

1.3.2 Water resources

1.3.3 Glaciers

Exercise

1. Write the classification of watershed areas/catchment areas.
2. Write any four properties of the watershed area/catchment area.
3. Write the type of watershed area/catchment area found in your surroundings.
4. Using the Internet, write down the average rainfall in your district.
5. Briefly explain any two properties of rain.
6. What are the key points about the density and frequency of rainfall in your area?
7. Write the names of various groundwater sources.
8. Write how magma water is formed.
9. Explain the distribution of water on the earth with the help of a diagram.
10. Write the characteristics of unsaturated aquifers.
11. Explain the types of surface water by stating what it means.
12. Find out the percentage of how groundwater and surface water is used in your state for the above purpose from the internet.
13. Write the classification of groundwater according to geographical location.

Unit 1 : Water Education

Chapter 4 : Soil and rock type

Due to the geographical diversity of India, the land in each region is different. The soil is found at the top of the earth's surface, then after digging the soil layers, first there is muddy soil (loam) and then compact basalt rocks beneath it.

Black Basalt :

In Maharashtra, Black Basalt is mostly found in the form of layers in horizontal, slightly sloped areas. These layers of Black Basalt formed as the lava erupted billions of years ago and cooled on the ground.

1.4.1 Black Basalt

A layer usually has two parts. The first, a homogeneous Black Basalt, the second porous, filled with green-white pebbles. Each such layer can be at least five meters to a maximum of thirty five meters thick. Between two layers of such Black Basalt, reddish-brown or rarely greenish-brown layer, with a thickness of one to five meters, called "Ocher /Red bole/ Red Layer" is formed. In some places, a layer of gray-white ash is formed by the accumulation of ash in lava eruptions.

Although Black Basalt is the major rock in Maharashtra, the other types of rocks that can be seen are the eroded, metamorphic rocks of this rock. Such as loam, man-limestone , sandstone and laterite (Jaambha) rocks.

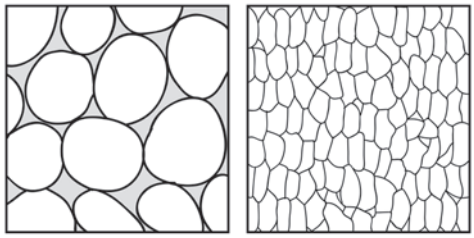
Internet My Friend :

Using the internet, collect pictures of various rocks as above and create an informative presentation and present it to the class.

These types of rocks are very important in terms of groundwater holding capacity, so when finding out groundwater, considering groundwater recharge, a special study of the porosity and permeability of these rock types is necessary. The ability to carry fluids(gas and liquid) through the rocks without any change in the original form is called permeability. If a drift is carried through a rock at a certain time, it is called permeable rock, and if the amount of fluids(gas and liquid) carried across is negligible, it is called impermeable rock.

Rock porosity:

The porosity of a rock is the proportion of volume of the cavity in it to the total volume. The porosity of the rock can be estimated by examining the rock samples. While handling the rock samples, it is not possible to see the cavities with naked eyes.



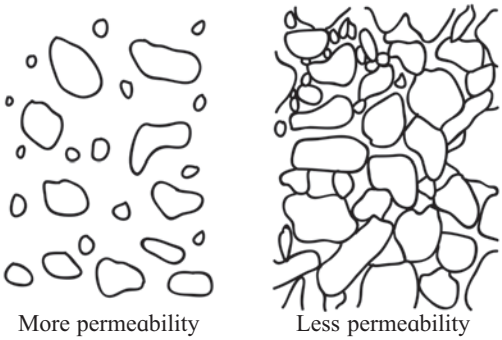
1.4.2 Black Basalt

Rock	Porosity (%)	Rock	Porosity (%)
Black Compact Basalt	0.14 – 1	Sand stone	10 -30
Vesicular Amygdaloidal Basalt (Manjrya)	3 - 5	ocher/ Red bole/ Red Layer	35
Hard muddy (loam)	1 - 8	Silt	35
Soft muddy (loam)	2 - 14	Sandy-Silt	45 – 50
Limestone	14	Clay	45 – 50

The permeability of the rock :

In terms of groundwater, it is not enough just to have porosity in the rocks, but also the important property required is permeability. For example, there is a big difference in the velocity of water flow between clay and silt with similar porosity. In short, more water flows through the rocks where the permeability is higher.

Permeability can be measured by taking a sample of cylindrical rock 20 mm in diameter and 40 mm high. When sampling a rock, it should be taken in one direction only. Fill a large calibrated container with distilled water and keep it for 6-8 hours. Then you will see that the water in the container has decreased which can be measured on the scale.



1.4.3 Permeability of rocks

Fracture :

The cracking properties of the Black Basalt, the degradation of certain minerals, the effect of sunlight-cold-rain, the temperature imbalance, the chemical reaction of water and the pressure on the ground and the small-large weatherings caused by the inner cavities, the combined effect of all these factors is fractures.

Soil :

The process by which rocks are transformed into soil is called weathering of rock. Due to the constant changes in air, water, temperature and pressure, rocks and boulders break up, erode and eventually turn into fine particles and become soil.

1.4.4 Weathering of rocks

Soil is made up of rocks, gravel, sand, fine clay, and organic matter. The soil particles vary in size , e.g.

1. Clay: Smaller than 0.0002 mm.
2. Silt: 2.022 mm. - 0.05 mm.
3. Sand: 0.5 mm. - 2 mm.
4. Stone: Greater than 2 mm.

Try it out :

1. Observe open terrain in dry river basins, mining areas, near hills and observe weathering.
2. Perform experiments to measure their porosity and permeability.

Humus formation in the soil :

The remains of plants and animals are mixed in the soil. The microorganisms in it cause the decomposition of these remains. It produces nitrogenous compounds and increases soil fertility. The soil formed from the decomposition of plant and animal remains is called humus. Soil is a hotbed of microorganisms. Numerous types of microorganisms are found in the soil. It takes approximately 800 to 1000 years for a 2.5 cm thick layer of fertile soil to form naturally.

Internet My Friend :

Get information about these types of soil like, 1. Silt soil 2. Red soil 3. Black / Regur soil 4. Sandy soil 5. Yellow soil 6. Rocky soil. Explain the relationship between fertility and soil type.

Importance of soil :

1. The soil supports the plants.
2. Various minerals, nutrients required for plant growth are obtained from soil.
3. The soil stores the water required for the growth of plants.
4. The soil is also home to a variety of microorganisms that are essential for plant growth.

Can you tell ?

1. What type of rock is there in your taluka-district?
2. Study the soil type in your area.
3. Visit the soil testing center in the city.

Exercise

1. How is black basalt formed?
2. What are the main components of black basalt?
3. Explain the main process of erosion.
4. State the types of soil particles?
5. How does soil help land fertility?

Unit 2 : Water Conservation

Chapter 1: Water structure - Well, Lake, etc.

Well

The construction of a pit to draw water from the ground is called a well. The well is one of the most popular structure designed to reach groundwater level and make water available for use. Water from wells is extracted by electrical equipment or manpower and is used for domestic use as well as for irrigation.

Structure - First the proper place is selected and a pit is made there. It leads deep to the groundwater level. Then the walls of the pit are constructed with stone / bricks / concrete. To get the water out, a moat (pulley) or a pump that works on electricity or other energy (diesel, solar, etc.) is arranged. The width of the well depends on how much water is stored. The structure of a well is generally circular.

Types of wells

1. **Aad (आड) -** A well which is narrow and often square in shape and deep, is called an Aad. These wells are found in areas where groundwater is very deep.

2. **Narrow and deep well (कूप) -** A deep well which is narrow is called a coop **(कूप)**. It is not square in shape. Well and Aad are similar sources.

2.1.1 Narrow and deep well

3. **Round well -** This is the most widespread and visible well. It is circular. The only difference is in its diameter and in the construction material (using stone, bricks, concrete, concrete ring,etc)

2.1.2 Round well

4. **Square well -** It is square in shape. The rest of the well is similar to a round well.

2.1.3 Square well

5. **Elongated well (दिर्घिका) -** As the name suggests, this well is long. All other features are similar to round wells.

6. **Tube well -** In areas where the soil content is very high, it is very difficult to dig a well as the soil is constantly falling. In such places water is made available

2.1.4 Tube well

by going to a deep water level using pipes. This well occupies less space and less cost. But its storage capacity is less than that of wells.

7. **Pushkarani/Pond (पुष्करणी)-** In general, it is a popular type of pond with steps in the shape of a square, shaped stones. Most of the time this structure is built and maintained in temples, palaces, etc.

2.1.5 Pushkarani

Do you know ?

Baramoat (बारामोट – well with 12 pulleys) a historical well at Limb in Satara district is a marvel of Shivaji maharaj period architecture. There is also a spacious palace in the well and tourists always flock to see this well.

8. **Barav (बारव)-** In some places you can see large, stepped wells with good stone construction. It has steps from the ground to the water. In many places, side accommodations are also available. Many baravs also have a moat that can be used to pull water up.

2.1.6 Baraw

9. **Budki (बुडकी)-** A well which has water only in the rainy season and then dries up due to lack of living springs is called Budki. This type of structure is found in large numbers in the tribal areas in the hills of the Sahyadri. Generally this structure is done along a stream or river.

2.1.7 Budki

10. **Bore well -** When ground water level is deep, soil layer is low and sloping area is high, bore well is drilled. In this, by selecting the right place, digging by

2.1.8 Bore Well

machine and going to the reservoir, the water storage is used. This is a very useful solution where the groundwater level is very deep. Unfortunately, this measure is currently being misused due to the lure of benefits like low cost, less space required and less time, machine work, etc.

11. **Ringwell -** This is done using a small diameter well concrete ring. This solution works best where the groundwater level is good and close to the beach. This well is usually 10 feet to

2.1.9 Ring Well

20 feet deep. This measure is especially useful when conserving rainwater in urban areas.

Pond / Pool

A pond is a natural or artificial reservoir in a shallow part of the land which is given a definite shape by the construction of edges, ridges, sculptures etc. Ponds are usually smaller in size than lakes and larger than wells. There are also names like talaaw, Pushkarani, Vapi, Vapika. Some of these names are characteristic. For example, a Pushkarani is a lotus pond. Depending on the size, its subtypes Sun Pushkarani and the Moon Pushkarani are found .

Like rivers, ponds have gained religious significance in India. Ponds, especially Pushkarani's are found in the premises of most temples. Areas where large rivers are less, the number of ponds is high there. It was customary to build Ghats, pillars for lamps (Deepmaala), overpasses (Owari), pillars, large gates etc near these ponds. It was not the king's job to supply water in those days, but the people were able to meet their water needs by their own efforts. At that time, building a pond for public use was considered a sacred act according to Dharmashastra. Such ponds

2.1.10 Pond/ Pool

were built and offered for public works. We can see the record of this in the place of such ponds even today.

The pond has been used since ancient times for many reasons such as water supply to the village, decoration of the temple, religious activities, fire fighting, beautification of the temple, facilities for the travellers. If the ponds are of natural spring or artificially stored water, their sweetness varies accordingly. It is noticed that in the past, water was stored in dams or dug in the ground to make the ponds last longer. The construction of the pond can be made with stones to prolong the drainage process.

In historical times, it was customary to build cold storages, baradari, gardens as well as ornate decorations and arches along the embankment of check dam lakes. The Rajsamand of Udaipur (d. 1662–76) and the Anasagar of Ajmer (12th century) are good examples. In Varanasi, it is said that the three rivers Varuna, Assi and Ganga were connected by a network of lakes in the past. Lakes are planned in the town planning at Mandavgarh near Indore. The Jahajamahal (Mandu) area is also famous for its lakes. The 'Golden Lotus Lake' at the Meenakshi Temple in Madura is famous. Legend has it, that Indra bathed in this lake to get rid of the sin of Brahmahatya. There are large halls and overpasses around the lake. Bandiyur or Mariyaman Teppakulam (1645), built by Tirumal Nayak, is considered to be the largest stone lake in South India. Its length is 304 x 80 m. width is 289 x 56 m. As the water is taken from the Vaigai river basin, the reservoir does not dry. In the center there is a small island with a small dome and a temple in the center.

Lakes have also played an important role in modern urban planning. Gardens by the lake, baths, ghats etc. are planned. In the eighteenth-nineteenth centuries, many large lakes were built in Mumbai. Mahalakshmi, Gavdevi, Laxminarayan etc. The temples of the place had large built ponds. Some lakes were extinguished due to the growth of the city and government facilities for drinking and drinking water supply. The lakes at Mumbadevi and Mahalakshmi have recently been extinguished.

Farm ponds/Puddle/Lake :

Farm ponds are constructed on the upper side of the farm to store rainwater. Ponds dug for the availability of water to the crop when there is a shortage of water, are called farm ponds. The farm pond is constructed in the barren land, on the sloppy banks of the stream. Land with low water permeability is selected. Black soils with high clay content are suitable for construction. However, land with loamy, sandy, porous rocks or saline soils is unsuitable for farming. Farm ponds can be set up to store runoff water where it is not possible to dig wells easily.

There are two types of ponds constructed in such a way that the water enters the farm pond considering the natural furrows or streams. Ponds with water source in natural furrows and farms in plain lands.

Groundwater in the catchment area is recharged. Water can be made available to the crop when there is a shortage of water. Farm ponds are well used for fish farming, improvement of salty lands and wetlands.

2.1.11 Farm pond

Bodi repair:

In the districts of Vidarbha, small reservoirs are constructed and water is stored in the upper part of the paddy field by earthen check dams. The stored water is fed to the paddy in the lower part of the reservoir as required. This small lake is called Bodi in Vidarbha. Due to the breakage of the pre-built Bodis and the accumulation of silt in it, it is necessary to deepen and renew the old Bodis . In Bhandara, Gondia, Chandrapur and Gadchiroli districts of East Vidarbha, the old Bodis are renewed as an effective measure of water conservation.

The objectives of Bodis renewal are to recharge them by interrupting the running water. To provide protective irrigation to the rice crops in case of emergency.

2.1.12 Bodi

Exercise

1. What is a well? What are the different types of wells?
2. What is a Bodi?
3. Where should a farm pond be built ?
4. What are the uses of the pond / lake?

Unit 2 : Water Conservation

Chapter 2: Concept of Water Conservation

Distribution of rain water

In nature, there is the season cycle of summer, monsoon and winter. The water required for life is available to us during the monsoon season. Not all parts of Maharashtra receive uniform rainfall. The water that falls during the rainy season naturally seeps into the soil. Some is stored as surface water. In addition, some of this water evaporates, some is used directly by some plants, and the rest is carried away in the form of runoff. A runoff is a stream of water flowing over the surface.

The water sources found in the hills, river basins and wells in the form of springs start depleting within a few days after the end of monsoon. At such times water is needed. Some areas are constantly facing drought conditions. In such cases, it is necessary to stop this wasted runoff and collect the maximum amount of rain water, store it in a suitable place or bury it in the ground.

What is Water Conservation?

"Water Conservation" is the use of man-made measures to block, store and intake the rainwater in an area by constructing various structures and allowing it to be used for drinking, consumption, industry and agriculture until the next monsoon.

2.2.1 Mountain slopes, streams, deforestation and water and soil carried away due to them.

Increasing Need of Water Conservation:

Recently the rainfall period and simultaneous rainfall have become erratic. Four months of low but continuous rains have now become erratic due to climate change. There are frequent instances where the maximum rainfall falls in a short period of time and the dry period of two rains lasts a long time. Eventually, the amount of infiltration of running rain water is declining.

Trees control the speed of rainwater. The roots of the trees carry the water from the surface to the ground. Water is being carried away from the land rapidly due to the disparity in large scale deforestation and tree planting.

2.2.2 Problems arisen due to lack of water conservation.

After building a house in town or village, a thick layer of cement and sand is spread in the space around the house. As a result, the area and the rate of infiltration of water into the soil is greatly reduced.

Water is still available as much as it used to be available in the past, but water consumption is also increasing due to huge population growth. The amount of water available from water conservation and the amount of water used is declining drastically. Considering all these factors, there is a need for water management and water conservation.

Usefulness of water conservation:

With a view to economic development of rural areas of the state based on public participation as well as natural resources, the following can be achieved through water conservation:

Sustainability : If the abstraction/lifting of water from the catchment area is less than the recharge rate and also the reduction in per capita water consumption, water retention will occur unknowingly and a sustainable water supply can be ensured.

Energy conservation: Electricity is used for water management. 15% electricity is used for this. Reducing water consumption will also save energy and conserve energy.

Habitat Conservation: Reducing the use of freshwater will keep freshwater reservoirs intact and protect the organisms from drying out.

Rainwater harvesting:

Rainwater harvesting is the process of diverting, infiltrating, and making rainwater available in the same area, in the right place, in the right way, for later use. There are two types of this,

A. Temporary use: When it is raining, store rainwater (enough for about 4-5 days) and use it.

B. Use after the end of the rainy season: Store rainwater in tanks, wells, borewells, or other places and use it after the end of the rainy season.

Rainwater harvesting can be done perfectly in both cities and villages, and its benefits are well documented.

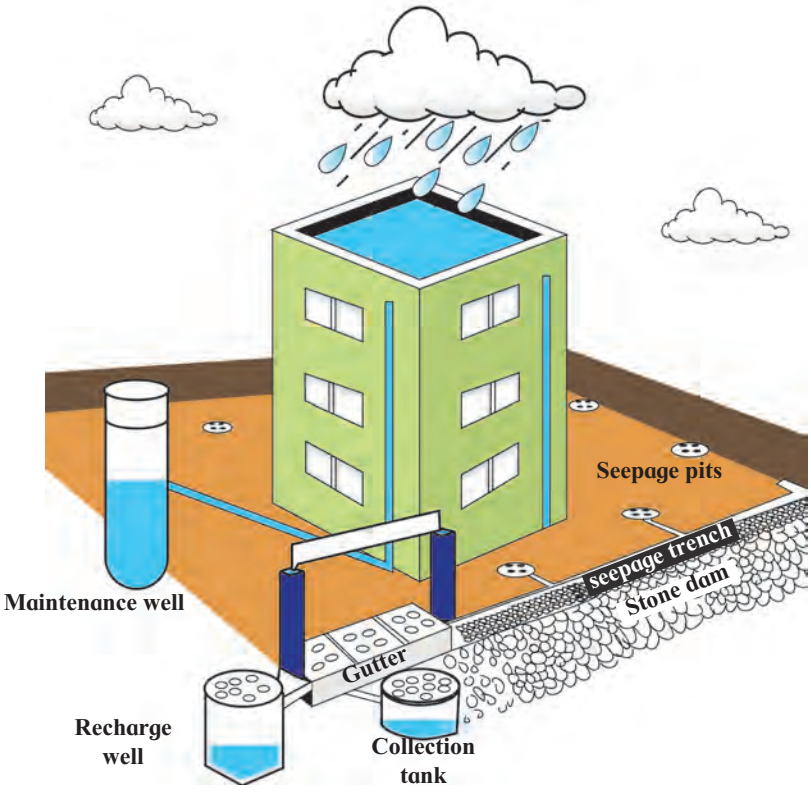
Urban Water Conservation:

When it rains in the city, water falls from the roof of the building. It is carried down through the pipes in most places to the municipal drain. From there it converges and flows into nearby streams, runnels, rivers, creeks, or seas.

Depending on the surface of the land, the amount of water that will be absorbed and carried is determined. The surface also determines, if the water will be absorbed or carried away. If there is open ground or soil, 50% of the falling water settles in the soil. But if it is concrete, hardly 10% won't be absorbed, most of the water is carried away.

In the past, there was soil in the premises of the buildings. There are lot of grounds and open spaces are available. So the water would first seep into the ground and then come out of the yard. So the water came slowly and it took time to fill the runnels. Now, due to depletion or disappearance of soil, the water immediately and completely enters the runnels and creates flood-like conditions in the area. This is currently happening all over the cities and there is also negligence in constructing unauthorized buildings, roads and sidewalks (where they are), road dividers. This is compounded by irregularities in non-sanitation or alleged irregularities in waste disposal, etc., and this creates the current dire situation.

Due to concreting of most parts of the city, it cannot be used for water infiltration. In addition, it is seen how the rainwater will go towards the sea as soon as possible. As a result, the water content of the soil has decreased. This leads to flooding in the rainy season and water scarcity in the summer. This picture can definitely change if rainwater harvesting is done in every building. If the wells, borewells, etc. in the area are recharged, the life of those sources will be extended but the picture is not



2.2.3 Water Conservation

visible as floods in monsoons and scarcity in summers. And, most importantly, the area is self-sufficient in water, not completely dependent on the government for water. Only, it requires public participation.

Water Conservation in Rural Area:

The water requirement of the village can be met by diverting, infiltrating and storing water in the same area. It needs to be considered not only for drinking but also for domestic use, for cattle, for other uses, and for the second and third season crops.

If water conservation is planned and implemented the village location, the population, the water requirement of the village, the water sources, their capacity, water requirement for agriculture, number of cattle in the village, land type, soil type, number of layers, depth of the rock , the slopes etc., are the factors considered, it is sure to be successful. If water conservation is to be successfully implemented for a long time, it requires the participation of local people.

2.2.4 Water storage method

Try this:

1. Create a table of water conservation practices in urban and rural areas
2. Visit different forts and record observations for water conservation structure.
3. Carry out water conservation activities with the help of teachers to retain rainwater in the school premises.

Benefits of Rainwater Harvesting:

1. Existing water sources are strengthened.
2. Improves water quality.
3. Prolongs the life of a well or borewell.
4. Waterlogging, flooding, etc. can be avoided.
5. The salts in the water of the borewell can be reduced and the water can be made drinkable.
6. The journey towards water self-sufficiency continues.
7. No need to rely entirely on the government for water .

The Department of Water Conservation :

It was established by the Government of Maharashtra on June 5, 1992 . The department has been entrusted with the responsibility of monitoring important Central and State sponsored schemes like Water conservation, Soil Conservation, Integrated Watershed Development, Minor Irrigation, Wasteland Development. As on 31st May 2017, the Department of Water Conservation has been restructured by the government and a separate Department of Soil and Water Conservation has been set up. Its functions are, with minimum land acquisition process, implementation of small and medium scale irrigation projects at low cost in 1 to 2 years, raising of ground water level, siltation for large and medium projects, prevention of soil erosion, creation of decentralized water reservoirs.

To carry out rapid development and regulation of watershed and water conservation works including minor irrigation projects and to make special provision for related matters, the Maharashtra Water Conservation Corporation was established on 22nd August, 2000 and is headquartered at Aurangabad. The department has a 21% share in the total generated irrigation capacity of the State.

Historical water conservation structure

Whether it is on an ocean island, near the shore, whether it is a uban fort or a mountain fort, it is easy to see that rain water was being conserved and the required water was being made available. On-site structures were constructed and maintained with proper care to ensure adequate water supply to the people in the area through wells, tanks, lakes, ponds, pushkaranis etc.

Measures taken on sea forts:

If you observe Colaba, Janjira, Sindhdurg or any other sea fort, you will notice that despite the salt water all around, all these forts have fresh water reserves, in the form of lakes or wells! How was this possible? This is an excellent example of on-site water conservation. While constructing the ramparts of the fort, care was taken that rain water falling in the vicinity of the fort would not be carried out. A water reservoir was built on the fort and then that water was used throughout the year as needed. Many measures were taken in construction and design to reduce the evaporation of that limited water reserve. Care was taken to ensure that direct sunlight did not reach the water, and that the water remained clean. All of this is still working properly today.

2.2.5 Pond/ lake at Murud Janjira fort

Water conservation on hill and urban forts:

There are many examples of water conservation on such forts in almost all

parts of the country. Water conservation and management measures are also used in places like Naldurg or Onsa on land, most of the hill forts in Maharashtra as well as sea forts. Here too, while constructing the ramparts of the fort, care was taken that the rain water falling in the vicinity of the fort would not be carried out. This water was infiltrated into the area, then used for wells and stored in ponds or tanks. Even today we see this system working properly. Using this principle, fresh water was provided by water conservation and management even on marine forts.

2.2.6 Lake at Raigad fort

Exercise

1. What is water conservation?
2. Explain the division of rainwater.
3. Why do you think water conservation is needed?
4. In which type of soil, water conservation is done? what care needs to be taken?
5. Explain the usefulness of water conservation.
6. What are the functions of Maharashtra Water Conservation Department?
7. Why are there limitations in rainwater harvesting in urban areas? How can water conservation be done through public participation?

Unit 2 : Water Conservation

Chapter 3 : Catchment/watershed treatment

Catchment/watershed area

The area from which water naturally flows and flows through a particular place is called the catchment/watershed area of a stream. Each surface reservoir and each stream has its own catchment/watershed area.

Some of the methods used to soak up rainwater in such catchment/watershed are called catchment treatment. This method achieves the objectives of soil conservation i.e. prevention of soil erosion and protected irrigation for plant growth.

(A) In-situ treatment

1. Farm bunding:

2.3.1 Check dam

Before sowing, a dam is built in the sloping area of the field to prevent the water falling in the field during the rainy season. A horizontal embankment is called a main embankment and a vertical embankment is called a side embankment. When it is raining, water is pumped out of the field with a large hose to keep the dam from bursting and soil erosion.

2. Sloping or level check dams :

Sloping check dams construction work is carried out in rainfed areas. These check dams are laid along the fields. Accordingly, a level check dam is constructed by connecting a level earthen check dam or a slope earthen check dam and biological check dam. It is not for storing water but for slowing the moving water. Sloping dams are used to reduce soil erosion and to trap groundwater.

2.3.2 Sloping or level check dams

3. Bunds:

Water flows very fast on steep slopes. In such places, sloping lands are converted to bunds to cultivate and water the soil. From a long distance, these slopes look like steps on some hills. It is a field prepared on slopes by digging some part and filling half part like steps. Where the soil depth is sufficient and water is available, the slope is converted to bunds. In the rain-fed region of Maharashtra, paddy fields are prepared on hill slopes and land is brought under paddy crop. The types of these bunds are as follows: bunds with plain

2.3.3 Bunds

fields, bunds sloppy at the inner side and bunds sloppy at the outer side .

4. Contour Trench:

Flat trenches are dug in the fallow land on the hill slopes. On land with 0 to 33 % slope, Consecutive contour trenches of this size 0.60 m. wide and 0.30 m. deep as well as 0.60 m. wide and 0.45 m.deep are dug. Depending on the slope of the land, the length of the trench is 833 m. to 2174 m. Normally per thousand running meters length and 0.30 m. depth, 180 cubic meter and 0.45 m. depth, 270 cubic meter water is stored.

Contour trenches slow down the rapid flow of rainwater on the mountain tops and reduce soil erosion. Trenches, grass or tree roots slow down the flowing water and it gets absorbed in the soil. Due to protected irrigation, waste land becomes productive and this area is brought under cultivation to some extent.

2.3.4 Contour Trench

5. Deep Continuous Contour Trenches :

Continuous Contour Trenches treatment is applied on fallow land which is unsuitable for cultivation. 1 m. wide and 1 m. deep continuous contour trenches are dug. The water flowing down the hill slope is stored in the trenches and results in good soil and water conservation. 240 m long, 1 m. wide and 1 m. deep trenches should be dug per hectare. The vertical distance between the two trenches should be 33 m. And after every 20 m.long trench, leave a gap of 2 m to remove excess water and then dig another 20 m. long trench . While digging the second row, the first trench must be 10 m long instead of 20 m. Leave a 2 m gap. At the same level dig another trench of 20 m.length. Sow 4.80 kg of grass seeds per hectare at full length of trenches . Eg. Hamata, Pavana, Marvel, Mountain grass, Madras Anjan, Sheda, Nil grass.

2.3.5 Deep Continuous Contour Trenches

These deep furrows / trenches are very useful for retaining the fertile soil layer on the ground and for infiltrating water in the soil. It prevents soil erosion. Due to the seeped water in the mountains, the groundwater table lasts longer. Helps in tree and grass conservation.

(B) Stream control treatment:

A stream is a natural current of water flowing down a slope or from a flat land. Brooklets, runnels are included in the stream. All these are considered while controlling the flow. These streams flow for some time after the rain stops. The water in it is conserved for taking a crop. In this method the following types of dams are laid on this stream.

1.Rough stone dam / Loose Boulder Structure :

In the upper part of the catchment area, rough stones are used to stop the erosion of the streams. The rough stones are the stones found in nature. These stones are small and large in size. Coarse stone check dams are laid horizontally on the stream. This increases the rate of water retention in the soil. It also prevents soil erosion.

2.3.6 Rough stone dam / Loose Boulder Structure

2. Gabion check dams:

The gabion dams are the dams built in streams / runnels (nala) .They are made up of coarse stone embedded in metal meshes. Gabion-style dams are constructed to conserve water in areas where the slope of the runnels is high and the rough stone dams cannot survive due to excess rainfall. The dam is built into a stream of water by placing large and small stones in a galvanized mesh cover. The mesh is inserted up to 2 m. in the runnel banks, on both sides.

2.3.7 Gabion check dams

During the construction of the dam, the cavities in the stone are filled with small stones or chips. Care is taken to ensure that the shape of the dam does not change under any circumstances due to floods. The head width of the dam is 0.45 m. The inner and back side of the mesh is lifted and placed at least 15 cm above the head. It is made to overlap and tied to the head with binding wire. The mesh is tied tightly by rubbing with the stone check dam. The hollow on both sides of the mesh is filled with soil and the runnel bank is made as before. 1 meter long and 1 meter wide stone pitching of the gully and backside (tapering towards the runnel edge) is done. The pitching width at the runnel banks is equal to the base width of the gabion structure.

3. Earthen stream (Mati Nala) Dam:

Earthen stream Dam is a treatment for both flood control and V-shaped valley control. The purpose and benefits of an earthen stream dam are as follows. After the formation of V-shaped valleys (ghal) and stream, rain water flows through it very fast. As a result, the banks of the stream become eroded and the stream bed expands and the surrounding arable land decreases.

2.3.8 Earthen check dams

In such a case, if the water is stopped by constructing a check dam at the right place in the stream and the excess water is released at a controlled speed, the day to day expansion of the stream will be curtailed.

In drought prone areas, such stopped water seeps into the soil, helping to increase groundwater reserves. The water level of the wells in the area of influence of the dam increases. In the case of sure or high rainfall areas, the water stored at the site of stream check dams can be used during the temporary drought period to save some of the crops that are drying up due to lack of rainfall.

Water is available to the animals for drinking seasonally. There are different types of earthen stream dams depending on the catchment area. Stream dam with catchment area 10-40 hectares and with catchment area 40 to 500 hectares.

4. Concrete cement stream check dams :

The concept of constructing a concrete cement stream dam came into existence with a view to infiltrating the rain water on the spot and preventing leakage of water from the dam. Due to such dams , water storage has increased to a large extent, which has increased the water level in many wells as well as the ground water level. The use of cement concrete instead of stone construction will increase the quality and the lifespan of the dam.

2.3.9 Concrete cement stream check dams

5. Deepening the streams:

Within a few years after the construction of concrete cement check dams or other types of check dams, they are filled with rock soil or accumulated vegetation remains, so in the rainy season, excess water continues to flow rapidly from nearby fields or filled sreams. As a result, a large amount of soil erosion has been found in the fields. Therefore, it is necessary to deepen such filled check dams.There are some criteria for deepening the streams. Eg. streams should not be deepened where there is sand storage in the streams basin. These works should be implemented as a priority in highly absorbed areas and absorbed catchment areas. It is not advisable to undertake the work of deepening the streams in the alluvial (made up of silt) region as the soil layer is impermeable due to clay. Therefore, water will not be infiltrated and won't be converted into groundwater. However, the "Bazada" part of the topography in the silt area is very suitable for this measure.

6. Diversion check dam:

The cement dam that is built in the stream basin to divert the water flowing from the stream to the field through the river is called a diversion dam. In many places of the Konkan and Ghat head, water is flowing from the streams till the month of December / January. Every year on such streams, the farmers irrigate the crops by placing raw earthen embankments/ bunds and diverting the water to the fields. The earthen embankments burst every year. So, if these dams are paved and the water flowing from the stream is diverted to the fields and made available to the crops, the wetlands of the place will increase and alternatively the yield will increase. The cost of such a dam is also reduced. In this way the water is diverted naturally and as long as the water flows through the stream, 24 hours running water is available to the crops in the field. This allows for 1 to 2 guaranteed water

2.3.10 Diversion check dam

shifts for the crops grown during the rabi season as well as for stress during the rainy season, so this work is in great demand among the farmers.

Precautions to be taken for Catchment/ Watershed treatment:

1. There are definite benefits if proper water conservation measures are taken by studying the type of soil, slope, thickness of soil layer, type of soil, geographical conditions etc.
2. No one can exactly predict the properties, location and capacity of the water source. It can only be guessed. It is better to have this work done by an expert and experienced officer, so the success rate increases a lot.

3. It is a misconception that if the well gets water then the borewell will also get water.

4. Water conservation work should be done on tributaries, streams, springs, etc. before working on the main river.

5. Before removing the sludge, when deciding the nature of work, first study the surrounding slopes, geographical conditions, speed of water flow, etc. and then decide the amount of sludge to remove. Consult a suitable experienced person. Build at least 2 Gabion dams at the top of the stream. So the mud will not come back immediately in the rain. While removing sludge, maintain the natural slope of the source. It should not be changed, a 45 degrees slope on both sides must be kept. It brings stability and avoids the sides from collapsing.

6. If you decide to build a check dam, the plan should be prepared by the officer in charge of the concerned department. In order to prevent siltation in the dams, there should be ways for sludge to escape. The type of dam should be selected according to the local geographical conditions. No dam type should be chosen arbitrarily. It also risks permanently destroying the resource.

Exercise

1. List the catchment/ watershed treatments in your area.
2. Explain the care to be taken while deepening the streams ?
3. State the main benefits of catchment/watershed treatment.
4. What should be done to prevent check dams from collapsing?

Record observations

1. Which of the following check dams would be suitable for water conservation, a rough stone dam and a gabion dam in a rain-fed catchment area?
2. Does soil erosion hinder water conservation work? Explain your point.
3. Explain the statement “Farm ponds with plastic bottoms cannot be part of water recharge”.
4. Which treatment in the catchment / watershed area has made it possible to cultivate in the hills?
5. Would water conservation works be useful on a flat surface with abundant rainfall?

Visit:

1. Visit the website of the Department of Soil and Water Conservation. Understand its functions.
2. Observe the condition of dams in your area.
3. Observe the difference between an earthen check dam and a cement check dam.

Unit 2 : Water Conservation

Chapter 4 : Water Recharge

Groundwater recharge:

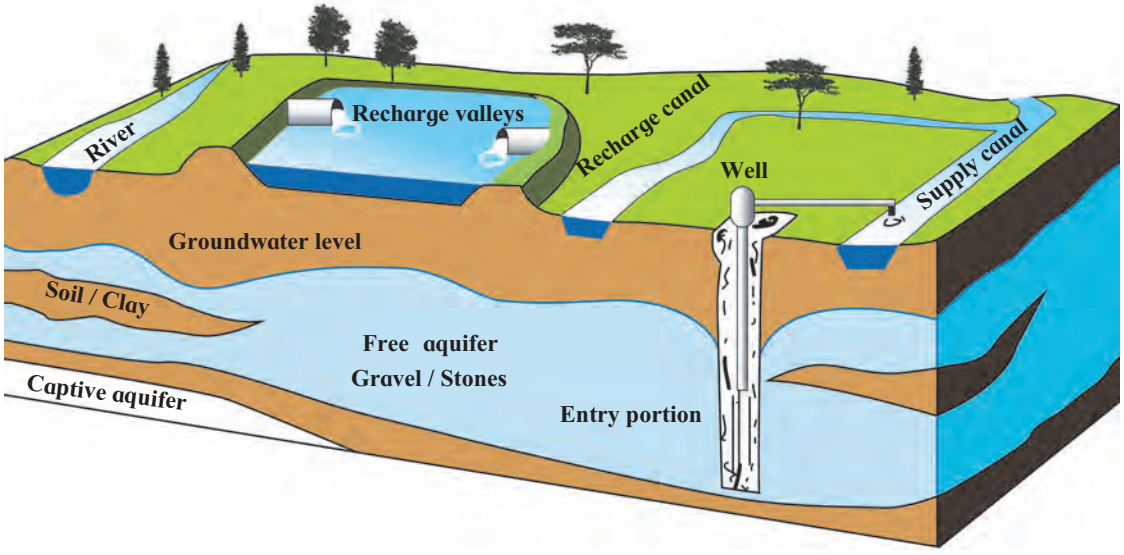
Groundwater recharge is the process of infiltrating rainwater into the soil in various ways to increase groundwater storage. Water recharge can be done in different ways. Storing rainwater for a certain period of time.

Groundwater

Groundwater is the water which stored under land. The rainwater seeps into the soil. As the upper soil layer becomes saturated, water continues to flow into the lower layer. This water is absorbed through the loam in the soil and the cracks in the rock. The rate at which water seeps into the soil depends on the geological condition of the place. The higher the slope, the less water is absorbed. Conversely, if the slope of the land is low and slow, the rate of waterlogging is high. The second factor is the porosity of the rocks. Porous soils, jointed rocks, fractured rocks, fused porous rocks, and rocks with cavities are more prone to waterlogging. Naturally, more groundwater reserves are formed. This groundwater is used for drinking and agriculture.

The need for groundwater recharge

We are surrounded by borewells and wells without water. The main reason for this is the lowered water level in the soil. This requires a collective effort to recharge the water. Where water is not available through river the canals, wells, borewells are used. Agricultural water is also obtained through the borewells. Currently, the water level of these springs is about 400 to 500 feet deep. As groundwater level is declining day by day, wells and borewells need to be recharged. Groundwater is not being recharged in the proportion it is being pumped out, so the groundwater level is getting deeper day by day. In order to increase the ground water level, it is necessary to try to infiltrate rain water wherever possible. At the same time, it is also necessary to use the available ground water sparingly and scientifically. Groundwater reserves are depleted due to various reasons. As a result they need to be recharged.



2.4.1 Groundwater Recharge

Efforts are made to infiltrate rainwater by digging ditches, absorption pits, in different places in the soil and at different distances, in different layers of the soil. Attempts are made to restore groundwater levels by storing as much groundwater as possible. At present, due to depletion of open space and soil in urban areas and significant increase in the amount of concrete or pavement, the natural recharge is very low and we are beginning to feel the loss. For this, there is an urgent need to study the scientific method of how to absorb the maximum amount of rain water in the ground and to take measures according to the location and with the participation of local people.

Care to be taken while recharging groundwater:

Appropriate care should be taken when recharging groundwater or using rainwater for it. When infiltrating water in any place, it is very important to filter the rain water through a proper filtration system. Rainwater may be acidic sometimes or the roof surface may be unclean. Therefore, after the onset of rains, the first one or two rainwater recharges should be avoided. We can purify the polluted water on the ground. But if the groundwater source is contaminated, it is impossible to purify the water in it.

Infiltration of water in the ground alone is not enough. When borewells are drilled, every borewell must be refilled. Due to the characteristic structure of the groundwater you have, if you do not refill, it can dry out suddenly at any time.

Recharging groundwater and sources not only increases their water holding capacity, but also has the added benefit for urban areas. If rainwater is diverted to groundwater or sources, there will never be water logging or flooding in the area.

In short, the most important and necessary thing is to try to get water throughout the year, efforts must be made in the rainy season. The most important and necessary thing to do is to take measures according to the location so that the available water can be used after the end of the rainy season by properly reciprocating the available water. It needs to be done with the guidance of the right expert and experienced person. Doing so will create a year-round source of water and groundwater.

Groundwater recharge and rain:

Before adopting various methods of groundwater recharge, you need to know the amount of rainfall in the area. The amount of water that can accumulate in the area can be calculated based on the amount of rainfall.

Rainwater Mathematics:

Area of the premises = 500 square meters

Roof area of the building = 100 square meters

Total annual rainfall = 2.2 m

Total amount of water = Area of the surrounding × Total rainfall

For 500 square meters = 500 × 2.2 = 1100 cubic meters (11,00,000 liters)

Assuming we only take 60% of the water,

Water content = 11,00,000 × 0.6 = 6,60,000 liters

Water on the roof of the building = 100 × 2.2 = 220 cubic meters (220,000 liters)

If 80% of this water is taken,

Water content = 2,20,000 × 0.8 = 1,76,000 liters.

Generally, one person needs 10 liters of water a day. So, if you think about the above mathematics, that water will be enough for about 50 people to drink only for a year.

The amount of rainfall varies according to the geographical conditions and the amount of water in each place will change accordingly.

Filtration system required for filtration of rainwater:

An important part of the rainwater filtration system is the suction pit. For recharge of water in sources like well or borewell, the suction pit acts as a filter. Also, if you want to recharge the source with your roof water, there are different filtration systems.

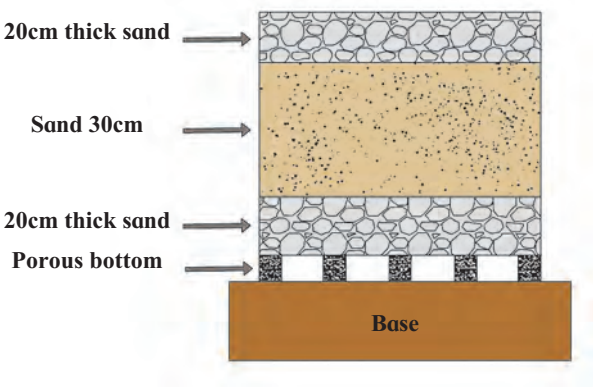
Suction pit design:

To absorb the water, a pit is dug at that place in which the water is to be recharged. The size of the suction pit is decided on the basis of component (well, bore well, roof water) to be recharged. The proportion of elements in the suction pit, i.e. stone, sand is also taken according to the size of the pit. At the bottom is a pipe of three or four inches in diameter, carrying the filtered water. The filtered water from this pipe goes to wells, borewells and underground. The pit is divided into three to four sections with large stones at the bottom. Then small stones of the same type are thrown. Above this layer, is a layer of thick sand and at the top, a very fine layer of sand. Rainwater or the water (free from silt or other components) from the source is released on this fine sand layer. This water is filtered through these three-four layers. This water accumulates in the soil, wells and borewells.

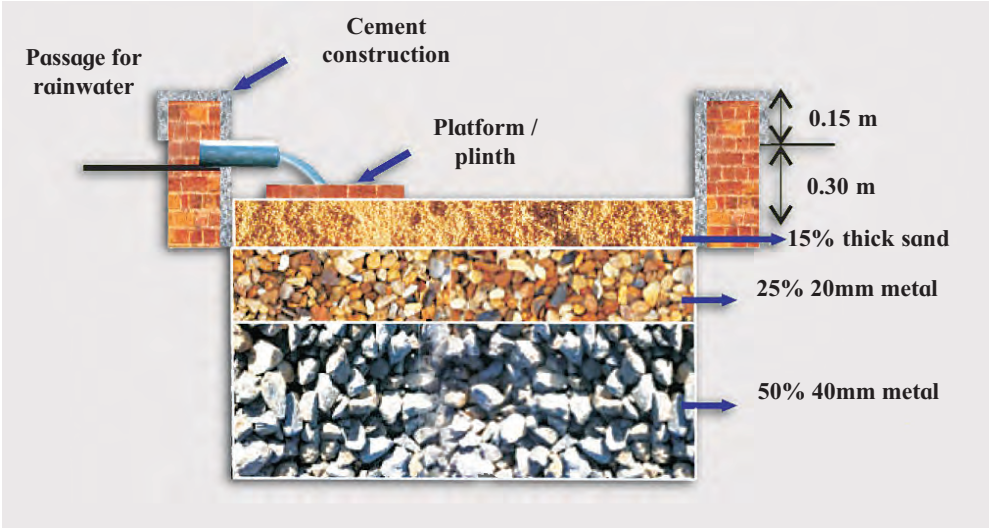
Different types of filtration devices:

You can't use rainwater directly from the roof. It has to be filtered. For that you have to prepare a filter. When preparing it, their size and the proportions of the components in it, it is decided on the amount of water to be recharged. According to the components in the filtration system, following types are found-

1. **Sand filter :** A container of suitable size has layers of fine sand and gravel on top of each other. On one side there is a layer of porous material. On top of that there is a layer of medium sized gravel. Then there is a layer of fine sand. The topmost layer is of gravel. The water to be recharged is released from this layer and the water is filtered out of the porous layer. Its structure is shown in the figure below.

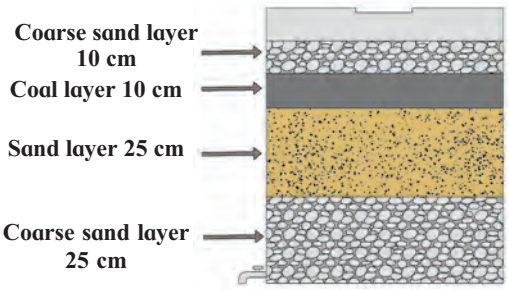


2.4.3 Sand filter



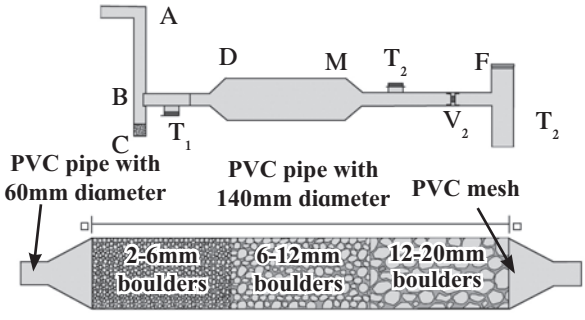
2.4.2 Absorption pit

2. Coal filter: It is similar in structure to sand filter but on the top there is a layer of fine coal as shown in the figure. Recharge water is released from this top layer. The water is filtered and can be taken from the bottom layer for use. Its structure is shown in the figure below.



2.4.4 Coal filter

3. Filter in Pipes: The filter shown in the figure below is made in a plastic pipe. The pipe is approximately 140 mm in diameter and 1.2 m in length. There are three layers of fine to large gravel. The first layer is made of gravel of size 2-6 mm. The second layer is a layer of gravel 6-12 mm thick and the third layer is a layer of 12-20 mm thickness. The water to be recharged is released from the side with the fine gravel and the filtered water recharges the water source as it flows out from the other side. The wells are recharged with this filter. This filter has been constructed by Rural Engineering Services Devas (Madhya Pradesh). That is why it is called a "Devas" filter.



2.4.5 Filter in a pipe

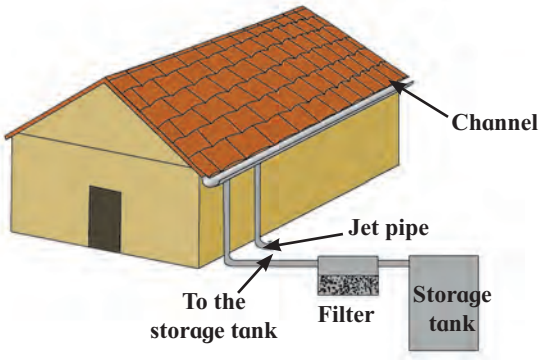
After the various filtration components, we will study the different methods of water recharge.

Roof rainwater recharge:

Rainwater is first considered through both reuse and recharge. Rainwater harvesting is the process of recharging with rainwater. There are different types. In the first type, rainwater is stored in a tank and is used for drinking or other purposes. The second type is that the rain water is infiltered in the soil through the suction pit. Such water becomes part of the groundwater.

1. Storing rainwater in the tank:

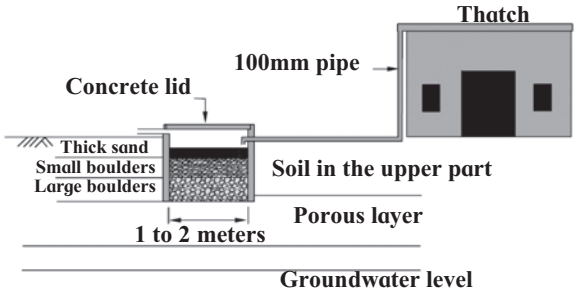
For the purpose of saving water and in places where drinking water is not available, rain water falling on the roof can be stored in a closed tank for drinking purposes. After cleaning the roof with a couple of showers, the rain water should be collected through a channel / pipe (panhali), filtered and stored in a tank. A special type of filter is used for this. Water should not be used without filtering through the filter. Use the recommended amount of liquid chlorine or tablets when drinking water.



2.4.6 Rainwater harvesting

2. Recharge of Soil with Rainwater:

Raising groundwater level is a need of the hour. For this, recharge of rain water is important. Rainwater is collected from the roof and allowed to pass through a mesh, leaving mulch or other elements trapped. The filtered water is discharged into the suction pit.

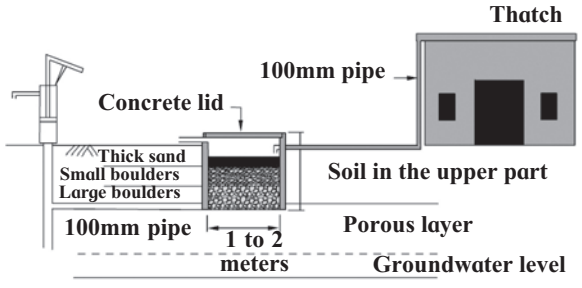


2.4.7 Absorption Pit

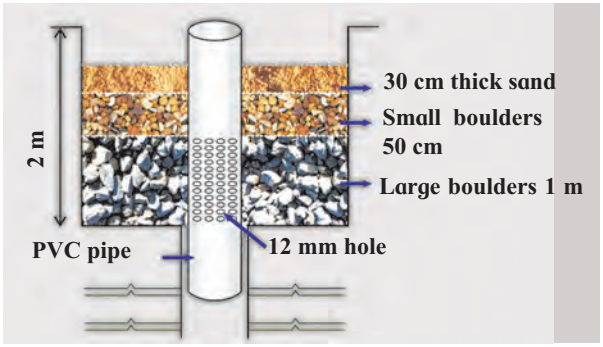
For this proper type of suction pit is dug. Its structure is shown in the accompanying figure.

3. Recharge of borewell with rainwater:

This type of refill is used for dry borewell in farms, villages or in the vicinity of large housing societies. In order to recharge the borewell in the field, the water of the runnel or stream is diverted as the source. The roof water is diverted to the suction pit to recharge the household or village borewell. A pit, two meters wide and two meters deep is dug around the borewell or a pit of suitable size is dug. In the area of the casing pipe of borewell, holes of specific diameter are drilled at a distance of 1-2 cms on all sides. Coconut strings (kaathyaa) are wrapped tightly or a plastic mesh is placed on these holes as a filter. The pit is divided into four sections, filled with rocks at the bottom, gravel above it, then coarse sand, and fine sand at the top. The water from the source is released at the top as shown in the figure. The



2.4.8 Recharge of the bore well



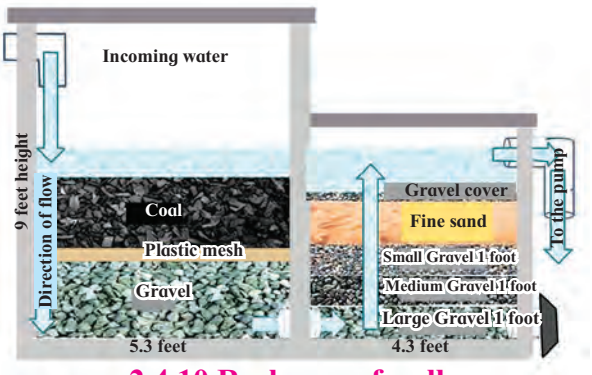
2.4.9 bore well structure

water that goes down through the filtration process becomes part of the groundwater.

4. Recharge of wells with rain water:

Two separate pits of three meters and two meters length are dug between the well and the stream.

The first pit is dug three meters long, three meters wide and one meter deep. The second pit is dug at a distance of three meters from the first pit. The second pit is dug two meters long, 1.5 meters wide and two meters deep. Taking a horizontal hole in the center of the first pit, this pit is connected to the second pit by a six inch PVC pipe. The first pit is filled with stones. The bottom of the second pit is filled with a 0.45 m thick layer of gravel. A 0.45 m thick layer of sand is applied on that layer. Then it is filled with a 0.45 m thick layer of fine sand and a 0.15 m thick layer of coal is spread on it. The pit is connected to the well by a four-inch PVC pipe from the bottom. The mulch, waste, etc. from the river water will settle in the first pit and the water without particles will go through the pipe to the second pit. The clean water filtered from the second pit will go through the well pipe and recharge the well.



2.4.10 Recharge of wells

Precautions to be taken while filling well and borewell:

1. The water coming to the stream should be free from salts and chemicals.
2. Water should be piped to the bottom of the well.
3. There should be two filter pits before refilling.
4. Remove the sludge from the well before refilling.
5. Recharge should be done with filtered and clean water only.
6. Water on the area where salt has spilled i.e. salts have accumulated, should not be used to recharge wells.
7. The filter made up of sand and gravel should be cleaned once before the rainy season.

Do You Know ?

In 1946, the 'Department of Engineering Geology and Groundwater' was set up independently at the Geological Survey of India. An agreement on technical cooperation was signed between India and the United States after independence.

In the scheme prepared under the agreement following were the aims -

Near about 2650 tube wells and borewells would be dug in the Ganga river basin from Punjab to Bihar. Underground geological information would be obtained. Sample wells would be drilled and future action plans would be planned. Currently, groundwater survey and development systems have been set up in every state and union territory in addition to the Geological Survey of India. Groundwater Survey and Development Agency was established on 16th July 1971 in Maharashtra also. The function of this organization is to conduct groundwater survey, research, groundwater assessment, development, monitoring, management for drinking water, agricultural and industrial needs as well as survey and research for groundwater emergence.

Internet my friend :

https://gsda.maharashtra.gov.in/index.php/GWRechargePriorityMap

The above site belongs to Maharashtra Groundwater Development Authority. A map of your village and maps of artificial water recharge priority maps are also available to raise the groundwater table of your village on this site.

Your village is guided through a variety of colors as to what type of artificial water recharge works are expected to be done in which area. With that, we can undertake the task of artificial water recharge.

Government Departments and Symbols:

Exercise

1. What are the methods of water conservation?
2. Explain the need of water recharge in brief.
3. Explain the importance of suction pits in the process of water recharge.
4. What care should be taken while recharging a well or borewell ?
5. Explain with reason the most useful method of water filtration in your area.

Unit 3 : Water Management

Chapter 1 : Water is the basis of life

Water and living things:

The earth is described as 'Bahuratna Vasundhara'. Water is one of the most important natural resources among the many gems on earth. All living things on earth are made of water. The source of life for plants and animals is water. From ancient times the development of human beings can be seen in the places where water is available, i.e. rivers and reservoirs. History tells us that the ancient cultures of Mesopotamia, Egypt, and Harappa were formed on the banks of rivers. Therefore, careful use of water is very important and it is the responsibility of all of us.

3.1.1 Concept picture - Earth

3.1.2 Some examples of water scarcity

Water scarcity in Maharashtra :

According to the Falcon criteria, the region is considered to be in good water condition only if more than 1700 cubic meters of water is available per capita per year. If the annual per capita availability of water is less than 1000 cubic meters, then the scarcity of water adversely affects the living standard of the people. If the per capita annual availability of this water is less than 500 cubic meters, it is also a problem for the animals. Considering the present state of Maharashtra, only 788 cubic meters of water per capita per year is available for consumption, so our state is a region of water scarcity. If the availability of water is reduced to such an extent of 500 cubic meters, it will fit into a very difficult for human life.

Drought man-made or natural?

Maharashtra has been suffering from drought for thousands of years. Even today, there is a shortage of water everywhere. Maharashtra has sufficient rainfall as well as the number of dams. What is the reason for the shortage of drinking water despite the huge increase in the number of dams? On the one

hand there is a wet drought and on the other hand there is no water to drink. On the one hand, there are sugarcane plantations, and miraculous conditions like tankers in the same village. As per the total availability of water in Maharashtra, the need and the actual drought situation, the reasons for the disparity are natural or man-made?

Ground water abstraction/lifting :

In our country, farmers traditionally draw water from wells to irrigate their crops and irrigate the entire farmland.

3.1.3 Groundwater obstraction/lifting

So water is wasted and excessive use of water decreases groundwater level. Now, tube wells more than 400-500 feet deep are being dug and water is being pumped out of the ground. In our country, 65% of the water used for irrigation and 3% of the water used for domestic use is drawn from wells. Groundwater reserves are rapidly declining due to the depletion of such abdundant water for irrigation. Decreasing ground water levels is a matter of concern.

River system : dilapidation/be spoiled

Rivers are of paramount importance in every country. Many cities, industrial projects and factories are located on the banks of big rivers. As a result, a large amount of water has been polluted in the river. The health of the rivers has deteriorated due to sewage and waste from the factories. The springs of the rivers have been closed. The river has stopped flowing due to extreme ground water abstraction. It is imperative to revive such polluted rivers and improve their health.

Observe

Visit river, wells, tube wells and other reservoirs the surrounding and observe the status of water consumption. Also study the causes of pollution.

Exercise

1. Explain the relationship between water and living organisms.
2. How is water scarcity intensity divided according to Falcon criteria?
3. Give an example of unequal availability of water for use despite the same rainfall.
4. Why is groundwater depleted?
5. What is the relationship between river health and urbanization?

Unit 3 : Water Management

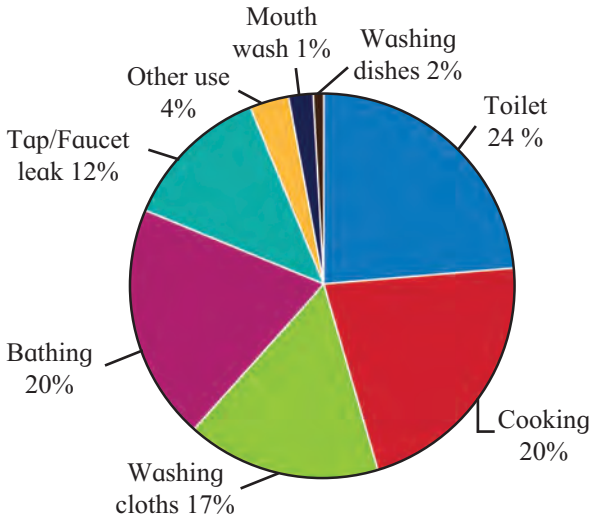
Chapter 2 : Our water consumption

Consumption of water

The water available on the Earth is used for many purposes. In this chapter we will learn more about water consumption.

Domestic water consumption :

In addition to drinking water, humans need water for cooking, bathing, washing clothes, washing cars, toilets use and cleaning, etc. The role of water is important from such basic human needs to industrial processes.



3.2.1 Domestic water consumption ratio

Water use for agricultural irrigation and industry :

Considering the factor of water in rural areas, the farmer is the center point of that factor. Crops are irrigated through the irrigation system. Economic development also depends on the availability of that water. Therefore, Water Use Organizations have been formed and water distribution has been done with the idea that water for agriculture should be properly managed, it should be managed and all farmers should get justice. Every crop needs water differently. Modern irrigation is done as per crop requirement

3.2.2 Water use for agriculture

according to the principle "water is needed for the crop, not for the whole land." There is a need to adopt a technological approach. Water is widely used for agro-based industries such as sugar factories, fruit processing and non-agricultural industries such as dams, roads, colonies, various factories etc.

Power Generatoin :

Many dams in the country generate electricity. The water from the dam is used for

3.2.3 Koyna dam

hydroelectric power generation. The water flow in the dam is released rapidly from the height, so the generator rotates and electricity is generated. In Maharashtra there are hydroelectric power generation projects like Koyna, Pophali, Bhira, Bhivapuri, Khopoli, Warna, Vaitarna etc.

Fishing and fisheries :

Fishing is practiced extensively in seas, creeks, dams, rivers, lakes and various reservoirs.

3.2.4 Fishing and Fisheries

The business generates huge financial turnover on the coast as well as in many port areas. In Maharashtra, fishing is done by producing fish seeds/eggs in small and big dams. Also, as a supplementary business to agriculture, fish farming is practiced in farm puddle/lake/pond and small ponds. It is generating huge economic output.

Shipping :

Today there are many options available for transportation. In this the cheapest option is shipping. There are some major shipping ports in India. E.g. Kandla, Mumbai, Cochin, Visakhapatnam, Chennai etc. The North Atlantic, Suez Canal, Panama Canal are the major waterways of the world.

3.2.5 Shipping launch

Tourism business :

Tourism in India is important for the country's economy. So it is important for the tourist to have other facilities including water in that place.

3.2.6 Tourist places

Sanitation, all amenities, attractive gardens, swimming pools, accommodation and, most importantly, abundance of water are important tourist destination. Musical fountains of water can be seen in tourist places. In Maharashtra, Aurangabad - Jayakwadi project, Dnyaneshwar Udyan in Paithan, Anand Sagar in Shegaon and in some other places artificial waterfalls a breathtaking view are developed. Many migratory birds from other countries come to the reservoir. E.g. Bharatpur, (Rajasthan), Ujani Dam - Reservoir (Maharashtra)

Water for environmental protection :

All living organisms need water to drink, as well as crops, forests and various plants also need water. Soil and rock formations are also affected by water. After all, there is no life without water. Water alone maintains the balance of all the organic-inorganic elements in nature and water helps to protect the food chains in nature including plants, animals, birds, insects.

3.2.7 Environmental imbalance

Try this:

1. Make a table of how many liters of water normally consumes per day by a person.
2. Make a list of differences between use of water in urban and rural areas.

Exercise

1. State the total types of water consumption.
2. How do we use water for domestic purposes?
3. How water is used for agriculture?
4. Which area needs maximum water?
5. Explain the relationship between environmental protection and water.
6. State the commercial uses of water.

Unit 3 : Water Management

Chapter 3 : The journey of water : Dam to house

Water is supplied through water taps, pipes in urban areas. Even when tap water is not available in summer, water is supplied using tankers. So many of us would love to know how this water reaches us from the dam and what processes are done on it.

Sources of the water

The existence of water on the planet Earth is one of the most important miracles in the universe. About 71% of the Earth surface is covered by water. There are many sources of water on earth. The journey of rain water on the earth is mainly after it rains and this journey, depending on the local geographical conditions. The journey of rain water is as per following way mountainhead-brooklets-springs, streams, runnels-rivers to wells, borewells, seas, oceans.

Dams, check dams, lake

Many rivers have small and large capacity dams. There are approximately 45000 large dams in the world. Of that, 22,000 are in China. There are 4200 dams built in India. Maharashtra has 40 of the largest dams in India. In addition, there are many types of lakes useful for rainwater store. Some of these are made naturally, while many are man-made. The purpose is to retain water for use after monsoon.

3.3.1 Dam

The location of the dam is determined by considering the right catchment area/watershed area, at the right place. Water requirement, rainfall and watershed capacity are also taken into account. Water supply start after completion of the dam and development of all water distribution and utilization systems.

Dam to Water Treatment Plant/Water purification center

Water is first brought to the water treatment plant through dams using energy or using slope.

Canal: A canal is a channel constructed to carry water or to supply water from dam to the desire location.

Sub-canals: A sub-canal is a canal built to carry water or supply water to a farm by connecting it to a main canal.

3.3.2 Canal

During monsoons, water from brooklets (Ohol), runnels (Nale), rivulets (Odhe), streams and rivers is stored in the dam. As it flows over different land surfaces, it contains many kinds of impurities. Therefore, water from natural water sources is not always drinkable. The place where various processes are carried out to make the water drinkable which stored in the dam is called a water purification center/water treatment plant.

Water lifting station (उपादान/उपसा केंद्र).....

The construction which is done to take out water from rivers, streams, canals, ponds, reservoirs, etc. for purification is called water lifting station. Depending on the location of the water source, different methods have to be constructed for water lifting station. The method of water lifting station construction on the river is different from the method of water lifting station construction on the reservoir. Also the water lifting station on the canal is different. Water is discharged from the water lifting station tower through a tap in a small well. The water is pumped out of the well and sent for purification. Generally, the water treatment plant is far away from the water lifting station. So to send the water taken out of the water lifting station to the treatment plant, a water transmission system has to be considered. A pump or sloped ground (if possible) is used to carry the water. While choosing a site following factors are considered, (1) The properties of water should not be affected, (2) water distribution system should be simplified, (3) availability of electricity or similar energy, (4) safety from crises like flood, fire etc. Similarly, it is important to decide the type of pump to use. Although low cost is the main principle, it should also be seen that there should be reliable working pumps. Normally more pumps are kept than required. This means that even if there is a breakdown or malfunction, the water supply can be maintained without disturbing the work.

3.3.3 Upadaan

Water supply planning -

The following methods are adopted while planning the water supply of large cities. (1) Selecting the source of water by getting basic information about water supply. When choosing a source, it is important to check the quantity and properties of the water. (2) Estimating the future population and determining the total demand for water per person per day. This should include the demand for water for industry and firefighting. (3) Observing and measuring the entire city, its water source and its catchment area and taking notice of all landforms. (4) To think how to bring water from the place of origin to the place of purification. (5) Determining the purification process by checking the properties of the water and determining the locations and levels of the components of this process by making an illustrated plan. Arrangement for storage of water after purification and transport to storage tanks. (6) To plan for collection tanks and pipelines to be used for water distribution and to determine the pressure in it.

After considering more than one alternative plan for all the above factors, their cost is determined, and a plan that is least costly and acceptable is chosen. In this way, when the plan is ready, the technical inspection has to be done by the governmental department. If the scheme is very large, all of the above can be done by the public health department of the state government. The first phase water supply scheme is planned in such a way that a second and third phase can be added at any time. Therefore, if it becomes difficult to get the financial support required for the entire scheme at once, it can be increased as the finance is available.

Cities usually have to fetch water from far distances as they require more water. Mumbai has to fetch water from distant lakes like Tansa-Vaitarna etc.

3.3.5 Water tank

Cities that are close to the seashore (e.g., Mumbai, Chennai, Calcutta, etc.) no longer have a choice but to supply water by distilling seawater in case of water shortage. Currently, such cities have to rely on distant lakes. As these cities are ports, their population and industries are increasing. Therefore, more attention has to be paid to the water supply of such cities.

What is water purification ?

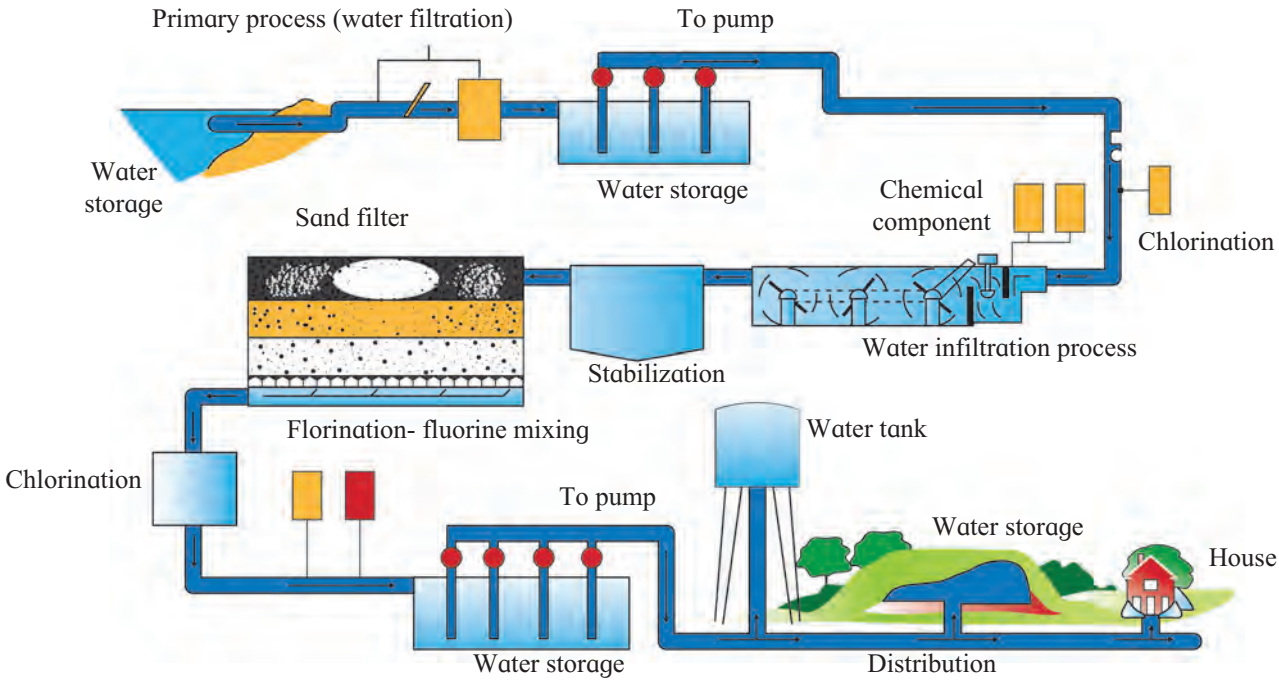
The extent to which the water is purified depends on its use. E.g. water for domestic use should be colorless, odorless, good in taste and hygienically safe. Water for industrial use should not contain substances that adversely affect the production system and spoil the finished product. Water used for agriculture should not contain substances that are harmful to soil and crops. Reservoir water contains a wide variety of minerals, carbon compounds, salts, larvae, microorganisms, viruses, various plants, etc. These substances are soluble or suspended (hanging). This can lead to contamination of water and spread of many diseases. Also, this water is used in various factories. To produce good products, water of certain quality is required. So water purification is very much essential. Chemicals in water have adverse effects on the body. Water with high levels of fluoride adversely affects the teeth of young children. For all these reasons, water is purified to make it as clean, healthy and drinkable as possible.

3.3.6 Water Purification centre

Process of water purification -

At the water treatment plant, it is churned after mixing chemicals. The water is filtered after the sludge settles down. To remove unwanted gases (CO_2, H_2S), substances that give water a foul and unpleasant taste, water volatile substances (eg. chloroform) and reduced compounds of iron and manganese in water, aeration is carried out. This process is mainly used to purify groundwater. This process is also used to increase the amount of dissolved oxygen in groundwater. Removal of carbon dioxide from water reduces the amount of metal corrosion in contact with water. It is then purified using disinfectant. The quality of purified water is tested by various tests. This pure water is stored in storage tanks mounted at high altitudes. These tanks are used to reach every house through main aqueduct, sub-aqueduct, plumbing.

As the rivers flow through the cities like Delhi, Ahmedabad, Kanpur, Solapur, Pune in the interior of the country, the source of water is the river and the dam on it, but due to the possibility of discharge of dirt and sewage in the same river, care must be taken while locating the water lifting station. It is also important to take proper care of disinfection. Such cities are also more likely to get water by digging wells.



3.3.7 Process of Water purification

Maintenance Management:

The responsibility of the water supply system is usually with the government till the completion of construction as per the cost of the scheme. But after completion of all the work it is handed over to the gram panchayat, municipality or corporation. In this system, it is more difficult to manage the water supply of a big city than a small village. The management includes maintenance of various machines and instruments used. Eg. repairing a broken faucet or leaking pipelines, delivering the water with the right amount of pressure everywhere. Every day it is necessary to examine the water coming from the source, the water coming out of the sedimentation tanks and filters, and the water available for direct drinking at all such stages, to ensure that the purification process is carried out properly. It is also important to check whether all the chemicals are being applied properly and whether the stock of chlorine and coagulants is adequate. Because it is important to be aware that, if there are not enough stocks, people's health is likely to be endangered until they are available. Also, at least one standby machine, pump etc.must be ready. They are used when a faulty device or pump is being repaired. It is the job of the chief manager to get the pump driver, chemist, mechanic, technician to do the job properly. There should be a laboratory near the water purification center in the city so that there is a possibility of experimenting with new types of discoveries or doing some new basic research.

Try this:

Visit the nearest water treatment plant/ water purification plant and observe the purification process.

Exercise

1. Describe the stages of water flow from the dam to the house
2. What is water purification?
3. Briefly describe the process of water purification.
4. How is the water purification project maintenance system works?

Unit 3 : Water Management

Chapter 4: What is water management?

What is management?

Take an example of a small family. While running a family, tasks need to be shared according to the needs, income, arrangements and strengths of each member. Now, just as it is possible for a big or small family, to live in an environment where the needs and incomes are more or less dependent on the environment, it is necessary to make arrangements accordingly. The key to ensuring a happy family life is the habit of keeping the needs to a minimum, a disciplined effort for a sufficient income, adequate education to carry out one's role properly and then honest work on it. But if family members have no idea about the total household income, will they limit their needs? Won't all planning go wrong? If the management is required, good, then the habit of keeping inward and outward accounts is important.

Management is important in everyone's life. Management is the condition available to complete the task, action, planned use of the convenience, human and material resources etc. Water use is an integral part of daily life. So everyone needs to know about water management and its importance.

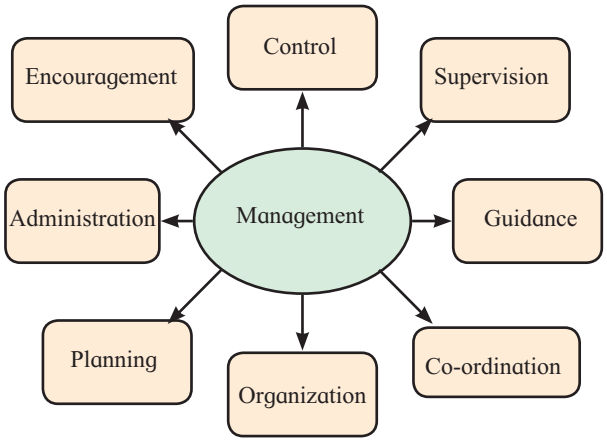
Observe and discuss.

Consider the concept of management and note the highlights of your day-to-day dealings.

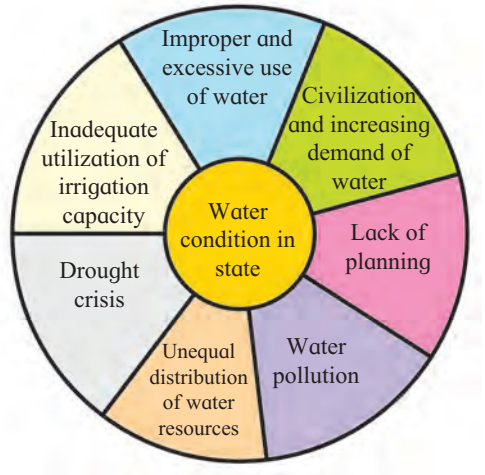
The need of water management

Considering this element of water from ancient times till now, many changes have taken place in its use. Man in the early days was using water for drinking and to fulfill his own needs. After the discovery of agriculture, he started using water for agriculture. After the Industrial Revolution the use of water for industry and other ancillary businesses increased. The policy of storing water from small and big dams on the river has been adopted, which has resulted in the availability of some amount of water. But with the increasing appetite for human development in the modern era, these natural resources have been greatly depleted and now the condition of water supply in the world as a whole is becoming more and more worrisome.

The coming period will be difficult considering the overall situation of population growth, living standards and agricultural practices. The water problem is one of the



3.4.1 Management a mechanism



3.4.2 Challenges facing Maharashtra

biggest problems facing the world. Unfortunately, this issue is still not taken seriously. Water management is the policy of allocating water on the principle of equal justice for all, taking into account all the problems in the three areas of drinking water for a certain population, water for agriculture and water for industry.

How will be the water management ?

For this, it is necessary to calculate the total need of your water use, the exact availability of water and the actual use of water. If this calculation goes wrong, there will be a problem of equitable water distribution due to lack of planning despite water availability. The situation in the state is getting more serious day by day and further measures are needed to reduce the severity of the problem.

3.4.3 Water management in ancient period

1. **Water Conservation :** It is considered as a permanent solution to the drought situation. Water conservation through water can resolve the water problem permanently. Every drop of rain can be used if water conservation works are carried out in different parts of the state. If the policy of recharging of wells, deepening and widening of runnels (nallas), diversion of water using small dams in some places is implemented, the problem of water can be resolved permanently.

3.4.4 Water conservation

2. **Groundwater Recharge:** Groundwater recharge not only increases the ground water level but also allows proper use of rainwater. The government, NGOs and all of us need to take the initiative to recharge the wells and tube wells to effectively increase the groundwater level.

3.4.5 Recharge of tube well

3. **To stop water pollution :** Citizens should not perform rituals in rivers, streams, springs, wells, tube wells etc. or in the flow of drinking water and should not immerse the objects obtained through it. Water should be used sparingly. Disposal of substances like waste discharged from factories , hazardous chemicals, hazardous liquids, sewage etc. should be done in such a way that it does not harm the environment. Polluted water should be treated and reused.

3.4.6 Water pollution

4. Economical use of water in agriculture: Drip irrigation, sprinkler irrigation, micro irrigation methods should be adopted to avoid wastage of water in agriculture. For this, along with orchards, government subsidy of 75% to 100 % of the cost should be provided to the farmers for drip irrigation, sprinkler irrigation and micro irrigation as per the requirement of all types of crops. Use vegetative or polythene cover around the fruit trees to prevent wastage of water through evaporation. Also, in times of scarcity, the number of branches and leaves of the tree should be limited so that orchards will be able to withstand less water as evaporation decreases.

3.4.7 Sprinkler irrigation and drip irrigation

5. Enhancing Public Participation: Due to lack of public participation, despite spending thousands of crores of rupees on irrigation, there has not been much progress in irrigation resources and irrigation sector in the state. It is essential to increase public participation in all these projects by emphasizing and raising awareness about the importance of water conservation,

3.4.8 Public participation for water management

benefit area development, groundwater recharge, farms, puddles/ponds seepage ponds, etc. Only then will water be used properly, economically and in a planned manner. For this, it is necessary to create awareness on a large scale through newspapers, radio and television. Along with this, there is a need to launch a campaign like Tanker Mukti (freedom from tankers) and Jalsamriddh Gram (water rich villages) on the lines of Sant Gadgebaba Gram Swachhta (cleaning villages) and Hagandari Mukta (Free of open defecation) Abhiyan .

6. Sewage Recycling : Sewage can be recycled by processing it in the same way as paper, plastic, metal. About 21% (13.7 TMC) of the water available in Israel comes from wastewater and wastewater recycling. This water is used for agriculture. In the same way, it is possible to recycle water from the state, urban areas as well as from industrial use, but for this, the

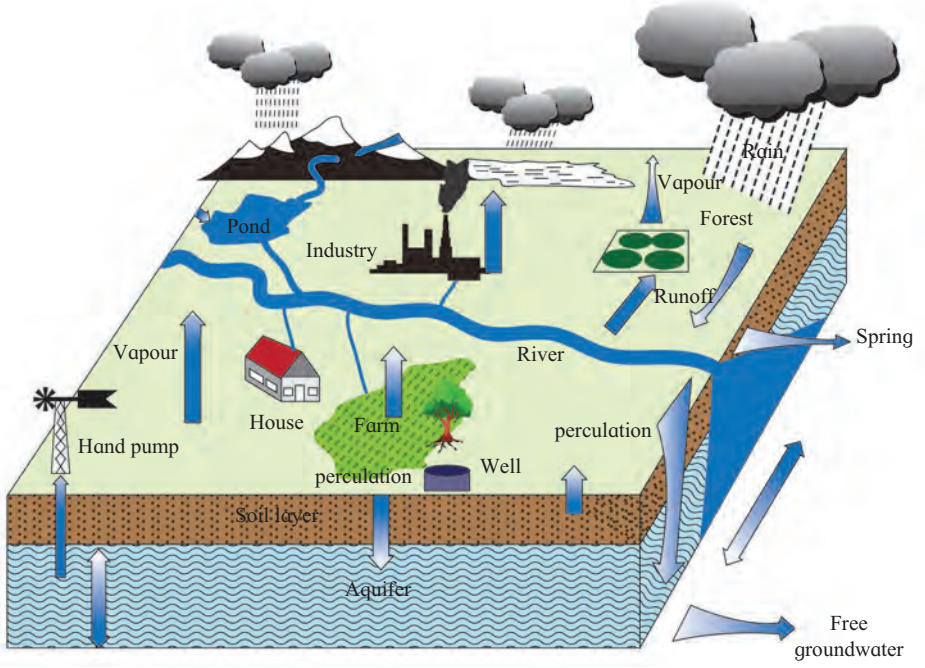
3.4.9 Sewage purification project

government and local self-governing bodies need to set up a competent system.

7. **Full utilization of irrigation capacity:** In order to make full use of the constructed capacity of all the developed projects in the storage capacity of the state, it is necessary to reduce the gap between the constructed irrigation capacity and the actual irrigated area by giving priority to the incomplete works of canals and distribution. Apart from this, if the obligation to complete the irrigation project within the stipulated time is imposed on the contractors, the concerned contractor should be fined and his license should be revoked if necessary. Apart from this, instead of discharging water from reservoirs into river basins on rainy days, it should be stored in canals through ponds, percolation tanks / ponds, small and medium irrigation projects for water scarcity. Water is released from the dam into the main canal. At that time, thousands of liters of water from the main canal flows into the soil on both sides and from the bottom. The main canals and sub-canals need to be well cemented to prevent water infiltration. Timely maintenance of canals and sub-canals can prevent wastage of water. If cement pipe or iron pipe is used instead of canals and sub-canals, large wastage of water due to stagnation is stoped. Automatic gates should be installed to prevent wastage of water at the time of opening and closing of gates of canals and sub-canals, thus saving water.

8. **Water audit:** In order to use water carefully, tap water meters should be installed in urban areas and water bills should be charged according to meters so that people can use water carefully like electricity. Also, higher water users should be taxed at a higher rate and wastewater treatment systems should be set up from the available funds. Apart from this, water audit should be made mandatory for all irrigation projects and water supply agencies should be provided with cubic meter measuring devices, so that water can be used carefully.

9. **Water literacy:** Considering the availability and need of water, the knowledge and actual action to use the water available in the area carefully and properly can be called water literacy. Now this needs to be a mentality in the society that, saving water is the greatest asset. Because only a water literate society can take a leap towards development in the



3.4.10 Water plan (source, uses, etc)

future. But for that, along with the government, NGOs, media, various organizations and associations need to take steps towards water literacy.

10. **At the domestic level:** Water saving needs to be done collectively as well as at individual level. It needs to be done from your own home. By saving the water in our daily work, we can help to reduce the water scarcity crisis in the country / states. Now days adopting some easy ways to save water at home is needed. Take a small amount of drinking water in a glass / as per need, it save water. Water the garden or field before sunrise and after sunset to reduce water evaporation and save water. Sewage water should be used for garden plants. When washing, vegetables, fruits take water in a bucket and do not wash them under the tap, it save water. In the morning, while washing your face avoid wastage of water. While shaving, using a mug instead of running tap water saves a lot of water. Take a bath with a bucket of water. Do not use a shower or running tap. When washing utensils, take water in a bucket and wash it. Don't wash utensils under the faucet. The tiles and stairs in the house, bikes, cars should not be washed with water, wipe them with a damp cloth. The water tank in the house often overflows, an automatic switch off mechanism must be fitted there. Use water carefully and encourage others to do the same.

Try this:

1. List the ways in which we can save water in the home and the society.
2. Make rules to save water and put it in the front of the home and society.
3. If you see a leaking pipe or a broken pipeline in a public place, immediately bring it to the notice of elders and try to fix it.

Observe

1. Write briefly few incidents of water wastage in your area ?
2. What are the habits to be adopted to avoid wastage of water in the house?
3. How water can save in society/ residential colony?

Exercise

1. What is management explain with an example.
2. Explain the need for water management.
3. What are the problems encountered in water management?
4. What are the important activities for water management?
5. How to save water in rural and urban areas?

Unit 4 : Water Quality

Chapter 1 : Water Quality and Criteria

Water quality

We have a glass of water in front of us. Can we say for sure if it is drinkable or not? The answer is 'no'. It may contain metals, salts, chemicals or some organic matter. Some of these are visible and some are invisible. Some of them change color, taste and smell of water. If it is visible to the eye, it is easy to estimate the quality of the water. But if they are not visible, then the quality cannot be checked by looking at the water alone.

What exactly is water quality?

Water quality depends on the percentage of dissolved physical and chemical substances in the water. Water quality is considered to be degraded when these substances are mixed in more than a certain amount of water. Water quality does not need to be the same for all uses (such as water used for agriculture, factory, drinking water). Since man is a sensitive animal, the quality of water he needs should be higher. Like that plants and land also needs pure water. Polluted water spreads the contamination to grains and vegetables, and as human use these, eventually humans will be harmed by it. Water supplied to the machines can be used even though it is of comparatively low quality. The wastewater from the city of Nagpur is purified and used to keep the machinery cool at the 'Koradi power plant' in Nagpur. This use is called water recycling. Reuse of the same water naturally reduces the demand for water.

Quality water is useful for the proper growth of human beings, animals and plants. It is unfortunate that approximately 29% of the world's population today does not have access to safe drinking water. Consumption of such water leads to various ailments. Water quality can be enhanced by natural and chemical action.

How does water get polluted?

Water is polluted both by nature and humans. We get water because of rain. We have already understood how it rains through the water cycle. Due to heat the sea water evaporate, forming clouds of vapor, which are turned to land due to the wind and rain falls. This rain water is pure. But when this water travels from the highlands to the plane grounds, it keeps coming in contact with various objects. Water keeps accepting good and equally bad things. This can lead to pollution. Not only that, when it seeps in the ground, it goes through soil, loam, rocks. They contain traces of minerals, salts and chemicals. In Bangladesh and in our country, some regions like Kokan, arsenic has found in large quantity in the soil. As arsenic is a toxic chemical. So when this water is taken out of the ground and used for drinking without purifying it, it goes into the human body and he has to suffer the consequences.

Like nature, human are also responsible for increasing water pollution. Water pollution has also been exacerbated by domestic sewage, water contaminated by chemical fertilizers and pesticides, and water containing a mixture of chemicals and minerals from factories. We get water from three sources namely rivers, lakes and ground. Of these, the river water flows and is oxygenated, and most of the water is pure, but the stagnant lake water and groundwater do not have such a process, so it is difficult to remove the pollution.

In our country, sewage generated in homes, farms and factories is discharged into the drains without being treated. These runnels flow into the river. As a result, all the rivers in our country are polluted. Bathing in the

water of some rivers can have adverse effects on your body. Water resources are already limited and if there is pollution, the availability of water is further reduced. For example, Powai Lake in Mumbai- despite having such a large reservoir in the center of the city, its water is polluted and cannot be used for drinking. So we have to fetch water from a distance of more than 100 km.

Water is always classified into surface water and groundwater. If surface water is to be purified, it can be easily purified. But if unclean/polluted water seeps into the ground, it is extremely difficult to purify it. So seepage of this unclean/polluted water into the ground must not be there. We always have to be aware of that.

Water quality Important concepts

pH (Potential of Hydrogen) of water :

Depending on the amount of acidic or alkaline substances mixed in the water, we have a measure of pH. Universal indicator is use for measurement of pH.

The numbers of 0 to 14 on the given scale are indicated by different coloured marks. It indicate the amount of acidic substances decreases from 0 to 7 and increases alkaline substances from 7 to 14 and 7 number indicates neutral pH e.g. Rainwater. Running water pH levels are generally 6.5 to 8.5.

Groundwater pH levels, however, range from 6.0 to 8.5. The higher the level of ions of iron, manganese, copper, lead, zinc in the water, that water is more acidic in nature. Such water causes rust on metals, stains on clothes, its consumption harms human health. Conversely, an increase in calcium carbonate leads to an increase in salinity.

pH of some substances are as follows :

Apple Juice : 3
Orange Juice : 3.5
Coffee : 5.5
Milk : 6.2
Soap Water : 10
Solution of bleaching powder : 12

Disolved Oxygen :

The most important factor in water quality is the dissolved oxygen in the water. Fish and other living things in water need oxygen to survive. Due to the movement of air, oxygen enters from the surface of the water and exists in a dissolved state. Oxygen formed during the photosynthesis process of aquatic plants, in wetlands or in mud is also soluble in water. This oxygen is useful for fish and other living things to breathe. The amount of oxygen in flowing and turbulent water of streams or rivers is higher than that of stagnant lake water. This dissolution continues until saturation occurs.

There is a correlation between the temperature of water and the dissolved oxygen. It is lower in hot water and higher in cold water. The amount of dissolved oxygen can be increased by creating artificial turbulence in the water or by exposing the oxygen to the water. In short, the amount of dissolved oxygen depends on temperature, air pressure, and salinity of the water. The oxygen level is higher on the surface of the water, it lowers as you go deep into the water. The reason for this is that the amount of oxygen naturally decreases as the aquatic life uses it.

Biological Oxygen Demand (B.O.D.) :

The bacteria that maintain the quality of the water must get the required amount of oxygen dissolved in water. If it is reduced, the bacteria will not be able to survive. Nature is constantly supplying oxygen to the flowing water. When water and oxygen come in contact, the oxygen dissolves in it. Standards have been set for how much it should be.

If this amount is 1 to 2 mg per liter, then water is considered to be very good.

It is considered satisfactory if it is 3 to 5 mg. If it is 6 to 9 mg, it is considered to contain polluting organic matter. As the proportion increases, so does the pollution.

BOD levels of water required for agriculture and industry are also higher.

Chemical Oxygen Demand (C.O.D.) :

The chemical oxygen requirement of water is examined from the point of view of checking the efficiency of the sewage treatment plant. If the COD of water is high, it is considered to be harmful to aquatic organisms. If more organic matter is dissolved in water, then COD is higher. A mechanism is set up to reduce it. With the help of this system, it is beneficial to reduce the COD in the wastewater and then dump it in the river. Most cities do not have such systems. That is why the rivers of our country are found to be in the grip of pollution. COD in water should not exceed 250 mg per liter.

Is it must the Rainwater Be Pure?

Rainwater is pure because the water evaporates due to heat, creating clouds and water droplets. In the past, distilled water was needed for injections. For fulfilling this need of water they collect the rain water in rainy days and consider that the water is pure.

But one thing is not taken into consideration. When it starts to rain, the water droplets travel from the clouds to the ground. It is also important to consider how clean is the air in the atmosphere. Soil particles in the air, microscopic chemicals contained in the smoke are polluting these raindrops and when this drop falls on the ground, there is no guarantee that the water in it will be pure. In Dombivali, an industrial estate in Mumbai's suburbs, has received green rain. When this was studied, it was found that there were some chemical industries in this colony, the chemicals were released in the form of vapor in the air. It affected the rain and the raindrops turned green.

When there is first rainfall in Pune, it's pH is 4 to 6. For this reason, when the roof water is used for recharge, it is said that the first rain water should not seep into the ground.

Do you know

Experiment of New Water in Singapore :

Singapore is considered to be one of the most advanced nations in the world. The water problem of this country is very acute. Despite the good rains, the problem is compounded by the fact that there are very few dams, rivers and streams in the country and there is not enough space to store water. Therefore, this country imports water from Malaysia to solve the water problem. Water is imported through a long-term agreement with that country. But the country is in a crisis of high demand and limited supply. With a lot of research, this country has come up with the right answer to the question. For this, they used two ways. The first way is to desalinate seawater. Seawater is made potable by setting up big factories. In this way they complete country's 35 % need of water.

In spite of this, unable to fulfill the demand, they did another experiment. The wastewater generated in the cities is purified to such an extent, that it is also used for drinking. For this 47 different tests are done and only then the water is used. This water is called New Water. Initially, the public strongly opposed to use this water. But through government efforts and with the help of media, they were convinced that the water was pure. Now the fears in the minds of the people have completely disappeared and it is being used for drinking water. In this way 35% need completed. Gradually, the water supply will be increased to such an extent that the country will not even have to import water from Malaysia.

Let's Tell

If you decide to reuse wastewater from your town or village, write down the plan for uses of that water.

When considering water quality, one has to consider the purpose for which the water will be used. Water is used for various purposes like drinking, domestic use, swimming, agriculture, industries etc. Accordingly the required quality of water changes. The amount of physical, chemical and biological elements in water is the quality of water. Water is a universal solvent. Water has the capacity to absorb and dissolve as many components as possible. According to the standards set by the Indian Standards Organization (ISO) for drinking water quality, water is said to be contaminated if one or more components are found to exceed the ceiling. This contaminated water is detrimental to the proper growth of living organisms i.e. humans, animals and plants. Groundwater quality is being affected by the increase in total population, changing lifestyles, increasing use of groundwater in rural and urban areas, as well as the use of factories and their wastewater, agriculture and its fertilizers and pesticides.

4.1.1 Water Testing

Although the taste, smell, color and cleanliness of water are all indicators of water quality, to determine its safety for drinking, it is necessary to carry out physical, chemical and biological testing of drinking water. Turbidity caused by small sand or mud particles in the water and odor caused by substances like hydrogen sulfide can affect the acceptability of water. All these offensive elements are reduced when water is filtered properly. When water comes in contact with clean air and sunlight the odor is reduced

Following things are necessary to make water drinkable :

1. The water should be good in taste. It should not be brackish, salty or oily.
2. It should be crystal clear, colorless and transparent (showing bottom).
3. The water should not have odor, no algae or oily layer.
4. Harmful chemicals should not be overdosed or not at all.
5. It should not contain harmful bacteria or viruses.
6. The pH of water should be 6.5 to 8.5.
7. Water should be stored in a clean, covered and convenient container.

4.1.2 Water quality testing machine

Our body definitely needs certain amounts of elements like iron, calcium, magnesium. But if their amount in water increases, they can be dangerous to all living organisms including human beings. In addition, metals like arsenic, barium, cadmium, chromium, and lead from man-made substances can be dissolved in water .

Maximum limits of vital properties (or proportion of constituents) of water taken as per Indian standards (Central Public Health Engineering Code of Practice) given in chart.

Water Quality Standards

Water Components	Standards	Permisibile Value
pH of Water	6.5-8.5	8.5
Hardness of water ($CaCO_3$)	300 mg/liter	600 mg/liter
Chloride (Cl^-)	250 mg/liter	1000 mg/liter
Sulphate (SO_4^{2-})	200 mg/liter	400 mg/liter
Florides (F^-)	1.0 mg/liter	1.5 mg/liter
Nitrates (NO_3^-)	45 mg/liter	45 mg/liter
Calcium (Ca^{2+})	75 mg/liter	200 mg/liter
Iron (Fe^{2+})	0.3 mg/liter	0.3 mg/liter
Mangenese (Mn^{2+})	0.1 mg/liter	0.3 mg/liter
Copper (Cu^{2+})	0.05 mg/liter	1.5 mg/liter
Zink (Zn^{2+})	5.0 mg/liter	15 mg/liter
Arcenic (As^{3+}), Chromium (Cr^{2+}), Lead (Pb^{2+})	0.05 mg/liter	Not more than 0.05 mg/liter
Cadmium (Cd^{2+})	0.01 mg/liter	Not more than 0.01 mg/liter
Mercury (Hg^{2+})	0.001 mg/liter	Not more than 0.001 mg/liter
TDS	500 mg/liter	2000 mg/liter

Microbes - The highest probability index of Coliform species should be zero or less than one in 100 ml. Also the highest probability index of the total number of microorganisms in any sample should not be more than 10 in 100 ml. The maximum limits of these substances are mentioned. In addition, these standards should include maximum limits on the amount of viruses, asbestos and chlorinated carbonaceous substances.

The effects of harmful substances in water

Sr.No.	Substances	Consequences of crossing the limits
1.	Turbidity	Due to turbidity, there is room for growth of pathogens in the water. People will not use muddy water for drinking as it does not look attractive or clean.
2.	pH	If the concentration is less than 7 or more than 8.5, the biochemical activities/processes in the body are not carried out properly.
3.	Heaviness (due to salts)	It takes time to cook food, soap does not foam, stains on clothes and utensils, etc.
4.	Iron and manganese	In rare cases it can cause gastric ulcer.
5.	Chloride	More than 1000 mg per liter of chloride makes water salty and people do not use it for drinking. Also, chloride in water is an indicator of fecal contamination.
6.	Fluoride	If the fluoride level is less than 1 mg per liter, spots will appear on the teeth. Fluoride levels greater than 1.5 mg per liter cause bone diseases.
7.	Phosphate	Helps to grow of algae and other aquatic plants and water quality deteriorates.
8.	Nitrate	A life-threatening circulatory disease like 'Blue Baby'
9.	Arsenic	Arsenic poisoning can cause skin damage, muscle weakness, and prolonged drinking of this water can lead to skin or lung cancer.
10.	Bacteria and viruses	Diseases like typhoid, dysentery, diarrhea, cholera, jaundice, polio, scabies are caused by pathogenic bacteria and viruses in the water.
11.	Worms and germs	Diseases like stomach worms, malaria, filariasis etc. can be caused.

In short, water quality is a very important factor in water use. That is, water quality is also an important factor in determining water type associated with use. Roughly speaking, there are various types of water quality such as for drinking water for domestic use, water suitable for agriculture as well as water that can be used for factories. Of course, the quality of drinking water must be highest in all these.

Exercise

1. Explain the concept of : BOD and COD.
2. Get more information about the New Water experiment and present it to the class.
3. Write any four criteria for drinking water quality.
4. Briefly describe the consequences of exceeding the quality limit.
5. Write a definition of contaminated water.
6. With the help of elders in the house, check the quality of water coming into your house from the inspection center provided by the water supply department.
7. Inspect the pH of various water sources in the village or surrounding area.

Unit 4 : Water Quality

Chapter 2 : How to maintain the quality of water?

Let's Tell

What are the available sources of water?

The available sources of water can be stated as follows.

1. Running water in a river or canal, rivulet
2. Water in dam
3. Water from natural ponds
4. Groundwater

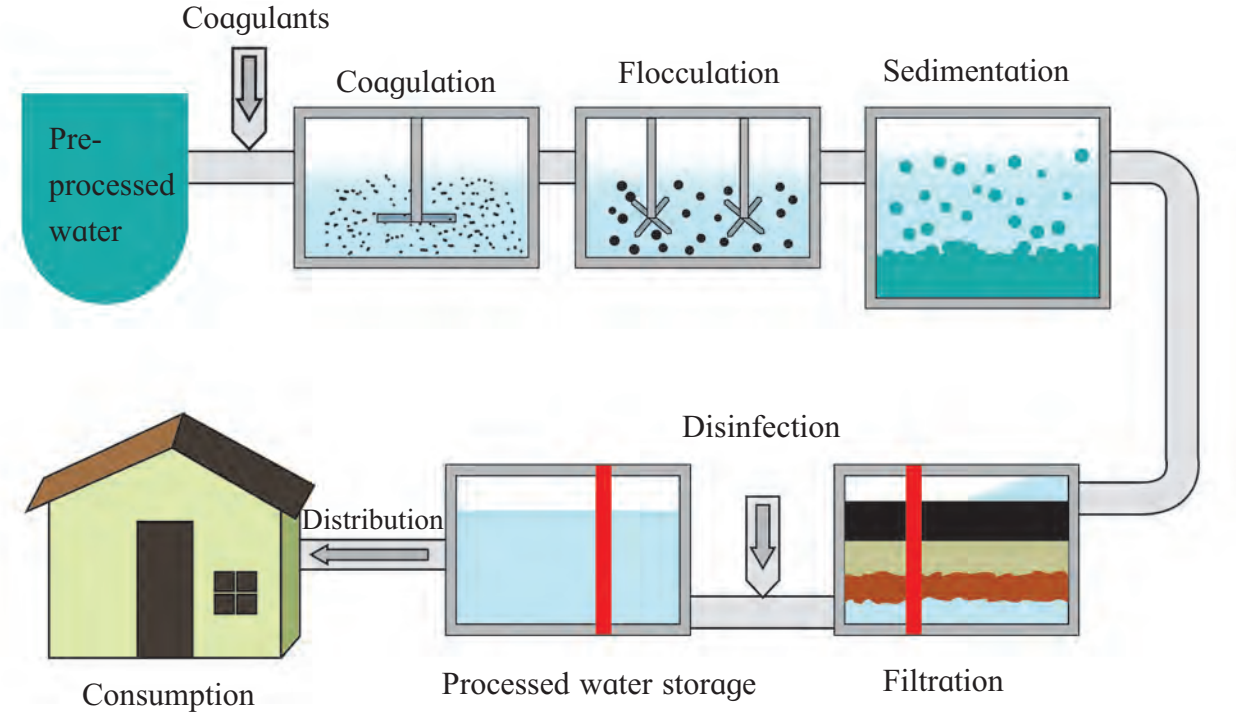
Many substances are mixed in the water available in nature. Eg. Before reaching the ground, rainwater mixes with solids such as dust, bacteria, pollen and gases like carbon dioxide, oxygen etc.

As it flows over the soil, the substances on it enter the water. Water which seeps into the soil, dissolves the organic and inorganic substances in the soil in it.

Maintain quality of water

Water is classified by considering all the factors. The water that comes to you is purified as follows.

1. Removing floating substances
2. Settling down the sludge
3. Softening the water if necessary
4. Filtration
5. Sterilize with chlorine gas.

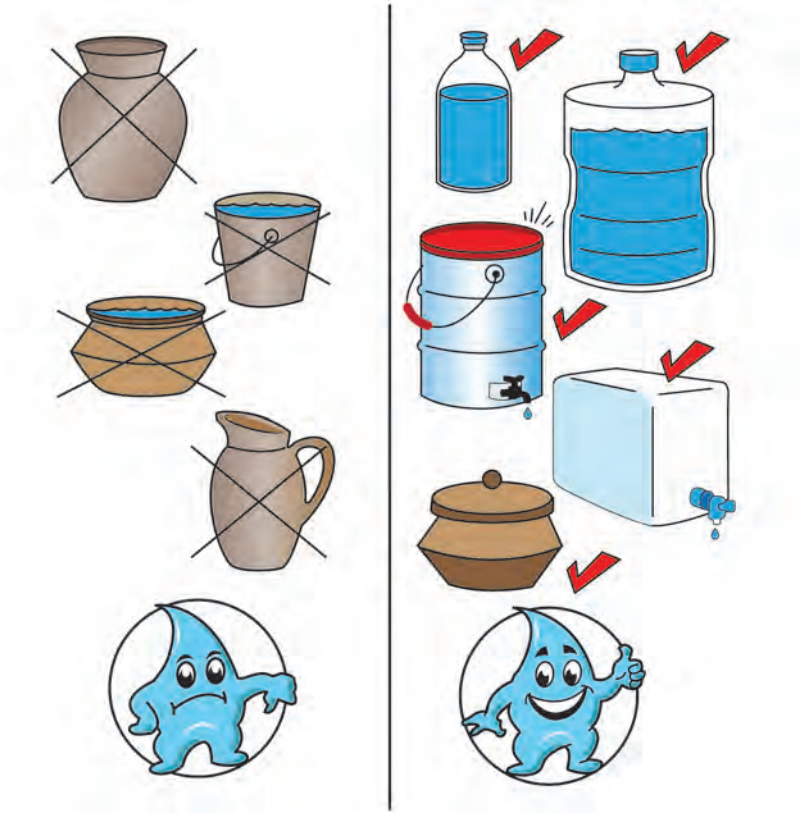


4.2.1 Purification of water

Clear-looking water can contain invisible pathogens. Water can be contaminated by bacteria, germs and viruses. Drinking contaminated water can cause different diseases. Diseases like typhoid, cholera, jaundice, dysentery, diarrhea, gastroenteritis are on the rise, so the water must be pure. For this, regular disinfection of water is essential. Chlorination is an easy way to disinfect. Chlorination in the form of bleaching powder is also done. This kills germs and viruses and makes pure water easily available. Bleaching powder (Also known as TCL powder) is manufactured by mixing chlorine gas in lime by machine. Fresh bleaching powder should contain more than 33% chlorine. To maintain this amount of chlorine, it is essential to keep bleaching powder in a sealed container, in a closed bag but in a dry place. If this type of care is not taken properly, the chlorine gas in the bleaching powder is released into the air over time and the disinfection power of the powder weakens.

Bleaching powder with no chlorine is inadvertently used for disinfection, but the expected purification does not take place. That is why O.T. test is to be done. [Orthotolidine (OT) test. The test needs to be done after a regular period. If the O.T. test is positive, well water or hand pump water purification has the expected benefit of such bleaching powder. However, special care has to be taken to maintain the quality of sterilized water from time to time and prevent water pollution.

After the supply of pure water to the houses, it is necessary to store that water properly. Proper handling of water stored at home level is essential. Failure to do so would affect the quality of the water and invite disease. Household storage utensils should be cleaned daily, must be kept in a clean place, on a high level out of reach of children. Stored water should be properly covered so that it is not contaminated by outside dust and debris.



4.2.2 Stock making of drinking water

Care should be taken not to touch pure water by hands as much as possible, for this use a water dispenser with a long rod. Never put the water pot in the ground. We see a pit dug in the ground and an earthen pot placed in it. They do this to keep the water cool. However, the water in such pots can be detrimental to health. If you use a glass for drinking water, it is not necessary to drink water by touching it to the mouth. It is necessary to get in the habit of drinking water without touching the glass to the mouth. This will save water by reducing the amount of glass washing each time and will make it easier to maintain purity.

Surface and groundwater areas are more likely to be polluted during monsoons. Outbreaks of epidemic diseases exacerbate during this time. Therefore, special care should be taken for disinfection on such days. In such cases, the amount of bleaching powder should be increased for disinfection. O.T. Tests must be done regularly.

Water is aerated, drained, disinfected to remove water color, odor, taste and all kinds of bacteria. Alum, ferric chloride, ferrous sulphate are used to coagulate or flocculate the suspended particles and clean the water effectively. Aeration is used to remove gases such as carbon dioxide, hydrogen sulfide and to increase the amount of dissolved oxygen in the water, as well as to separate the compounds of dissolved iron and manganese..

Exercise

1. Which steps are used in purification of water ?
2. How to maintain the quality of water?
3. Take turbid water and roll a piece of alum in it and observe the effect on the water.
4. Prepare slogans on the topic of 'pure drinking water for health'.

Unit 4 : Water Quality

Chapter 3 : Water pollution : Causes, Effects and Remedies

Humans have been using natural resources for various purposes. Considering the available natural resources, at present many problems are created in front of human beings.

Think about it

There are two forms of river in the picture. A river flowing through nature and a river flowing through human habitat. What is the difference between the two rivers? Discuss this. What do you think what is the reason for the change in the river?

4.3.1 Observe

Water pollution :

The natural quality of water changes directly and indirectly due to human action or other causes and water becomes unusable for any purpose. This is called water pollution.

Let's Tell

1. Where does your household waste water go?
2. In your village, where waste water is mixed, what substances are seen to have accumulated ?
3. Where do all these substances come from?

Water pollutants :

Water-pollutants are useless solid, liquid, gaseous wastes (harm to living things) that mix with natural water.

Sources of water pollutants :

Water pollution is caused by natural processes or human actions, are called source of water pollutant

1. Household discharge - water coming out of the safety tank, human urine in the urinals, bath water, Animal excrement.
2. Substances from industrial premises- Oil, grease released from washing vehicles mixed with water
3. Agricultural Factors - Pesticides or chemical fertilizers are given to the crops.

   These chemicals get mixed in the river due to the excess water given to the crops after application.
4. Sewage, minerals and chemical wastes coming out of the factory.
5. Sewage sludge and watershed sludge.
6. Hot water released after processing in a factory boiler.

Think about it

Check out the two scenes below. Make a list of things you need to do to prevent this from happening.

4.3.2 Water pollution

Observe above photograph : What are the possible consequences of this situation? Enter their information in the table below.

Factors Regarding Polluted Water	Change observed due to pollution
Drinking ability	
Colour	
Smell	
Fishes in the water	
Aquatic vegetation	
Minerals in the water	
Diseases caused due to water	
Effect on groundwater	

Internet my friend :

Get information about polluted rivers in the country from the internet.

Diseases caused by aquatic microorganisms:

Sr. no.	Pathogenic micro organisms in water	Disease caused
1	Entamoeba histolytica	Dysentery
2	Salmonella typhi	Typhoid
3	Vibrio cholerae	Cholera
4	Hepatitis (A, B, C, D, E)	Jaundice
5	Plasmodium species Through Anopheles mosquitoes (laying eggs on contaminated water)	Malaria

Do you know ?

We read news about river pollution everywhere, but there is a river called Umangot, about 95 km from Shillong, the capital of Meghalaya. This river is near a small town Doki in Meghalaya. This city is famous due to Umangot river. This city is near the border of Bangaladesh. This river originates from Doki, Darang and shenang village. The water of Umangot river is so clean, that the bottom of the river is visible. The vegetation at the bottom of the water is covered with stones, pebbles, etc. The water looks like glass. The reflection of the boat running on the water seems to be lying at the bottom of the river. The water of this river is rich in fish. The river is always cleaned and no pollution is allowed. A large number of tourists come to see the river. Tourists can take a boat tour of the river. However, keep in mind that if you pollute the river, you have to pay a fine.

Let's Tell

1. In what ways does sea pollution occur?
2. Is the intensity of pollution is higher on beach or in sea ?
3. Describe the accidents related to pollution in the sea.

Marine oil spills and environmental pollution :

There are mineral oil reserves in the sea and they are brought to the surface. In such cases oil spills in the sea due to human error. While oil is being traded from the Gulf to other countries, the ships crashed, and millions of tons of oil spill on seawater. When this oil reaches the coastal areas, it causes a lot of damage to the environment.

Do You Know ?

In August 2010, MSC Chitra and MV Khalija-3 collided in the Arabian Sea near Mumbai. The collision caused a huge oil spill in the sea. About 800 tones of oil spilled into the sea and spilled over a distance of 100 to 120 km off the coast.

Second incident happen in January 2017 near Kamraj port in Chennai. About 60 tons of oil spilled from the collision of the two ships.

Just Think

Oil spills caused by shipwrecks, spill over into coastal areas due to high tides and strong winds. All that time, there is a lot of damage to the aquatic life on the beach. It causes harm to Oysters those sticking to the rocks on the shore harm. Animals like crabs that live in burrows are die. They can't breathe because of the oil sticking to their bodies, so they die.

Oil spill also affects mangroves. The roots of the mangroves are on the ground. Once the oil coats on the roots, the biological breathing process by the roots stops and the mangroves dry up. Due to the oil layer on the leaves, the leaves turn yellow and then fall off. Birds are most affected. Their wings have a natural thin oil layer, so that water does not stick. But when the bird comes in contact with the spilled oil, the oil quickly penetrates into their wings which affects its function and making it impossible for it to fly. They become heavy and drown in the sea.

Internet my friend :

Find out information about the pollution caused by oil spills in the sea from the internet.

Water Reservoirs and their pollution :

Collect the information

1. Ask your grandparents about the lake in the village.
2. Is the water of the lake in the city or in the village drinkable? Be aware of this.

Lakes :

In the past, lakes existed according to the availability of water in each village. Some towns were famous for lakes. Today there are few lakes left in such villages or towns. Why would this have happened? You can see that the water in the village or in the city is contaminated by mixing with the sewage. In some religious occasions, people leave oil lamps, Idol immersion, Nirmalya immersion in the pool. The oil affects the eggs of the fishes. The eggs are destroyed. Also, some substances are added to fish as food. Their decomposition increases the amount of carbon dioxide in lake water, and affects aquatic life. Living things die because they do not get enough oxygen. The process of decomposition in water produces hydrogen sulfide gas which results in bad odor in the water. Increasing urbanization has led to the addition of waste to the lakes, reducing the size of the lakes. In some villages, the whole lakes themselves have been destroyed. Either buildings or grounds are seen there.

Collect the information

1. Make a chart of the number and names of lakes in different cities/towns of Maharashtra.
2. Find out the number of lakes that existed in the past and the number of lakes that exist now.

Wetlands :

Have you noticed that there are wetlands in various places around you? Observe the plants growing there. Observe the birds that come there. They have become extinct due to encroachment of structures on the wetlands and mixed sewage. A variety of birds are found in the wetlands. Wetlands are home to birds.

Do you know?

A conference was held on the importance of Ramsar, an urban wetland on the Caspian Sea in Iran. February 2 is celebrated as World Wetlands Day to promote the importance of wetlands in human life and protect them from pollution. The first day was celebrated in 1997.

The Central Government has issued laws and guidelines for the prevention and control of pollution. Some laws have been enacted for this purpose. Let us take a look at these laws.

Water (Pollution Prevention and Control) Act 1974 :

The Water Act has laid down some guidelines for determining water pollution and water quality values. It determines punitive action for water pollution or for non-compliance with these principles.

Features of Water Pollution Act :

1. Prevention and control of water pollution.
2. Water conservation or restoration.
3. Establishment of boards for prevention and control of water pollution.

Departments have been set up at the level of Central and State Governments for the implementation of this Act. The Central Pollution Control Board (PCB) and the State Pollution Control Board (SPCB) are responsible for controlling water pollution.

Functions of Maharashtra Pollution Control Board :

1. Planning of comprehensive programs for pollution prevention and control.
2. Inspection of sewage or industrial wastewater recycling reaction, waste disposal facilities.
3. Cooperation and promotion of ecofriendly programs like pollution control, reusing and recycling of waste materials.
4. Educate and guide new entrepreneurs by explaining appropriate technology and methods of pollution control.
5. To create awareness among the people for a clean and healthy environment as well as to address pollution related complaints.

Powers of Maharashtra Pollution Control Board :

1. Enforcement of Environment Act and Pollution Control Act.
2. Determining pollution standards and checking their compliance.
3. Monitoring and controlling all sources of pollution.
4. To fulfill the legal requirements by giving instructions within the prescribed period.
5. Resolving worrying cases violating pollution regulations.
6. To sue in a court of law in a matter of concern.

Exercise

1. If there is water pollution in your area, write a report and submit it to the class.
2. Write down the factors that cause water pollution.
3. Explain with the example how the oil spill in the sea harms the environment.
4. Prepare and present to the class what planning needs to be done at the village / city level to prevent water pollution caused by sewage in your village or city.

Notes

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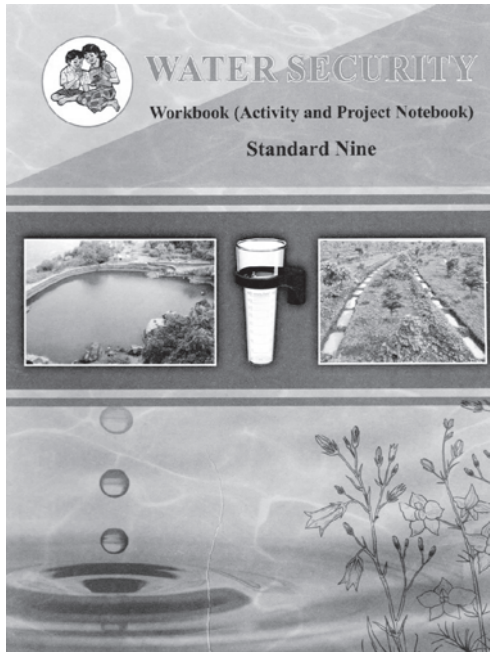

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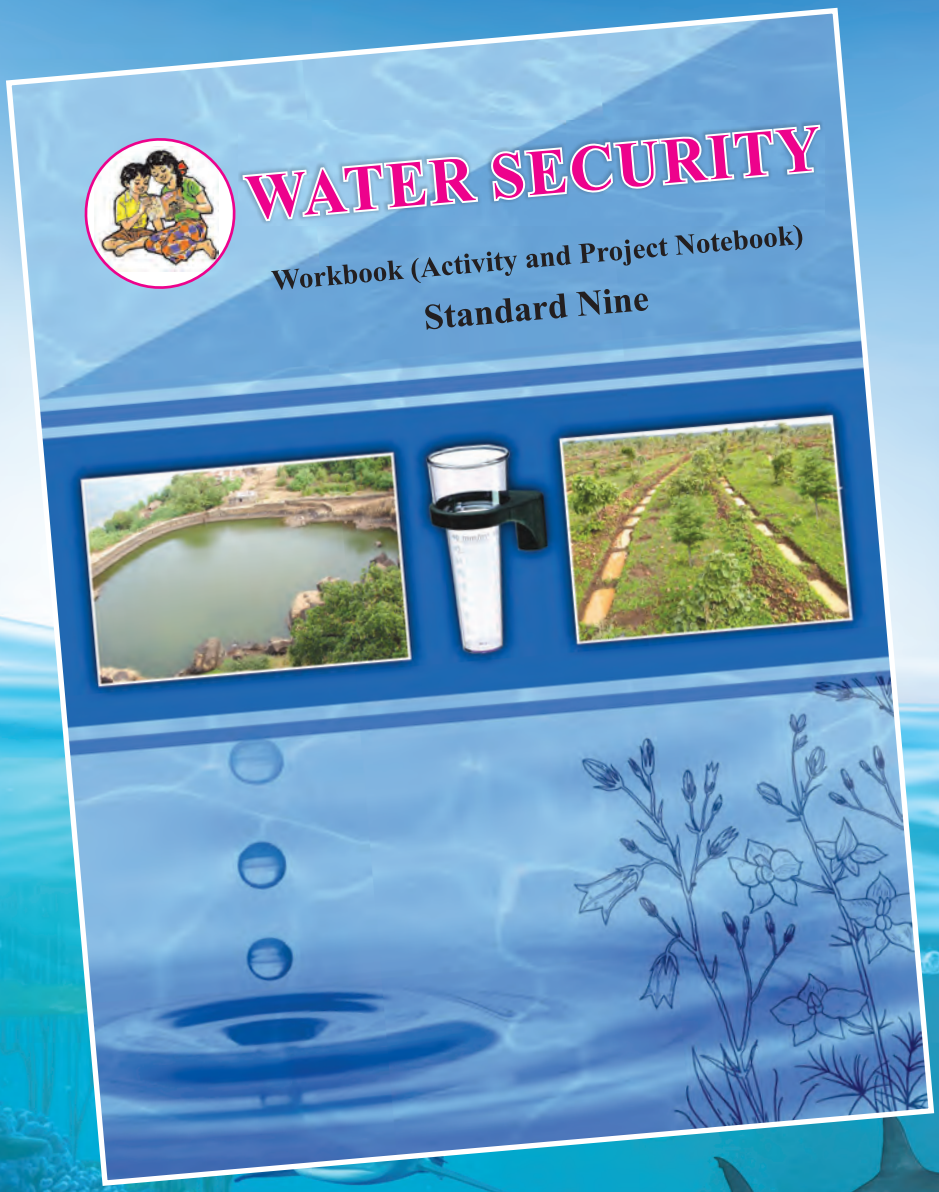

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