Unit 9

Water Resources

After studying this chapter the students will be able to:

- Recognize the various forms of water available on Earth.
- Identify the amount of fresh water available on Earth with an emphasis on Pakistan.
- Describe the existing ways of utilization of water resources in Pakistan and explain the issues and problems Pakistan is facing in utilizing the water resources effectively for its people.
- Identify the methods for reclamation and conservation of water.
- Explain the water resources are facing serious threats such as pollution, climate change, urban growth and landscape changes (deforestation) that are mainly caused by human activities.
- Describe the implication of the growing demand of water in the world.
- Suggest ideas for the sustainable development of water resources in Pakistan.

NOT FOR SALE

INTRODUCTION

Water is an important resource for all living organisms. It is the most abundant compound found in all living organisms. Water cycle operates in nature . It is a renewable resource as its supply is not affected by its use. It is used in various ways, for example in domestic and industrial activities, agriculture, hydro power generation, recreation, navigation, etc.

Access to water is regarded as a basic human right. Availability of clean drinking water reduces the occurrence of water-related diseases. Ecological conditions of an area can be affected due to large-scale withdrawals or transfers of water. Water is a shared resource in most parts of the world and is becoming a reason for conflict and tension between countries especially in the context of rising population and developing economies. In this chapter you will study the distribution of water, issues and problems in effective utilization of water and threats faced by water resource due to ecological problems.

9.1 FORMS OF WATER PRESENT ON EARTH

Water is present all around us, in air as water vapors, in rivers and lakes, in icecaps and glaciers, in the ground as soil moisture and in aquifers. Water resources refer to the supply of groundwater and surface water in a given area.

About 71 percent of the Earth's surface is covered by water. About 96.5 percent of all Earth's water is present in the oceans. Approximately 30 percent of the world's fresh water is present in liquid form held in ground water. This water is available for human use and is managed for carrying out different activities. Rest of the fresh water is present as polar or glacial ice or water vapors. Let's study some major forms of water available on Earth.

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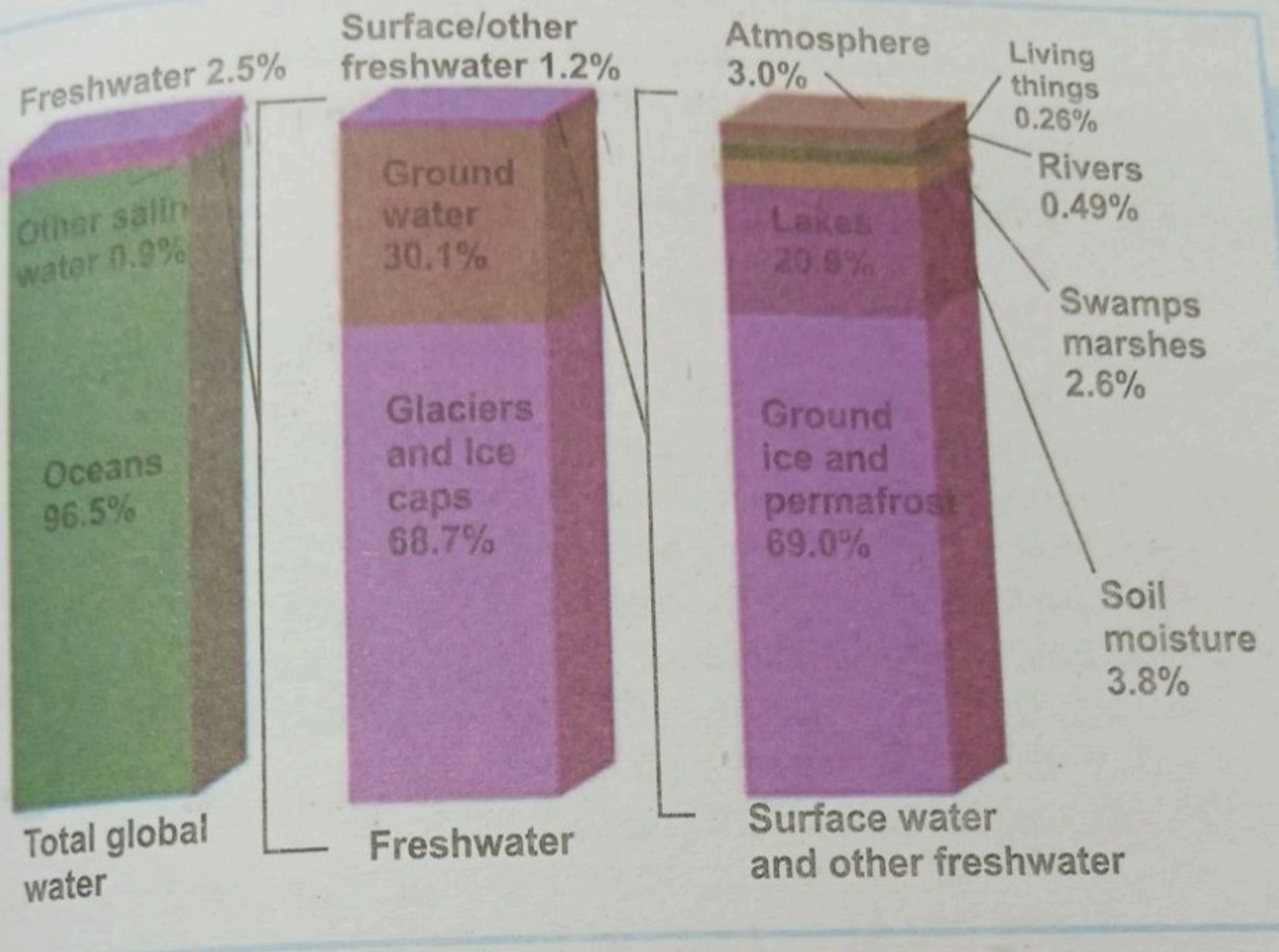

Fig: 9.1 Distribution of water resource in different forms.

9.1.1 Oceans and Seas

More than 70 percent of the Earth's surface is covered by water. Oceans are the largest bodies of water on Earth. These contain water which is saline or salty. All oceans present on the Earth are one large body. However, for geographic reference, this one large water body is divided into several sections geographically. The largest bodies of water on Earth are the Pacific ocean, Atlantic ocean, Indian ocean, Antarctic ocean, and Arctic ocean.

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9.1.2 Lakes

Lake can be defined as a small standing water body which is generally filled with a stream (source) and has an outlet for draining water. Lakes must have a constant source of water, otherwise continuous draining of water may result in the drying up of lake. Lakes are generally regarded as a source of fresh water.

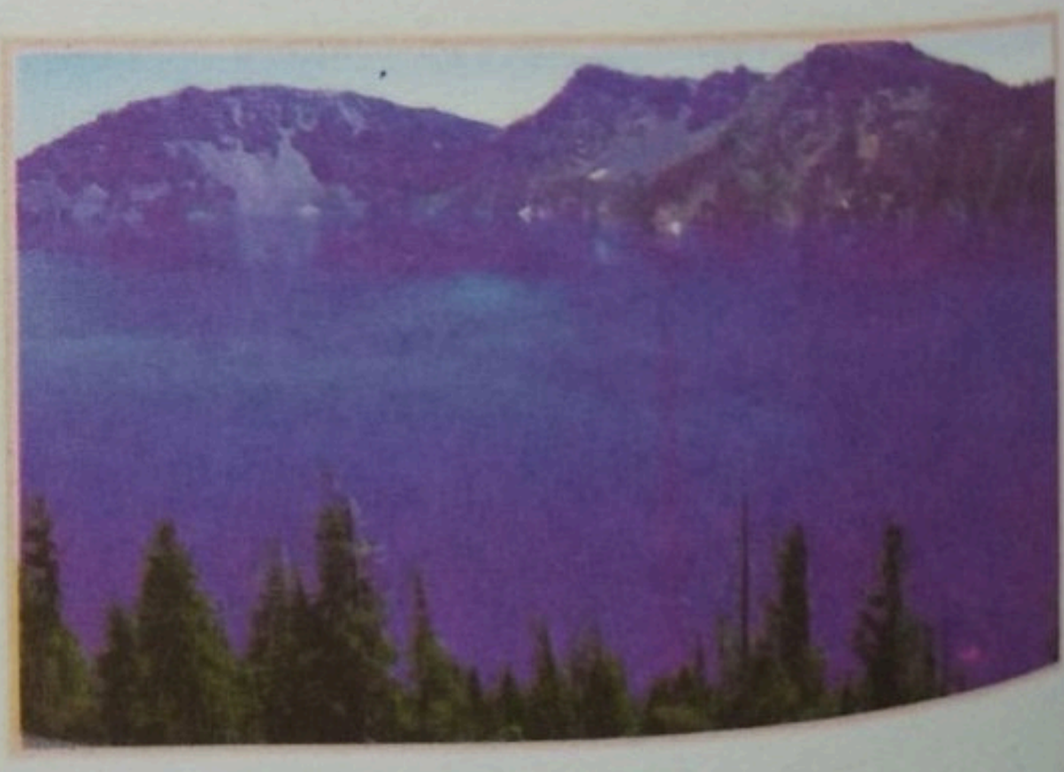
DO YOU KNOW?

The Pacific Ocean is the largest ocean on Earth, covering more than one-third of the Earth's surface and nearly half of Earth's water surface.

BAIKAL LAKE DEEPEST LAKE IN THE WORLD

Not only the deepest lake in the world but also the oldest fresh water lake. Baikal, is the second most voluminous lake in the world. Its average depth is 744.4 meters. It is estimated that it contains 20% of world's fresh water. Known as "Pearl of Siberia" lake Baikal is located in Siberian region near the city of "Irkutsh".

Another unique fact about the lake is that it nourishes 1700 species of plants and animals and 1100 out of them are not found anywhere else in the world.



Lake Baikal

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9.1.3 Rivers

Rivers are regarded as the life line of a country. They are main source of water for irrigation in an area. Historically all successful civilizations were flourished beside some famous rivers of the world. Rivers are flowing bodies of waters. Rivers are an important part of the Earth's water cycle as they carry huge quantities of water from the land to the sea.

9.1.4 Springs

Springs are water resources which come out from certain points on the land and flow on the surface of the land. Springs are good source of drinking water. The impurities found in water are naturally filtered off when water passes through different layers of earth. Spring water contains dissolved minerals. For this reason spring water is used domestically for fulfilling the day to day needs. Spring water to some extent is also used for irrigation purposes. In Pakistan natural springs are found in almost every part of the country.

9.1.5 Glaciers

Fig: 9.2 Siachen glacier

At present, glaciers occupy about 10 percent of the world's total land area. Most of the glaciers are present in polar regions like Greenland, Antarctica, and the Canadian Arctic. Glaciers form when snow remains at a particular location for a longer period of time and is transformed into ice. Glaciers have an incredible quality of movement and for this reason they can move like slow rivers. Glaciers can be as small as a football ground and as big as a small town extended to hundreds of kilometers long. Allah has gifted us with a large number of glaciers which are a source of water when they melt in the summer season.

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In Pakistan Siachen glacier is one of the longest glacier and it is also a major source of water. It is located towards north of Pakistan and extends towards China and India.

9.1.6 Underground water

One of the most useful source of water is ground water which is found in the cracks and crevices in soil, sand and rocks. This water slowly moves through aquifers and is extracted from aquifers using water wells and tube wells. In the field of agriculture, ground water extracted through tube wells plays an important role in the irrigation of agricultural lands. Ground water is also used for domestic consumption and industrial use.

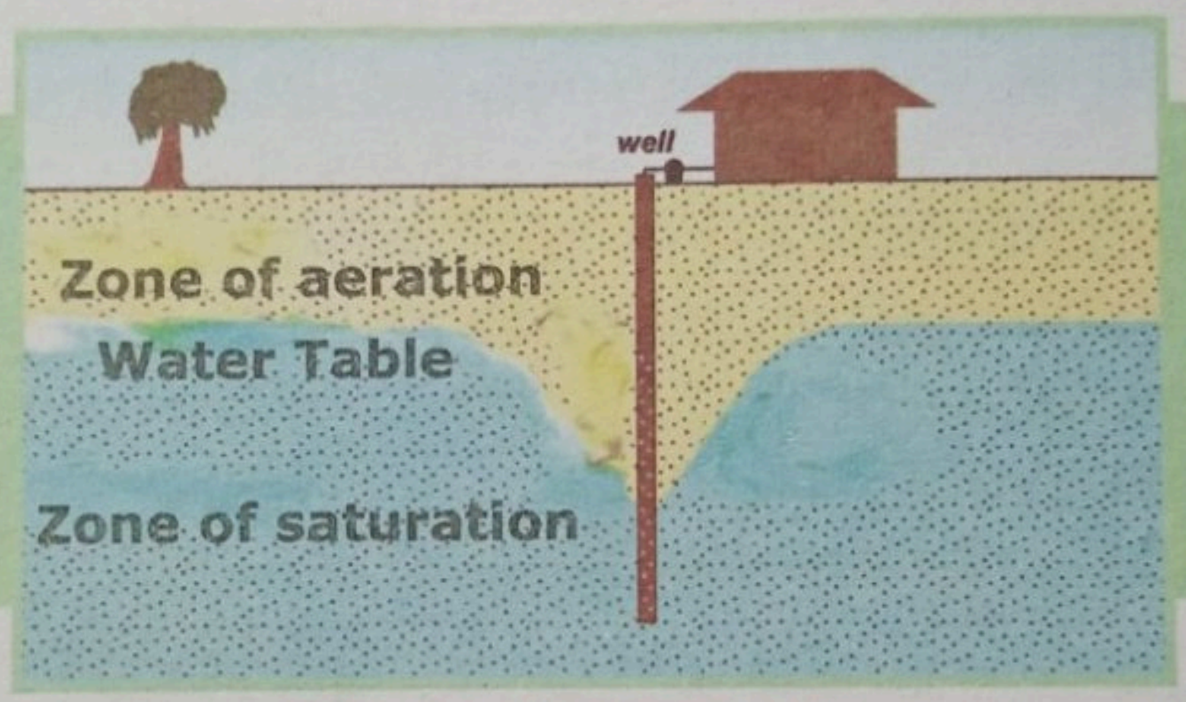
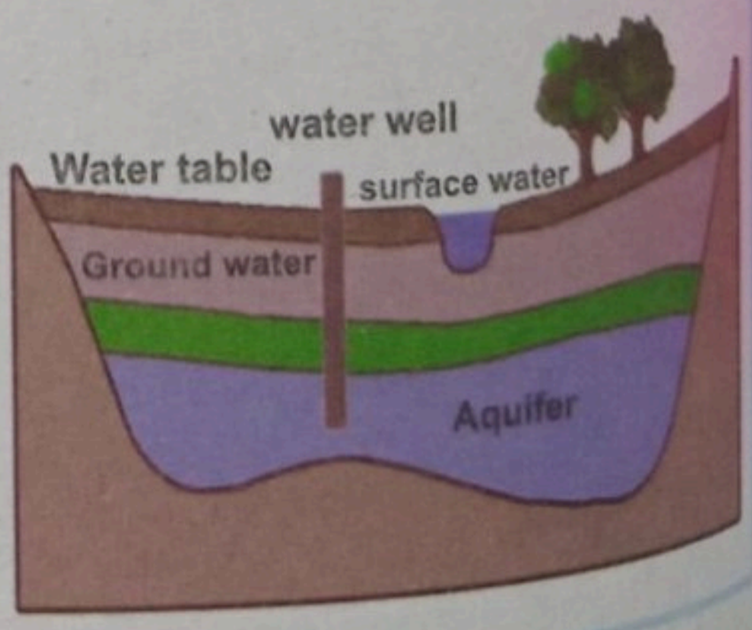


Fig: 9.3 Water Table.

Availability of ground water depends on the water table of the area which is defined as the upper level of an underground surface in which the soil or rocks are permanently saturated with water. The water table lies between the zone of saturation and zone of aeration.

DO YOU KNOW?

An aquifer is an underground layer of water-bearing permeable rocks or unconsolidated materials (gravel, sand, or silt) from which groundwater can be extracted using a water well. The study of water flow in aquifers and the characterization of aquifers is called hydrogeology.



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The availability of ground water depends upon the seasons and the quantity of rainfall recorded in a year. Climatic changes and amount of ground water used by the vegetation determines the status of water table and in turn the availability of ground water in an area.

9.2 AMOUNT OF FRESH WATER AVAILABLE ON EARTH

Freshwater can be defined as the water which containing less than 1000 milligrams per liter salts. As you have studied, in the pervious section, 97% of the global water supply is saline in nature and is found in the oceans. The remaining 3% is 'freshwater' which can be used for drinking purposes and domestic consumption. Of the total freshwater available on Earth about 69% is held by the glaciers and permanent ice sheets of arctic region. Underground water accounts for approximately 30% of the total freshwater supply. Fresh water is also present in lakes, streams, springs etc. Minute amounts of freshwater are also stored in the soil, the atmosphere and in biological organisms.

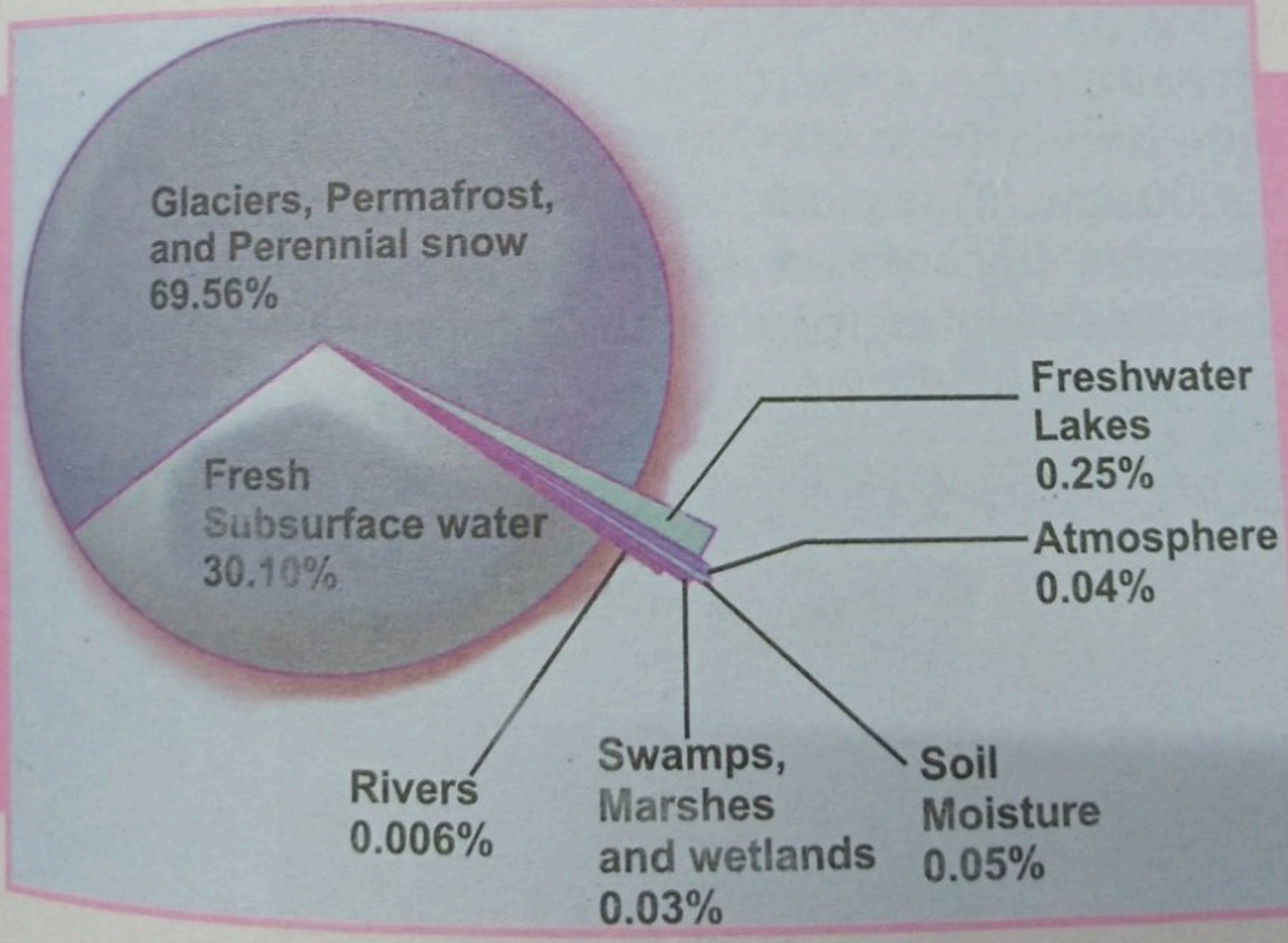

Fig: 9.4 Amount of freshwater on Earth.

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9.2.1 Freshwater Resources of Pakistan

Allah has gifted Pakistan with plenty of fresh water resources in the form of surface water, rainfall, and groundwater. Rivers and fresh water lakes constitute the surface water resources of Pakistan. Pakistan river system is mainly based on the flows of the Indus River and its tributaries. Five major tributaries join Indus on the eastern side are Jhelum, Chenab, Ravi, Beas and Sutlej; besides, three minor tributaries are the Soan, Harow, and Siran, which drain in mountainous areas. A number of small tributaries also join the Indus towards its western side. The biggest of such tributaries is River Kabul.

Monsoon rains constitute about 70 per cent of the annual rainfall that occurs in the months of June to September. These rains in most instances bring floods which damages our infrastructure, agriculture and overall economy of the people of Pakistan. If properly managed this rain water could be utilized for various productive activities. Unfortunately, we have not been able to utilize this precious resource and every year huge amount of flood water drains into the Arabian sea without giving any benefit.

Pakistan has a rich source of groundwater resources. Indus Plain in Pakistan extends from Himalayan foothills to Arabian Sea upto about 1,600 Km. This plain has rich alluvial deposits and is blessed with extensive unconfined aquifers. These aquifers are used for extracting fresh water for domestic consumption and it is also a useful source of irrigation.

Fig: 9.5 River Kabul & Indus Merging at Attock.

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9.3 WAYS OF UTILIZATION OF WATER RESOURCES IN PAKISTAN

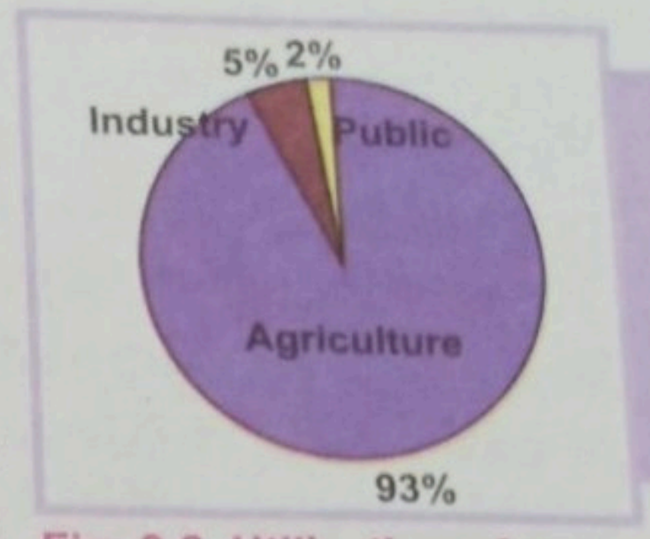
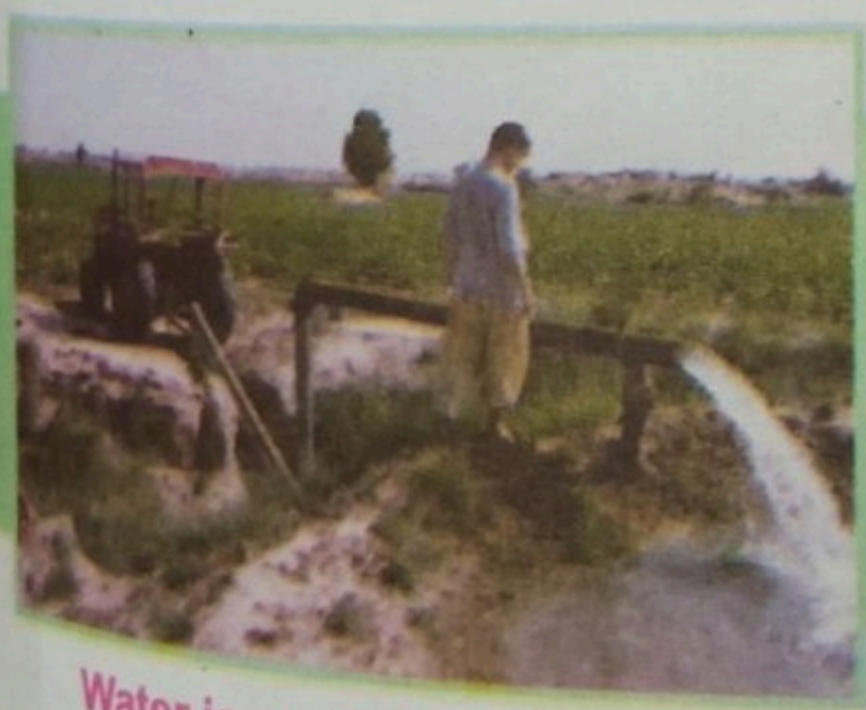


Fig: 9.6 Utilization of water by different sectors.

Allah has gifted Pakistan with abundant water resources. Rivers flow down from the Himalayan and Karakoram range. Melting water from mountainous glaciers adds to the flow of rivers.

In Pakistan water resources are used in three broad categories. Firstly, water is being used in the domestic activities which include water being used for drinking , cooking, bathing, washing etc. Secondly, water has an important role to play in industrial and manufacturing sector, for example, industries related to metals production, wood and paper products, chemicals etc consume large quantities of water. In industries water is used in processing, washing, diluting, cooling, or transporting a product.

Thirdly, the agricultural sector of Pakistan is largest consumer of water. Pakistan has a total area of 79.6 million hectares. Out of this about 27 percent of the area is currently under cultivation. Almost, 80 percent of the current cropped area is irrigated with the help of canals. Pakistan has one of the largest canal system in the world and so has one of the highest proportions of irrigated cropped area in the world. Apart from these Pakistan has built several water reservoirs and dams. These reservoirs are not only producing energy but these have a key role in managing the irrigation system of Pakistan.



Water is used for irrigation.

Water is used in different industries.

Fig: 9.7

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9.3.1 Issues and Problems of water resource utilization in Pakistan

You have learnt in the pervious sections that Pakistan water resources heavily depend on winter snowfall and monsoon rains. This weather phenomenon is limited to certain areas and the rest of the country receives very little rainfall and people living in such areas have little or no access to surface water. Summer season brings along with it melting of ice and monsoon rains. Water from these sources is fed into our river system. As water flows down, it seeps into ground and makes its way to aquifers where it stays and is available for extraction. Currently, Pakistan water resources are declining and are being degraded because of various types of problems. These include over-exploitation of groundwater, misuse and wastage of surface water and vulnerability of water resources to different kinds of pollution.

In order to increase agricultural yield and feed the ever increasing population, groundwater is either pumped extensively or too much water is diverted from the rivers for irrigation purposes. Consequently these practices results in the formation of salinity and degradation of fertile land. All these factors can lead to the problem of food scarcity in the long run. Pakistan has one of the largest irrigation system in the world. Overall the available infrastructure of canal system has resulted in loss of about two-third of water due to poor transmission and seepage. This in turn has resulted in the problem of water logging and salinity.

Fig: 9.8 We need to use wisely our ground water resource.

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Lack of access to clean drinking water is one of the leading cause of different types of diseases, for example, diarrhea, typhoid, cholera, malaria, dysentery etc. Hydropower is the cheapest source of energy. Pakistan's topography has the capacity where large dams can be built and every year a huge amount of water can be saved . The water stored in the dams is not only used for the agricultural purposes but also to provide electricity. In addition to this, dams provide an effective barrier to floods. Pakistan is an agricultural country and water is the key for its survival. A big investment in the repair of existing dams and large scale construction of new water reservoirs is the first step in conserving water resources of Pakistan.

Pakistan is among the list of those countries which can be severely affected by the climatic changes. In the backdrop of this scenario water resources of the country would be vulnerable to harmful effects of climatic changes. So it is essential that proper water management strategy should be devised to tackle the challenges of water problems.

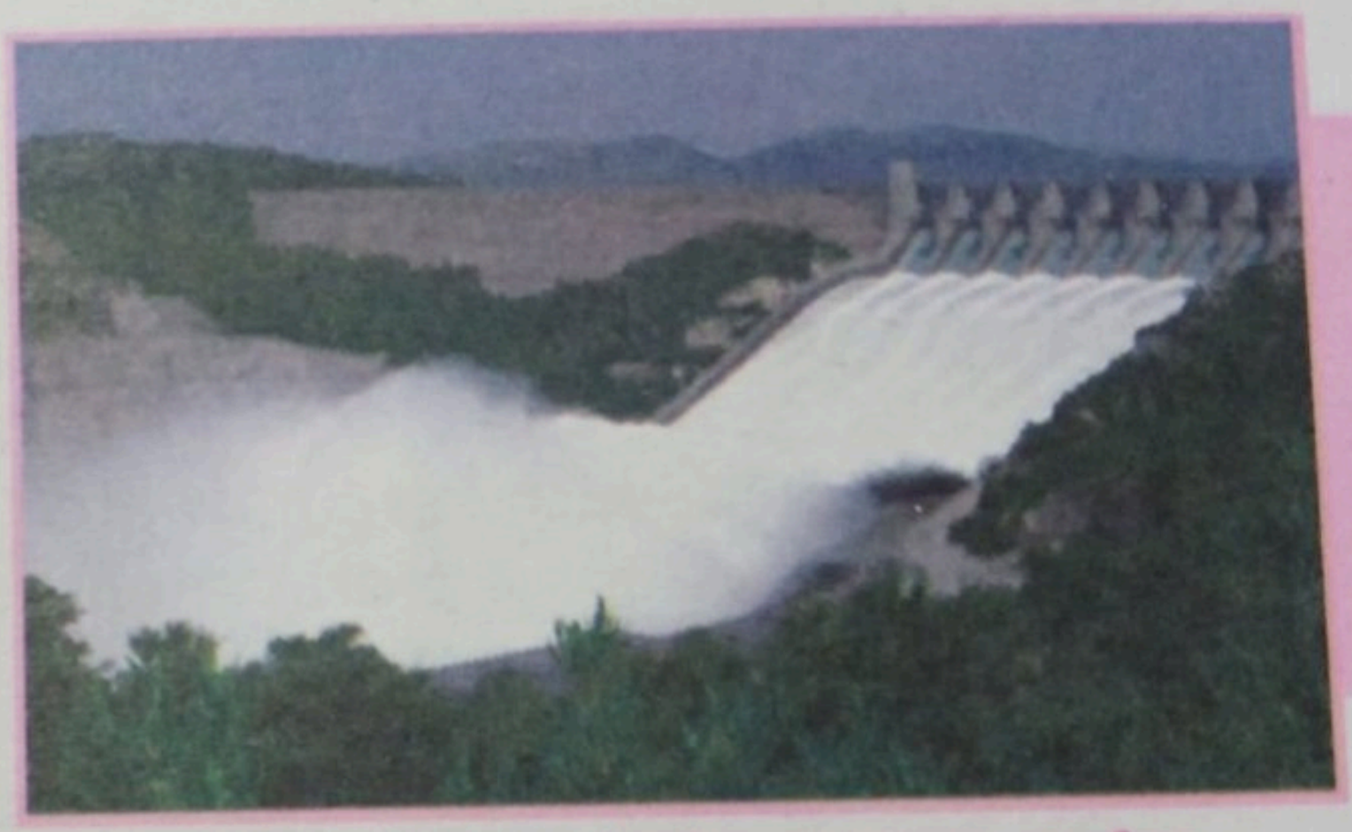

Fig: 9.9 Tarbela dam: a source for electricity and irrigation.

9.3.2 Methods for Reclamation and Conservation of Water

In today's water scarce environment reclamation and conservation strategy gain attention and is a well-established practice in many areas of the world. Historically water is being recycled for billions of years and every water molecule has been used countless times before it has reached us. Water continuously circulates through hydrological cycle, from the sea, to air and land, and back to the sea.

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The term reclamation of water means to reclaim usable water from waste waters and to use this water for irrigation and for other purposes. Reclamation strategies are initiated at places where abundant waste water is generated. There are a number of methods for the reclamation of water from waste water. One such strategy is given below:

1. Sewage is sent for primary treatment in which water is separated from large particles after which it enters sedimentation tanks. Solid particles settle at the bottom and waste water is separated.
2. After primary treatment waste water is sent for secondary treatment. Here bacteria are added to the waste water so that to ingest organic wastes.
3. In tertiary treatment waste water is filtered and is disinfected with chlorine, and any leftover salt is removed.
4. For recycled water to become drinkable, tertiary-treated water undergoes advanced water treatment technology. Water is then disinfected by ultra violet light (UV) or hydrogen peroxide. Finally it is added to groundwater or surface water reservoirs where it stays for several months to be further purified by natural processes.

FOR YOUR INFORMATION

The idea of applying waste water to cropland is not a new one. Scottish "sewage farms" were operating in 1650s and this practice also spread to other English cities. Today over 500,000 hectares (1,930 square miles) in fifteen countries are irrigated with municipal wastewaters. Australia's Werribbee Farm, in operation since 1897, is one of the largest reclaimed waste water operations utilizing system of waste water ponds.

Scottish "sewage farms"

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However, one of the best strategy in the natural resource management is to use the resource wisely and make strategies for its conservation so that the coming generations have the chance to take equal benefits from the resource too. Water being a key resource need serious efforts both at the individual and at the government level. Following are some of the measures which can be followed to achieve this objective.

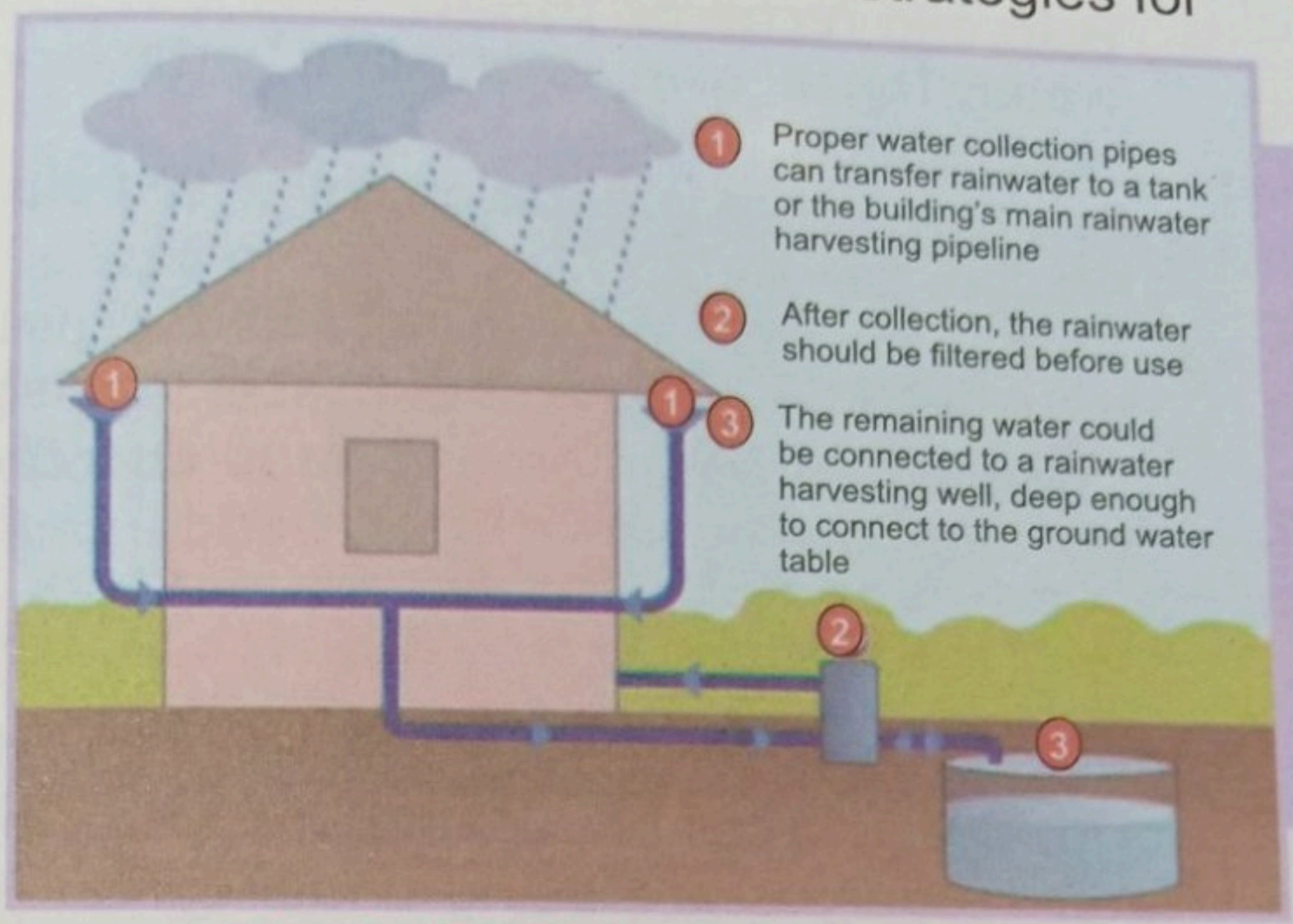

Fig: 9.10 Rain harvesting system

- You can save some precious water by following some simple measures like closing the tap while cleaning your teeth.
- In your home, make it sure that taps and showers are closed and do necessary repairs for leaking and damaged water pipes.
- Rain water can be collected and can be used for gardening and washing.
- In the field of agriculture water can be saved by the the use of efficient irrigation techniques for example, drip irrigation and overhead irrigation.

Fig: 9.11 Over head irrigation system.

Fig: 9.12 Drip irrigation.

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- One of the useful practice to recharge the underground water is to dug recharge pits for storing rainwater and stop runoff water. These give ample time to the land to recharge ground water supply.
- Increase in the vegetation cover and planting more trees can stop run off water.
- Storing surplus water in large water reserviors during rainfall season can make water available for use in the dry spells for irrigation purposes on one hand and control flooding during the rainy season on the other hand.

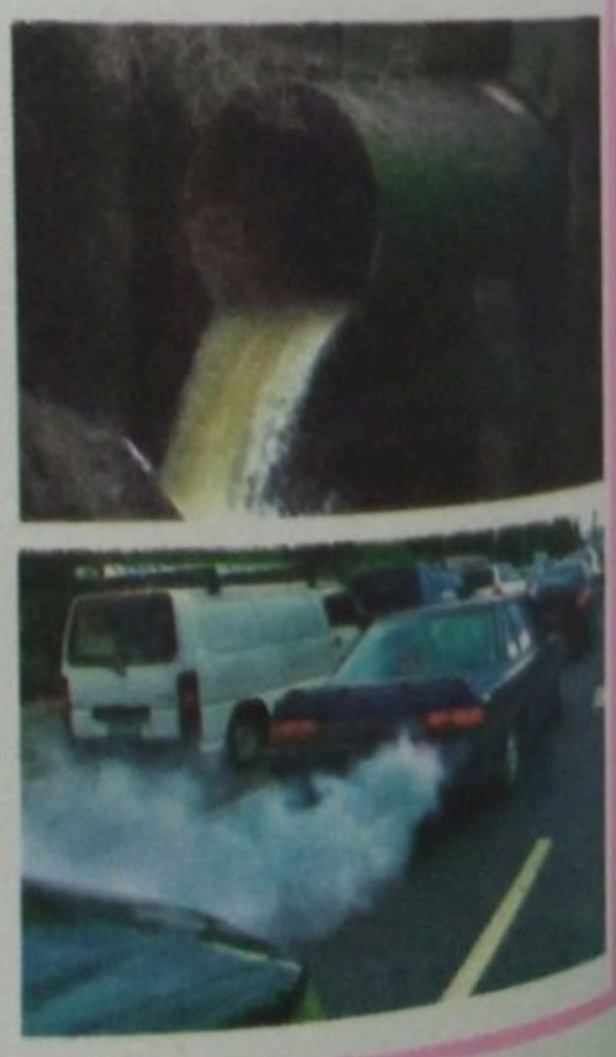
9.4 THREATS TO WATER RESOURCES

Although water is present in large quantities throughout the world, the sources of usable and drinkable water are limited. Water resources are being under threat due to unwise and unplanned human activities like growing trends of urbanization, over population, worldwide competition for controlling water resources and increasing pollution.

FOR YOUR INFORMATION

Point and Non Point Source Pollution

If the source of the pollution is stationary or immobile then that is point source of pollution. Domestic, municipal and industrial establishments are some examples of point sources. On the other hand, the pollution is non point if the origin of the pollutants is mobile or non-stationary. For example, means of transportation such as cars, buses, airplanes and ships.



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Recent adverse effects of climate change and changes in the overall ecological factors have made significant impacts on the water resources present on planet Earth. Let's study some of the major threats to water resources in some more detail.

9.4.1 Pollution

Human activities in one way or the other are a major reason for the pollution of water resources. Water pollution is brought about by industrial wastes, municipal wastes, agricultural wastes, fertilizers, pesticides etc. These wastes are dumped into the rivers. Industries pollute water by adding chemicals like acids, alkalis, salts, detergents, phenols and other compounds into it. This polluted water is highly toxic that may either kill the microorganisms that purify water or inhibit their growth.

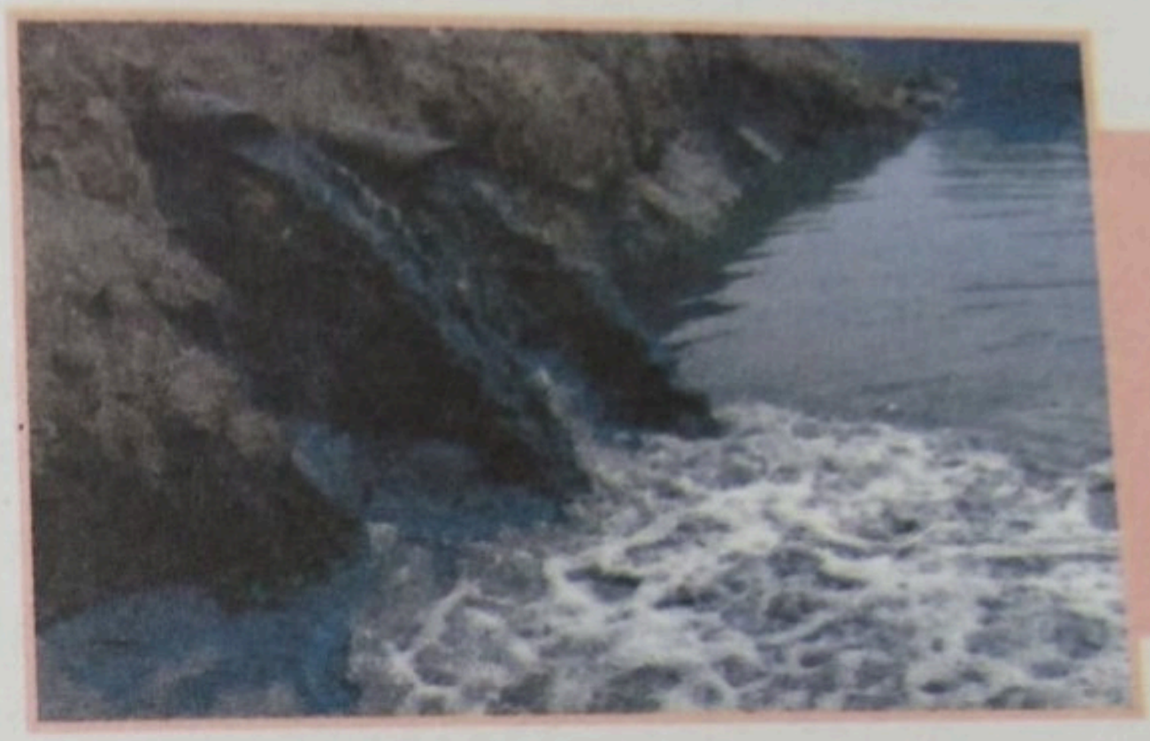

Fig: 9.13 Water is contaminated by effluents from factories.

The chemical wastes degrade the water quality and are harmful to other aquatic organisms. D.D.T and other pesticides may pollute water thus decreasing the fish population and that of the fish eating birds. Other agents of water pollutants are bacteria, viruses, algae, faecal wastes and other pathogens of typhoid and cholera which make water unsafe for many purposes. Sewage and runoff from farms, contain nutrient elements like nitrogen and phosphorus. Sewage with these qualities can be a reason for the excessive aquatic plant growth, and result in a process called eutrophication which causes algal blooms and damage ecosystem of that particular habitat. Oil and petrol also cause water pollution which spread over the water surface and prevents penetration of sunlight and mixing of oxygen in the ocean water.

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DO YOU KNOW?

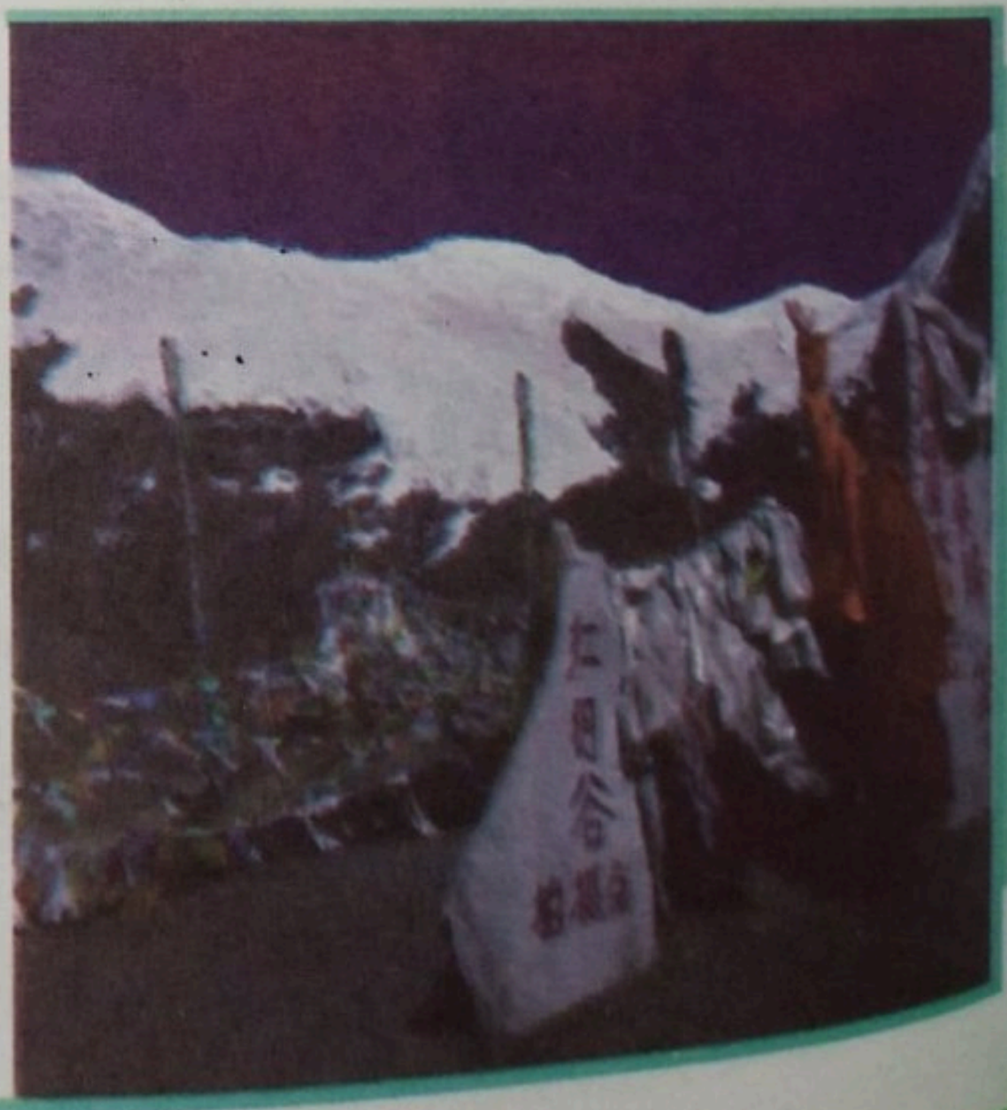
Eutrophication is a process in which water bodies such as lakes, ponds receive excess nutrients that stimulate excessive plant growth especially algae. Such condition reduces dissolved oxygen in the water.

9.4.2 Climate change

Globally climate change has resulted in heavy rains causing floods and extreme hot and dry conditions. Although these two conditions are opposite to each other, a quick glance at the water cycle shows that during water cycle water evaporates from the sea and land and returns to the earth as rainfall and snow. Global warming and rise in temperature has resulted in higher rates of evaporation and warm air holding intense rainstorms, bringing large amount of water which flows down into the rivers and streams. The soil remains dry and it increases the risk of drought. One clear evidence of climate change is the shrinking and melting of glaciers which have already been noticed in many parts of the world.

FOR YOUR INFORMATION

It has been predicted that most glaciers in Tibet could melt by 2100. And while it was initially thought that the water released could benefit China's arid north and west regions, however, it now appears that the melting water will evaporates long before it reaches drought-effected regions.



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9.4.3 Urban growth and landscape changes

The process of urbanization has resulted in the haphazard development of residential and industrial areas in large cities. These areas are the main source of point-source pollution. Urbanization trends generally suggest more economic activities and development. Development of roads, infrastructure and other human activities put stress on precious natural resources including water resource of that area.

Domestic wastewater combined with untreated industrial waste pose a serious threat. Ill managed sanitation system and sewage treatment is the threat to water bodies. Often the nearby water bodies are used for releasing untreated water from urban areas and industries. Rivers in developing countries are more like open sewers than rivers. Garbage collection and disposal facilities are lacking in most cases. So one can see polythene bags and other solid wastes in streams and rivers. In these conditions fish population has almost become non- existent.

Fig: 9.13 Urbanization results in haphazard growth of urban landscape.

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Coastal Urban centres dump untreated sewage in the sea which results in the contamination of beaches. This not only affects the marine habitat but it also poses a serious threat to those who visit these beaches for recreational purposes.

Fig: 9.15 City beach being contaminated by sewage.

Yet another problem is deforestation or cutting of forest. Trees are cut to clear land for agriculture, for the establishment of industrial zones, infra structure and for the development of residential areas. Once the land is exposed it is open for all types of environmental hazards. Exposed land is vulnerable to the process of erosion which results in the loss of soil nutrients and consequently fertility of the land is lost.

Forests also play an important role in the regulation and maintenance of water cycle. Roots of the trees not only hold precious soil but allow more water to be absorbed by the soil and moves this water to the underground water reservoirs.

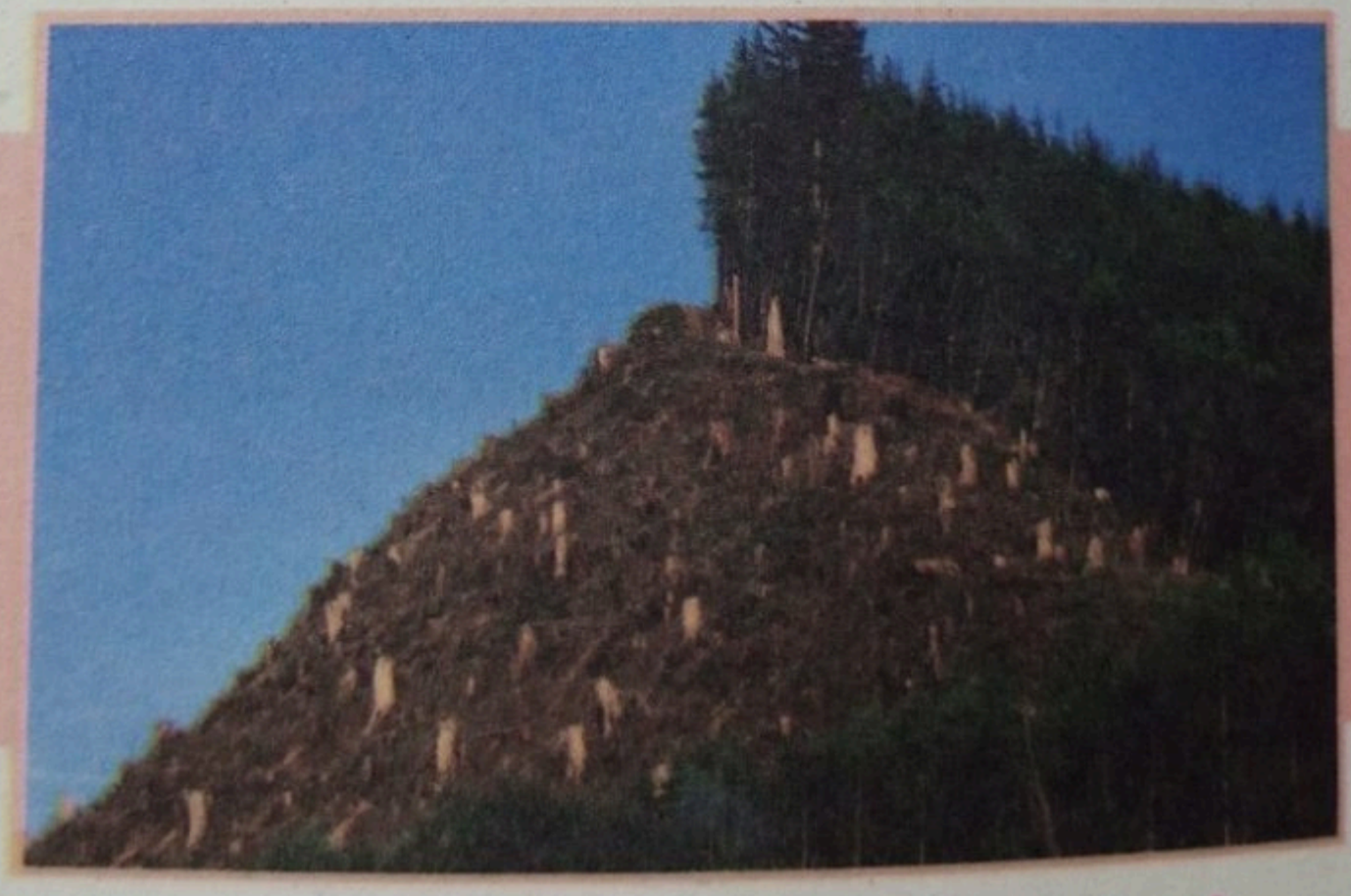

Fig: 9.16 Deforestation exposes land for erosion.

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The Earth is facing serious challenges in the form of climatic change, environmental degradation, as well as pressures due to human activities. All these problems in one way or the other are affecting the water resources. A strategy for the protection and conservation of water resources is the need of the hour for the future generations.

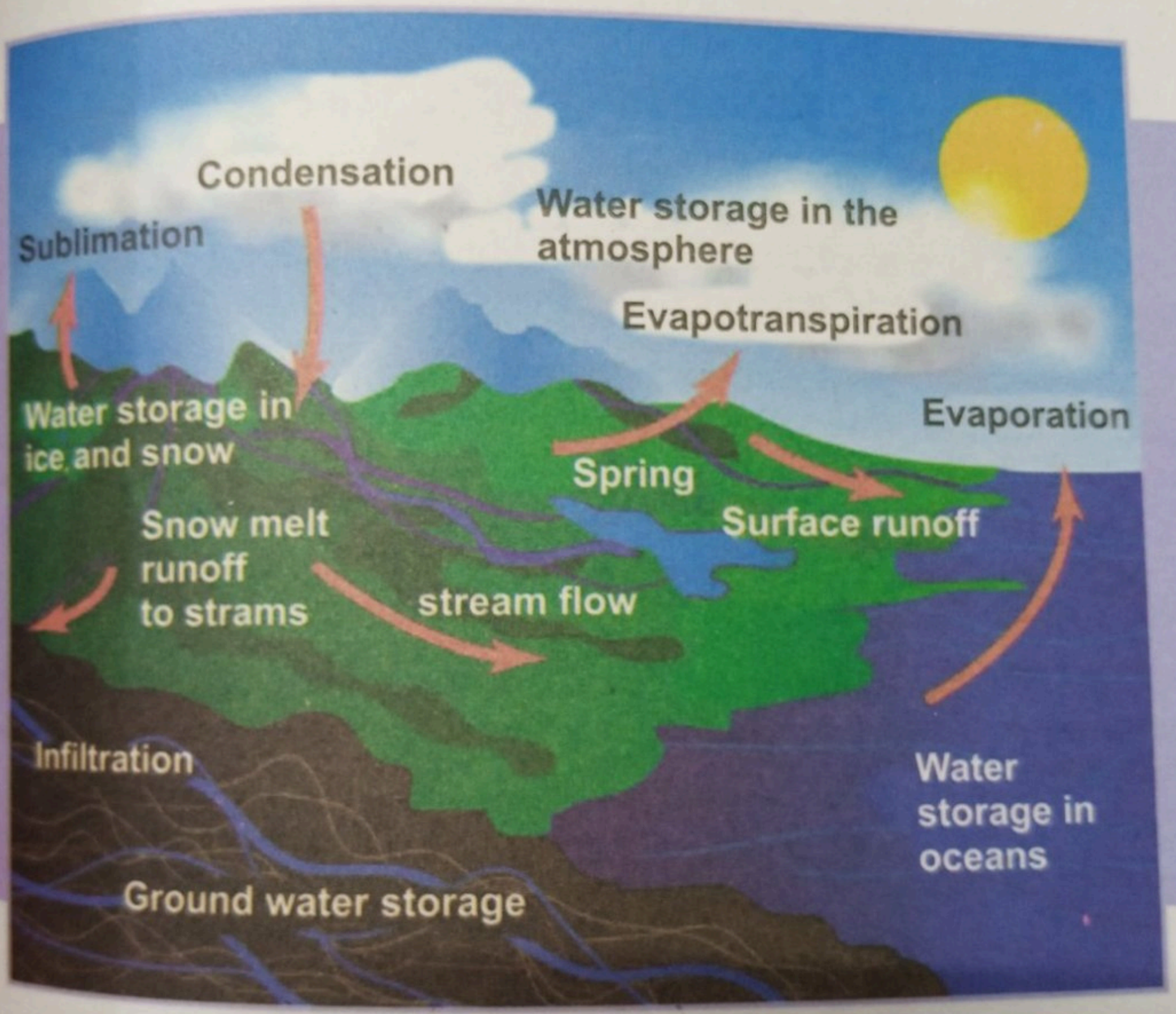

Fig: 9.17 The Water Cycle explains interactions between the atmosphere, hydrosphere, and lithosphere. Evaporation of water from the oceans, seas, rivers, and streams into the atmosphere produces precipitation. Water can take the form of ice caps and alpine glaciers. Ice melts, causing water runoff, that either percolates through the Earth to become part of the water table or makes its way back to the sea.

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9.5 IMPLICATION OF GROWING WATER DEMAND IN THE WORLD

You have learnt in the pervious sections that water used for human consumption is limited in quantity. Only 1% of the total amount of water present on planet Earth can be utilized. Due to this reason competition for water resources is growing and its effects are evident from the rising tensions between different countries and nations in different parts of the world.

Water is vital for our survival and its scarcity affects every sphere of life i.e social, political, economic and it even threatens the health of the ecological system. Water scarcity has already lead to growing pressure on freshwater resources in many places around the world. According to one of the estimates approximately 2 billion people are currently living in areas faced with water stress and its scarcity.

For the last many decades there has been a sharp rise in human population and this trend in human population growth has been a major contributor to water scarcity. Population growth limits the amount of water available per person. Growth in populations means mounting demand and competition for water in the field of agriculture, domestic, industrial, and municipal uses.

Population growth demands more food and more water is needed to produce that food. In agriculture sector water is mainly used for irrigation.

Fig: 9.18 Agriculture sector is a major consumer of water.

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FOR YOUR INFORMATION

Water is a precious resource. Countries around the world are making it sure that their water resources are safe and are available for use. Water shortage has become the cause of certain conflicts in many regions around the world. The bloody conflict in Darfur, (Sudan), that began in 2003 and killed as many as 400,000 Africans, started, in part, over access to a diminishing water supply in that region.

In this activity plenty of water is misused and is wasted. Overall agriculture accounts for about 70% of the total usable water present globally. Agricultural productivity determines the status of global food security. So the availability or scarcity of water directly impacts food security at the global level. Keeping in view the current trends in population growth it is expected that food demands at the global level will be almost double in the coming few decades. So food production will demand more water and put extra pressure on the already depleting water resources at the global level.

Yet another aspect of population growth is a rising trend towards industrialization. Water is used in industries for carrying out different activities, for example cooling, processing and disposal of waste products.

Another challenge to the water resources is growing trend of urbanization especially in the developing countries. Over populated cities put pressure on the water resources and increased levels of pollution deplete usable water resources thereby making people vulnerable to water shortages. At the same time it increases per capita consumption of water. These circumstances coupled with climate change could have negative implications on the livelihoods, health, and security of the people especially in the developing world.

Already it has been established by the international health organizations that water related diseases is the major health problem in many parts of the world. Children are more vulnerable to water brone diseases.

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Availability of clean drinking water is a major challenge at the global level and in many parts of Pakistan. Usually women and especially young girls are given the responsibility to fetch water from far flung areas for their families. This in turn affects their health and diminishes opportunities for continuing their educational activities.

Fig: 9.19 Women folk had to travel long distance to fetch water for their families.

Although water cycle renews itself at the global level, usable water is depleting with every passing moment. Sustainable development of water resources is a right step for saving this precious resource for the generations to come.

9.6 SUSTAINABLE DEVELOPMENT OF WATER RESOURCES OF PAKISTAN

Pakistan has sufficient water resources available for consumption. Surface water and ground water resources are present throughout the length and width of Pakistan. Monsoon rains bring huge amount of water but due to poor planning and mismanagement this valuable water takes a destructive form and cause floods.

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Pakistan needs a sound water conservation plan for avoiding water crisis, famine and any possible ecological disaster to happen. Following are some of the important measures for sustainable development of water resources of Pakistan.

- Improving planning, management and community participation in the utilization of local water systems.
- For effective utilization of water resource there must be a regular programme for cleaning canals and waterways.
- A huge amount of water is lost due to seepage from canals lining. Proper lining of the canal system could reduce these losses.
- Efficient irrigation techniques can reduce water loss. For example drip irrigation delivers water directly to the roots of crops and save precious water.
- Steps for the conservation of environment and to check and control those factors which are contributing to its degradation.
- Establishment and maintenance of proper sanitation system for ensuring less contamination of local water bodies.
- Maintaining a proper check on the extraction of ground water.
- Storage of flood water during monsoon season by construction of small dams especially in the barrani areas.
- Launching public campaign emphasizing conservation of water at all levels.
- Lastly construction of mega dams could store huge amount of flood water and could provide water for irrigation too.

9.7 POTABLE WATER SYSTEM

Potable water or drinking water can be defined as the water which is considered safe for consumption both for humans and animals. You have learnt that natural freshwater sources like springs, lakes, rivers, if not contaminated by human activities, provide safe water for human consumption.

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Contaminated drinking water coupled with poor sanitation are the major reasons for different types of diseases like diarrhea, dysentery etc. These conditions account for nearly two million deaths with children under the age of five being the major victims. It is highly desirable to treat water before it is pumped for distribution. In a treatment plant water comes from surface water like man made water reservoirs, rivers, lakes. This water has high levels of particulate matter, minerals, metals, compounds containing chlorides. As opposed to this, groundwater is low in oxygen and it contains hydrogen sulphides and sulphate.

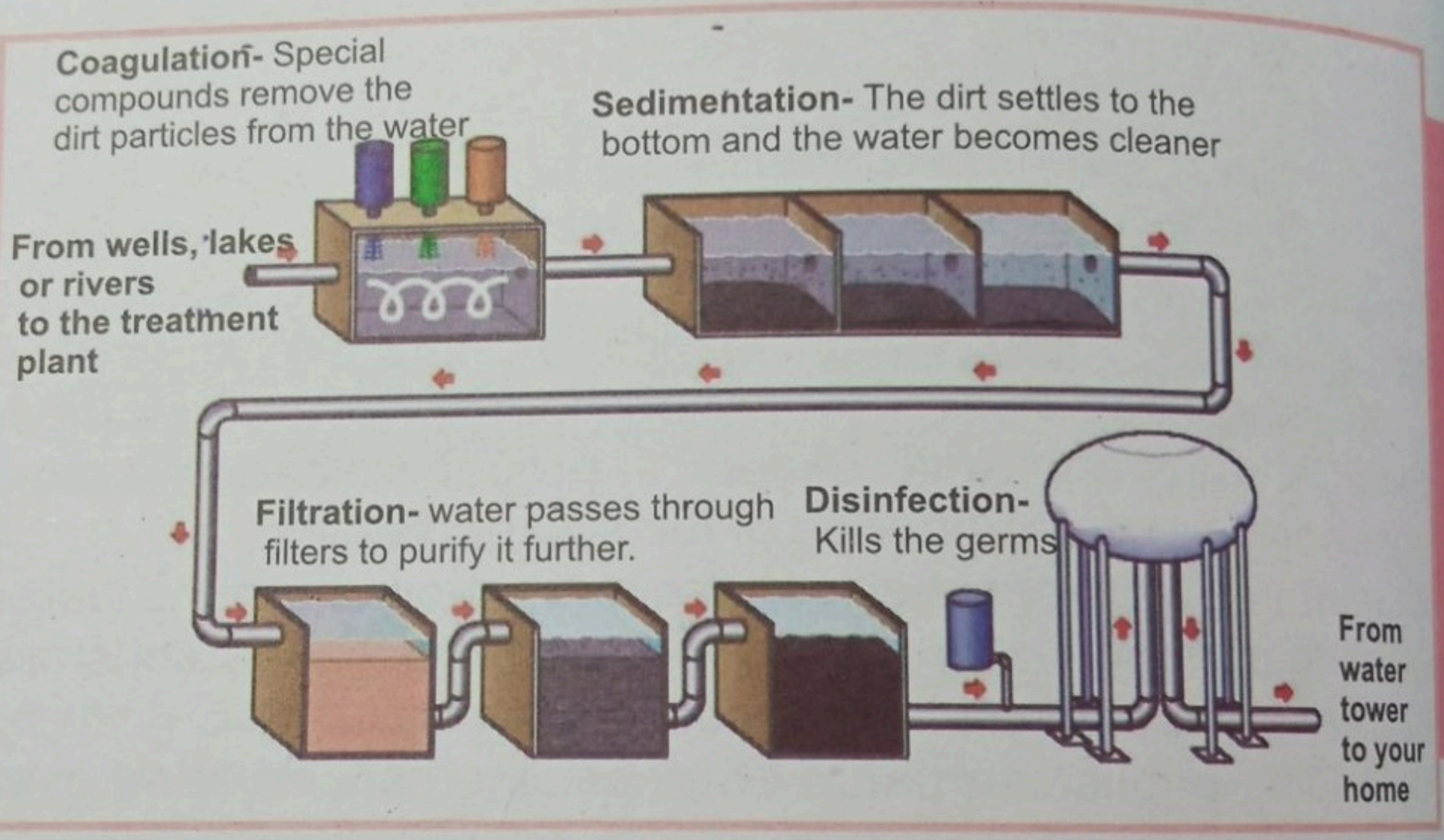

Fig: 9.20 Water treatment plant.

In a treatment plant, the first step is pre-chlorination for algae control and arresting biological growth. Second step is aeration along with pre-chlorination for removal of dissolved iron and manganese. Water is passed on for further chemical treatment using alum, caustic soda, ferrous sulphate. These chemicals help in neutralizing water and in the precipitation of metallic ions and particulate matter. Finally the treated waters proceeds for final filtration process. This filtration is done in stone/gravel filter beds or activated carbon. After this water is processed for final disinfection. This is done by an oxidant such as chlorine. After final disinfection, the treated water is pumped for distribution to different parts of the city.

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KEY POINTS

- Water is a vital resource used in various ways including direct consumption, agricultural irrigation, hydropower, industrial production, recreation, navigation, environmental protection, the disposal and treatment of sewage and industrial effluents etc.
- About 71 percent of the Earth's surface is covered by water and the oceans hold about 96.5 percent of all Earth's water.
- Approximately 30 percent of the world's fresh water is in liquid form held as ground water.
- Lake is a small standing water body which is generally filled with a stream (source) and has an outlet for draining water.
- Glaciers are made up of snow that falls over many years and compresses into large ice masses.
- Freshwater contains less than 1000 milligrams per liter of dissolved salts.
- The usage of water can be divided into three broad categories i.e. domestic consumption, commercial/ industrial use and usage for land irrigation.
- The total geographical area of Pakistan is 79.6 million hectares. About 27 percent of the area is currently under cultivation. Of this area, 80 percent is irrigated.
- Every glass of water consumed contains water molecules that have been used countless times before and in this way, all water on Earth can be reused again and again.
- Pressures on water resources are increasing mainly as a result of human activity – namely urbanization,

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- population growth, increased living standards, growing competition for water, and pollution.
- Freshwater pollution is caused by industrial wastes, sewage, runoff from farmland, cities, and factory effluents and the build-up of sediment.
- Mountain glaciers are shrinking, and this trend has accelerated considerably in recent years due to climate change.
- Urbanization is the process by which cities and towns develop and grow into larger areas.
- Deforestation is a process by which forest areas are removed and the land is utilized for other uses including agriculture, industrialization, resources or settlements.
- Poor water quality and unsustainable use of water resources can limit the economic development of a country, harm health and affect livelihoods.
- Potable water is water which is fit for consumption by human and animals.
- Population growth is a major contributor to water scarcity. Growth in populations means mounting demand and competition for water for domestic, industrial and municipal uses.
- Agriculture accounts for approximately 70 percent of global water use and for as much as 95 percent of water use in predominantly agriculture-based countries.
- Industrial production depends on water for processing, cooling and disposal of waste products.

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EXERCISE

A. Select the correct answers in the following questions.

1. **The largest bodies of water on Earth are:**
   a. Sea
   b. Rivers
   c. Oceans
   d. Underground water

2. **About 30% world fresh water is in the form of**
   a. Solid
   b. Liquid
   c. Gas
   d. Water vapours

3. **Glaciers are predominantly present in which one of the following regions?**
   a. Europe
   b. Antarctica
   c. Africa
   d. Asia

4. **Sea water is basically _____ in nature.**
   a. Acidic
   b. saline
   c. neutral
   d. fresh

5. **The concept of sustainable development encourages:**
   a. Form of growth that meets current basic needs
   b. Preservation of the resources for the need of future generation
   c. A change in all respects of life
   d. Growth to meet current needs, preservation for the needs of future and change in all respects of life

6. **How many percent of the world water is suitable for human use?**
   a. 25%
   b. 10%
   c. Less than 1%
   d. 40%

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7. **Water that is safe to drink is called**
   a. Tap Water
   b. Potable water
   c. Distilled water
   d. Non Potable water

8. **Which human activities need the most water?**
   a. Personal hygiene
   b. Cooking
   c. Irrigation
   d. Drinking

9. **How much of the global water supply is found in oceans?**
   a. Less than 28%
   b. About 75%
   c. About 87%
   d. About 97%

10. **What is the process by which water enters the small pore spaces between particles in soil or rocks?**
   a. Transpiration
   b. Infiltration
   c. Precipitation
   d. Sublimation

11. **Which of the following statements about the water table is false:**
   a. The water table changes when discharge is not balanced by recharge.
   b. The water table is generally flat.
   c. The water table is above the land surface in lakes.
   d. The water table is depressed near high volume pumping wells.

12. **The boundary between the saturated zone and the unsaturated zone is called:**
   a. Water table
   b. Aquifer
   c. Aquilude
   d. Sedimentation zone

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13. **Which one of the following is used in disinfecting water?**

a. Bromine
b. Chlorine
c. Iodine
d. Fluorine

14. **Which of the following can contaminate an aquifer?**

a. Land pollution
b. Air pollution
c. Extraction machines
d. All of these

B. Write short answers of the following questions.

1. Enlist various forms of water available on the Earth.
2. What do you mean by underground water?
3. What do you mean by freshwater. Why it is important to us?
4. What do you mean by potable water?
5. Enlist major pressures on water resources.
6. Give three main measures for sustainable development of water resources of Pakistan.
7. Give a brief account of climate change on water resources.

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C. Write in detail answers of the following questions.

1. Identify the amount of fresh water available on Earth with an emphasis on Pakistan.
2. The level of agricultural production is directly related to the availability and effective use of water as a major input. Justify the statement.
3. Describe the existing ways of utilization of water resources in Pakistan.
4. Explain the issues and problems Pakistan is facing in utilizing the water resources effectively for its people.
5. Explain the methods of reclamation of water.
6. Write an essay on conservation of water.
7. Explain how water resources are being threatened by urbanization and deforestation.
8. Describe the implications of growing demand of water in the world.

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