#### 14.3.2 - Energy from the Sea

**Tidal Energy**

Due to the gravitational pull of mainly the moon on the spinning earth, the level of water in the sea rises and falls. If you live near the sea or ever travel to some place near the sea, try and observe how the sea-level changes during the day. This phenomenon is called high and low tides and the difference in sea-levels gives us tidal energy. Tidal energy is harnessed by constructing a dam across a narrow opening to the sea. A turbine fixed at the opening of the dam converts tidal energy to electricity. As you can guess, the locations where such dams can be built are limited.

**Wave Energy**

Similarly, the kinetic energy possessed by huge waves near the seashore can be trapped in a similar manner to generate electricity. The waves are generated by strong winds blowing across the sea. Wave energy would be a viable proposition only where waves are very strong. A wide variety of devices have been developed to trap wave energy for rotation of turbine and production of electricity.

**Ocean Thermal Energy**

The water at the surface of the sea or ocean is heated by the Sun while the water in deeper sections is relatively cold. This difference in temperature is exploited to obtain energy in ocean-thermal-energy conversion plants. These plants can operate if the temperature difference between the water at the surface and water at depths up to 2 km is 20 K (20°C) or more. The warm surface-water is used to boil a volatile liquid like ammonia. The vapours of the liquid are then used to run the turbine of generator. The cold water from the depth of the ocean is pumped up and condense vapour again to liquid.

The energy potential from the sea (tidal energy, wave energy and ocean thermal energy) is quite large, but efficient commercial exploitation is difficult.

#### 14.3.3 - Geothermal Energy

Due to geological changes, molten rocks formed in the deeper hot regions of earth’s crust are pushed upward and trapped in certain regions called ‘hot spots’. When underground water comes in contact with the hot spot, steam is generated. Sometimes hot water from that region finds outlets at the surface. Such outlets are known as hot springs. The steam trapped in rocks is routed through a pipe to a turbine and used to generate electricity. The cost of production would not be much, but there are very few commercially viable sites where such energy can be exploited. There are number of power plants based on geothermal energy operational in New Zealand and United States of America.

#### 14.3.4 - Nuclear Energy

How is nuclear energy generated? In a process called nuclear fission, the nucleus of a heavy atom (such as uranium, plutonium or thorium), when bombarded with low-energy neutrons, can be split apart into lighter nuclei. When this is done, a tremendous amount of energy is released if the mass of the original nucleus is just a little more than the sum of the masses of the individual products. The fission of an atom of uranium, for example, produces 10 million times the energy produced by the combustion of an atom of carbon from coal. In a nuclear reactor designed for electric power generation, such nuclear ‘fuel’ can be part of a self-sustaining fission chain reaction that releases energy at a controlled rate. The released energy can be used to produce steam and further generate electricity.

The major hazard of nuclear power generation is the storage and disposal of spent or used fuels – the uranium still decaying into harmful subatomic particles (radiations). Improper nuclear-waste storage and disposal result in environmental contamination. Further, there is a risk of accidental leakage of nuclear radiation. The high cost of installation of a nuclear power plant, high risk of environmental contamination and limited availability of uranium makes large-scale use of nuclear energy prohibitive.

Nuclear energy was first used for destructive purposes before nuclear power stations were designed. The fundamental physics of the fission chain reaction in a nuclear weapon is similar to the physics of a controlled nuclear reactor, but the two types of device are engineered quite differently.

##### Do you know?

In a nuclear fission, the difference in mass, Δm, between the original nucleus and the product nuclei gets converted to energy *E* at a rate governed by the famous equation,

E=Δmc2,E = \Delta mc^{2},

first derived by Albert Einstein in 1905, where c is the speed of light in vacuum. In nuclear science, energy is often expressed in units of electron volts (eV): 1eV=1.602×10−191eV = 1.602 \times 10^{- 19}

joules. It is easy to check from the above equation that 1 atomic mass unit (u) is equivalent to about 931 mega electron volts (MeV) of energy.

Nuclear power reactors located at Tarapur (Maharashtra), Rana Pratap Sagar (Rajasthan), Kalpakkam (Tamil Nadu), Narora (UP), Kakrapar (Gujarat) and Kaiga (Karnataka) have the installed capacity of less than 3% of the total electricity generation capacity of our country. However, many industrialised countries are meeting more than 30% of their electrical power needs from nuclear reactors.

##### Do you know?

**Nuclear fusion**

Currently all commercial nuclear reactors are based on nuclear fission. But there is another possibility of nuclear energy generation by a safer process called nuclear fusion. Fusion means joining lighter nuclei to make a heavier nucleus, most commonly hydrogen or hydrogen isotopes to create helium, such as

2H+2H→\rightarrow

3He(+n)

It releases a tremendous amount of energy, according to the Einstein equation, as the mass of the product is little less than the sum of the masses of the original individual nuclei.

Such nuclear fusion reactions are the source of energy in the Sun and other stars. It takes considerable energy to force the nuclei to fuse. The conditions needed for this process are extreme – millions of degrees of temperature and millions of pascals of pressure.

The hydrogen bomb is based on thermonuclear fusion reaction. A nuclear bomb based on the fission of uranium or plutonium is placed at the core of the hydrogen bomb. This nuclear bomb is embedded in a substance which contains deuterium and lithium. When the nuclear bomb (based on fission) is detonated, the temperature of this substance is raised to 10710^{7}

K in a few microseconds. The high temperature generates sufficient energy for the light nuclei to fuse and a devastating amount of energy is released.

##### Activity 14.7

Discuss in class the question of what is the ultimate source of energy for bio-mass, wind and ocean thermal energy.

Is geothermal energy and nuclear energy different in this respect? Why?

Where would you place hydro electricity and wave energy?

#### Questions

What kind of mirror – concave, convex or plain – would be best suited for use in a solar cooker? Why?

What are the limitations of the energy that can be obtained from the oceans?

What is geothermal energy?

What are the advantages of nuclear energy?

### 14.4 - Environmental Consequences

We have studied various sources of energy in the previous sections. Exploiting any source of energy disturbs the environment in some way or the other. In any given situation, the source we would choose depends on factors such as the ease of extracting energy from that source, the economics of extracting energy from the source, the efficiency of the technology available and the environmental damage that will be caused by using that source. Though we talk of ‘clean’ fuels like CNG, it would be more exact to say that a particular source is cleaner than the other. We have already seen that burning fossil fuels causes air pollution. In some cases, the actual operation of a device like the solar cell may be pollution-free, but the assembly of the device would have caused some environmental damage. Research continues in these areas to produce longer lasting devices that will cause less damage throughout their life.

#### Activity 14.8

Gather information about various energy sources and how each one affects the environment.

Debate the merits and demerits of each source and select the best source of energy on this basis.

#### Questions

Can any source of energy be pollution-free? Why or why not?

Hydrogen has been used as a rocket fuel. Would you consider it a cleaner fuel than CNG? Why or why not?

### 14.5 - How Long Will An Energy Source Last Us?

We saw earlier that we cannot depend on the fossil fuels for much longer. Such sources that will get depleted some day are said to be exhaustible sources or non-renewable sources of energy. On the other hand, if we manage bio-mass by replacing the trees we cut down for fire-wood, we can be assured of a constant supply of energy at a particular rate. Such energy sources that can be regenerated are called renewable sources of energy.

Renewable energy is available in our natural environment, in the form of some continuing or repetitive currents of energy, or is stored in such large underground reservoirs that the rate of depletion of the reservoir because of extraction of usable energy is practically negligible.

#### Activity 14.9

Debate the following two issues in class.

The estimated coal reserves are said to be enough to last us for another two hundred years. Do you think we need to worry about coal getting depleted in this case? Why or why not?

It is estimated that the Sun will last for another five billion years. Do we have to worry about solar energy getting exhausted? Why or why not?

On the basis of the debate, decide which energy sources can be considered (i) exhaustible, (ii) inexhaustible, (iii) renewable and (iv) non-renewable. Give your reasons for each choice.

#### Questions

Name two energy sources that you would consider to be renewable. Give reasons for your choices.

Give the names of two energy sources that you would consider to be exhaustible. Give reasons for your choices.

### What you have learnt

Our energy requirements increase with our standard of living.

In order to fulfil our energy requirements, we try to improve the efficiency of energy usage and also try and exploit new sources of energy.

We also need to look for new sources of energy because the conventional sources of energy like fossil fuels are in danger of getting exhausted soon.

The energy source we select would depend on factors like the ease and cost of extracting energy from the source, the efficiency of the technology available for using that source of energy and the environmental impact of using that source.

Many of the sources ultimately derive their energy from the Sun.

### Exercises

A solar water heater cannot be used to get hot water on

a sunny day.

a cloudy day.

a hot day.

a windy day.

Which of the following is not an example of a bio-mass energy source?

wood

*gobar-gas*

nuclear energy

coal

Most of the sources of energy we use represent stored solar energy. Which of the following is not ultimately derived from the Sun’s energy?

geothermal energy

wind energy

nuclear energy

bio-mass.

Compare and contrast fossil fuels and the Sun as direct sources of energy.

Compare and contrast bio-mass and hydro electricity as sources of energy.

What are the limitations of extracting energy from—

the wind?

waves?

tides?

On what basis would you classify energy sources as

renewable and non-renewable?

exhaustible and inexhaustible?

Are the options given in (a) and (b) the same?

What are the qualities of an ideal source of energy?

What are the advantages and disadvantages of using a solar cooker? Are there places where solar cookers would have limited utility?

What are the environmental consequences of the increasing demand for energy? What steps would you suggest to reduce energy consumption?

## Chapter 15 – Our Environment



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We have heard the word ‘environment’ often being used on the television, in newspapers and by people around us. Our elders tell us that the ‘environment’ is not what it used to be earlier; others say that we should work in a healthy ‘environment’; and global summits involving the developed and developing countries are regularly held to discuss ‘environmental’ issues. In this chapter, we shall be studying how various components in the environment interact with each other and how we impact the environment.

### 15.1 - Eco-System — What Are Its Components?

All organisms such as plants, animals, microorganisms and human beings as well as the physical surroundings interact with each other and maintain a balance in nature. All the interacting organisms in an area together with the non-living constituents of the environment form an ecosystem. Thus, an ecosystem consists of biotic components comprising living organisms and abiotic components comprising physical factors like temperature, rainfall, wind, soil and minerals.

For example, if you visit a garden you will find different plants, such as grasses, trees; flower bearing plants like rose, jasmine, sunflower; and animals like frogs, insects and birds. All these living organisms interact with each other and their growth, reproduction and other activities are affected by the abiotic components of ecosystem. So a garden is an ecosystem. Other types of ecosystems are forests, ponds and lakes. These are natural ecosystems while gardens and crop-fields are human-made (artificial) ecosystems.

#### Activity 15.1

You might have seen an aquarium. Let us try to design one.

What are the things that we need to keep in mind when we create an aquarium? The fish would need a free space for swimming (it could be a large jar), water, oxygen and food.

We can provide oxygen through an oxygen pump (aerator) and fish food which is available in the market.

If we add a few aquatic plants and animals it can become a self-sustaining system. Can you think how this happens? An aquarium is an example of a human-made ecosystem.

Can we leave the aquarium as such after we set it up? Why does it have to be cleaned once in a while? Do we have to clean ponds or lakes in the same manner? Why or why not?

We have seen in earlier classes that organisms can be grouped as producers, consumers and decomposers according to the manner in which they obtain their sustenance from the environment. Let us recall what we have learnt through the self sustaining ecosystem created by us above. Which organisms can make organic compounds like sugar and starch from inorganic substances using the radiant energy of the Sun in the presence of chlorophyll? All green plants and certain bacteria which can produce food by photosynthesis come under this category and are called the producers.

Organisms depend on the producers either directly or indirectly for their sustenance? These organisms which consume the food produced, either directly from producers or indirectly by feeding on other consumers are the consumers. Consumers can be classed variously as herbivores, carnivores, omnivores and parasites. Can you give examples for each of these categories of consumers?

Imagine the situation where you do not clean the aquarium and some fish and plants have died. Have you ever thought what happens when an organism dies? The microorganisms, comprising bacteria and fungi, break-down the dead remains and waste products of organisms. These microorganisms are the decomposers as they break-down the complex organic substances into simple inorganic substances that go into the soil and are used up once more by the plants. What will happen to the garbage, and dead animals and plants in their absence? Will the natural replenishment of the soil take place, even if decomposers are not there?

#### Activity 15.2

While creating an aquarium did you take care not to put an aquatic animal which would eat others? What would have happened otherwise?

Make groups and discuss how each of the above groups of organisms are dependent on each other.

Write the aquatic organisms in order of who eats whom and form a chain of at least three steps.

Would you consider any one group of organisms to be of primary importance? Why or why not?

#### 15.1.1 - Food Chains and Webs

In Activity 15.4 we have formed a series of organisms feeding on one another. This series or organisms taking part at various biotic levels form a food chain (Fig. 15.1).

Each step or level of the food chain forms a trophic level. The autotrophs or the producers are at the first trophic level. They fix up the solar energy and make it available for heterotrophs or the consumers. The herbivores or the primary consumers come at the second, small carnivores or the secondary consumers at the third and larger carnivores or the tertiary consumers form the fourth trophic level (Fig. 15.2).

We know that the food we eat acts as a fuel to provide us energy to do work. Thus the interactions among various components of the environment involves flow of energy from one component of the system to another. As we have studied, the autotrophs capture the energy present in sunlight and convert it into chemical energy. This energy supports all the activities of the living world. From autotrophs, the energy goes to the heterotrophs and decomposers. However, as we saw in the previous Chapter on ‘Sources of Energy’, when one form of energy is changed to another, some energy is lost to the environment in forms which cannot be used again. The flow of energy between various components of the environment has been extensively studied and it has been found that –

The green plants in a terrestrial ecosystem capture about 1% of the energy of sunlight that falls on their leaves and convert it into food energy.

When green plants are eaten by primary consumers, a great deal of energy is lost as heat to the environment, some amount goes into digestion and in doing work and the rest goes towards growth and reproduction. An average of 10% of the food eaten is turned into its own body and made available for the next level of consumers.

Therefore, 10% can be taken as the average value for the amount of organic matter that is present at each step and reaches the next level of consumers.

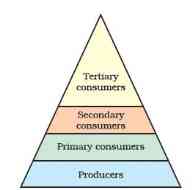
Since so little energy is available for the next level of consumers, food chains generally consist of only three or four steps. The loss of energy at each step is so great that very little usable energy remains after four trophic levels.

There are generally a greater number of individuals at the lower trophic levels of an ecosystem, the greatest number is of the producers.

The length and complexity of food chains vary greatly. Each organism is generally eaten by two or more other kinds of organisms which in turn are eaten by several other organisms. So instead of a straight line food chain, the relationship can be shown as a series of branching lines called a food web (Fig. 15.3).



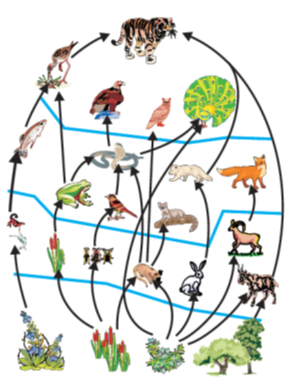
**Figure 15.1** Food chain in nature (a) in forest, (b) in grassland and (c) in a pond



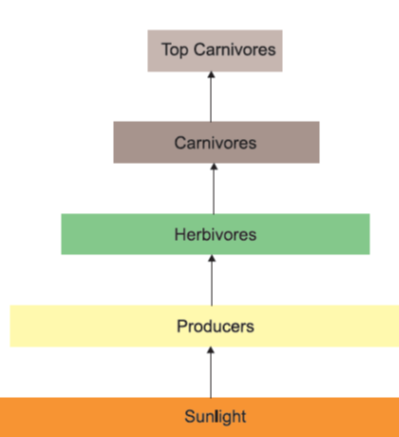
**Figure 15.2** Trophic levels

From the energy flow diagram (Fig. 15.4), two things become clear. Firstly, the flow of energy is unidirectional. The energy that is captured by the autotrophs does not revert back to the solar input and the energy which passes to the herbivores does not come back to autotrophs. As it moves progressively through the various trophic levels it is no longer available to the previous level. Secondly, the energy available at each trophic level gets diminished progressively due to loss of energy at each level.

Another interesting aspect of food chain is how unknowingly some harmful chemicals enter our bodies through the food chain. You have read in Class IX how water gets polluted. One of the reasons is the use of several pesticides and other chemicals to protect our crops from diseases and pests. These chemicals are either washed down into the soil or into the water bodies. From the soil, these are absorbed by the plants along with water and minerals, and from the water bodies these are taken up by aquatic plants and animals. This is one of the ways in which they enter the food chain. As these chemicals are not degradable, these get accumulated progressively at each trophic level. As human beings occupy the top level in any food chain, the maximum concentration of these chemicals get accumulated in our bodies. This phenomenon is known as biological magnification. This is the reason why our food grains such as wheat and rice, vegetables and fruits, and even meat, contain varying amounts of pesticide residues. They cannot always be removed by washing or other means.



**Figure 15.3** Food web, consisting of many food chains



**Figure 15.4** Diagram showing flow of energy in an ecosystem

##### Activity 15.3

Newspaper reports about pesticide levels in ready-made food items are often seen these days and some states have banned these products. Debate in groups the need for such bans.

What do you think would be the source of pesticides in these food items? Could pesticides get into our bodies from this source through other food products too?

Discuss what methods could be applied to reduce our intake of pesticides.

#### Questions

What are trophic levels? Give an example of a food chain and state the different trophic levels in it.

What is the role of decomposers in the ecosystem?

### 15.2 - How Do Our Activities Affect The Environment?

We are an integral part of the environment. Changes in the environment affect us and our activities change the environment around us. We have already seen in Class IX how our activities pollute the environment. In this chapter, we shall be looking at two of the environmental problems in detail, that is, depletion of the ozone layer and waste disposal.

#### 15.2.1 - Ozone Layer and How it is Getting Depleted

Ozone (O3O\_{3}

) is a molecule formed by three atoms of oxygen. WhileO2O\_{2}

, which we normally refer to as oxygen, is essential for all aerobic forms of life. Ozone, is a deadly poison. However, at the higher levels of the atmosphere, ozone performs an essential function. It shields the surface of the earth from ultraviolet (UV) radiation from the Sun. This radiation is highly damaging to organisms, for example, it is known to cause skin cancer in human beings.

Ozone at the higher levels of the atmosphere is a product of UV radiation acting on oxygen (O2O\_{2}

) molecule. The higher energy UV radiations split apart some moleculer oxygen (O2O\_{2}

) into free oxygen (O) atoms. These atoms then combine with the molecular oxygen to form ozone as shown—

O2→UVO+OO\_{2}\overset{\text{UV}}{\rightarrow}O + O

O+O2→O3(Ozone)O + O\_{2} \rightarrow \underset{\left( \text{Ozone} \right)}{O\_{3}}

The amount of ozone in the atmosphere began to drop sharply in the 1980s. This decrease has been linked to synthetic chemicals like chlorofluorocarbons (CFCs) which are used as refrigerants and in fire extinguishers. In 1987, the United Nations Environment Programme (UNEP) succeeded in forging an agreement to freeze CFC production at 1986 levels. It is now mandatory for all the manufacturing companies to make CFC-free refrigerators throughout the world.

##### Activity 15.4

Find out from the library, internet or newspaper reports, which chemicals are responsible for the depletion of the ozone layer.

Find out if the regulations put in place to control the emission of these chemicals have succeeded in reducing the damage to the ozone layer. Has the size of the hole in the ozone layer changed in recent years?

#### 15.2.2 - Managing the Garbage we Produce

In our daily activities, we generate a lot of material that are thrown away. What are some of these waste materials? What happens after we throw them away? Let us perform an activity to find answers to these questions.

We have seen in the chapter on ‘Life Processes’ that the food we eat is digested by various enzymes in our body. Have you ever wondered why the same enzyme does not break-down everything we eat? Enzymes are specific in their action, specific enzymes are needed for the break-down of a particular substance. That is why we will not get any energy if we try to eat coal! Because of this, many human-made materials like plastics will not be broken down by the action of bacteria or other saprophytes. These materials will be acted upon by physical processes like heat and pressure, but under the ambient conditions found in our environment, these persist for a long time.

Substances that are broken down by biological processes are said to be biodegradable. How many of the substances you buried were biodegradable? Substances that are not broken down in this manner are said to be non-biodegradable. These substances may be inert and simply persist in the environment for a long time or may harm the various members of the eco-system.

Visit any town or city, and we are sure to find heaps of garbage all over the place. Visit any place of tourist interest and we are sure to find the place littered with empty food wrappers. In the earlier classes we have talked about this problem of dealing with the garbage that we generate. Let us now look at the problem a bit more deeply.

Improvements in our life-style have resulted in greater amounts of waste material generation. Changes in attitude also have a role to play, with more and more things we use becoming disposable. Changes in packaging have resulted in much of our waste becoming non-biodegradable. What do you think will be the impact of these on our environment?

##### Activity 15.5

Collect waste material from your homes. This could include all the waste generated during a day, like kitchen waste (spoilt food, vegetable peels, used tea leaves, milk packets and empty cartons), waste paper, empty medicine bottles/strips/bubble packs, old and torn clothes and broken footwear.

Bury this material in a pit in the school garden or if there is no space available, you can collect the material in an old bucket/flower pot and cover with at least 15 cm of soil.

Keep this material moist and observe at 15-day intervals.

What are the materials that remain unchanged over long periods of time?

What are the materials which change their form and structure over time?

Of these materials that are changed, which ones change the fastest?

##### Activity 15.6

Use the library or internet to find out more about biodegradable and non-biodegradable substances.

How long are various non-biodegradable substances expected to last in our environment?

These days, new types of plastics which are said to be biodegradable are available. Find out more about such materials and whether they do or do not harm the environment.

##### Activity 15.7

Find out what happens to the waste generated at home. Is there a system in place to collect this waste?

Find out how the local body (*panchayat*, municipal corporation, resident welfare association) deals with the waste. Are there mechanisms in place to treat the biodegradable and non-biodegradable wastes separately?

Calculate how much waste is generated at home in a day.

How much of this waste is biodegradable?

Calculate how much waste is generated in the classroom in a day.

How much of this waste is biodegradable?

Suggest ways of dealing with this waste.

##### Activity 15.8

Find out how the sewage in your locality is treated. Are there mechanisms in place to ensure that local water bodies are not polluted by untreated sewage.

Find out how the local industries in your locality treat their wastes. Are there mechanisms in place to ensure that the soil and water are not polluted by this waste?

##### Activity 15.9

Search the internet or library to find out what hazardous materials have to be dealt with while disposing of electronic items. How would these materials affect the environment?

Find out how plastics are recycled. Does the recycling process have any impact on the environment?

#### Questions

Why are some substances biodegradable and some non-biodegradable?

Give any two ways in which biodegradable substances would affect the environment.

Give any two ways in which non-biodegradable substances would affect the environment.

#### Think it over

**Disposable cups in trains**

If you ask your parents, they will probably remember a time when tea in trains was served in plastic glasses which had to be returned to the vendor. The introduction of disposable cups was hailed as a step forward for reasons of hygiene. No one at that time perhaps thought about the impact caused by the disposal of millions of these cups on a daily basis. Some time back, *kulhads*, that is, disposable cups made of clay, were suggested as an alternative. But a little thought showed that making these *kulhads* on a large scale would result in the loss of the fertile top-soil. Now disposable paper-cups are being used. What do you think are the advantages of disposable paper-cups over disposable plastic cups?

#### Questions

What is ozone and how does it affect any ecosystem?

How can you help in reducing the problem of waste disposal? Give any two methods.

### What you have learnt

The various components of an ecosystem are interdependent.

The producers make the energy from sunlight available to the rest of the ecosystem.

There is a loss of energy as we go from one trophic level to the next, this limits the number of trophic levels in a food-chain.

Human activities have an impact on the environment.

The use of chemicals like CFCs has endangered the ozone layer. Since the ozone layer protects against the ultraviolet radiation from the Sun, this could damage the environment.

The waste we generate may be biodegradable or non-biodegradable.

The disposal of the waste we generate is causing serious environmental problems.

### Exercises

Which of the following groups contain only biodegradable items?

Grass, flowers and leather

Grass, wood and plastic

Fruit-peels, cake and lime-juice

Cake, wood and grass

Which of the following constitute a food-chain?

Grass, wheat and mango

Grass, goat and human

Goat, cow and elephant

Grass, fish and goat

Which of the following are environment-friendly practices?

Carrying cloth-bags to put purchases in while shopping

Switching off unnecessary lights and fans

Walking to school instead of getting your mother to drop you on her scooter

All of the above

What will happen if we kill all the organisms in one trophic level?

Will the impact of removing all the organisms in a trophic level be different for different trophic levels? Can the organisms of any trophic level be removed without causing any damage to the ecosystem?

What is biological magnification? Will the levels of this magnification be different at different levels of the ecosystem?

What are the problems caused by the non-biodegradable wastes that we generate?

If all the waste we generate is biodegradable, will this have no impact on the environment?

Why is damage to the ozone layer a cause for concern? What steps are being taken to limit this damage?

## Chapter 16 – Sustainable Management of Natural Resources



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‘Living in harmony with nature’ is not new to us. Sustainable living has always been an integral part of India’s tradition and culture. It has been integrated with our long-lasting traditions and practices, customs, art and crafts, festivals, food, beliefs, rituals and folklore. Ingrained within us is the philosophy that ‘entire natural world be in harmony’ which is reflected in the famous phrase in Sanskrit ‘*Vasudhaiv* *kutumbakam’* that means “the entire earth is one family”. The phrase is mentioned in ‘Mahaupanishad’, that is probably a part of the ancient Indian text, *Atharva Veda*.

In Class IX we have already learnt about some natural resources like soil, air and water and how various components are cycled over and over again in nature. Also, we learnt in the previous chapter about the pollution of these resources because of some of our activities. In this chapter, we shall look at some of our resources and how we are using them. Maybe we should also think about how we ought to be using our resources so as to sustain them and conserve our environment. We shall be looking at our natural resources like forests, wildlife, water, coal and petroleum and see what are the issues at stake in deciding how these resources are to be managed for sustainable development along with the input from our traditional practices.

We often hear or read about environmental problems. These are often global-level problems and we feel helpless to bring any change. There are international laws and regulations, and then there are our own national laws and acts for environmental protection. There are also national and international organisations working towards protecting our environment.

### Activity 16.1

Find out about the international norms to regulate the emission of carbon dioxide.

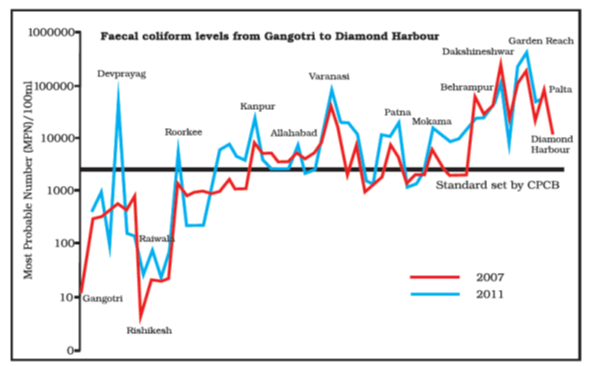
Have a discussion in class about how we can contribute towards meeting those norms.

### Activity 16.2

There are a number of organisations that seek to spread awareness about our environment and promote activities and attitudes that lead to the conservation of our environment and natural resources. Find out about the organisation(s) active in your neighbourhood/village/town/city.

Find out how you can contribute towards the same cause.

Awareness about the problems caused by unthinkingly exploiting our resources has been a fairly recent phenomenon in our society. And once this awareness rises, some action is usually taken. You must have heard about the Ganga Action Plan. This multi-crore project came about in 1985 because the quality of the water in the Ganga was very poor. Coliform is a group of bacteria, found in human intestines, whose presence in water indicates contamination by disease-causing microorganisms.



**Figure 16.1** Total coliform count levels in the Ganga. Source: Central Pollution Control Board, 2012

### Do you know?

**Pollution of the Ganga**

The Ganga runs its course of over 2500 km from Gangotri in the Himalayas to Ganga Sagar in the Bay of Bengal. It is being turned into a drain by more than a hundred towns and cities in Uttar Pradesh, Bihar and West Bengal that pour their garbage and excreta into it. Largely untreated sewage is dumped into the Ganges every day. In addition, think of the pollution caused by other human activities like bathing, washing of clothes and immersion of ashes or unburnt corpses. And then, industries contribute chemical effluents to the Ganga’s pollution load and the toxicity kills fish in large sections of the river. Namami Gange Programme is an Integrated Conservation Mission approved as a Flagship Programme by the Union Government in June, 2014. It was launched to accomplish the twin objectives of effective abatement of pollution conservation and rejuvenation of River Ganga. The National Mission for Clean Ganga is the implementation wing set up in October, 2016.

As you can see, there are some measurable factors which are used to quantify pollution or the quality of the water that we use for various activities. Some of the pollutants are harmful even when present in very small quantities and we require sophisticated equipment to measure them. But as we learnt in Chapter 2, the pH of water is something that can easily be checked using universal indicator.

We need not feel powerless or overwhelmed by the scale of the problems because there are many things we can do to make a difference. You must have come across the five R’s to save the environment: Refuse, Reduce, Reuse, Repurpose and Recycle. What do they refer to?

**Refuse:** This means to say No to things people offer you that you don’t need. Refuse to buy products that can harm you and the environment, say No to single-use plastic carry bags.

**Reduce:** This means that you use less. You save electricity by switching off unnecessary lights and fans. You save water by repairing leaky taps. Do not waste food. Can you think of other things that you can reduce the usage of?

**Reuse:** This is actually even better than recycling because the process of recycling uses some energy. In the ‘reuse’ strategy, you simply use things again and again. Instead of throwing away used envelopes, you can reverse it and use it again. The plastic bottles in which you buy various food-items like jam or pickle can be used for storing things in the kitchen. What other items can we reuse?

**Repurpose:** This means when a product can no more be used for the original purpose, think carefully and use it for some other useful purpose. For example, cracked crockery, or cups with broken handles can be used to grow small plants and as feeding vessels for birds.

**Recycle:** This means that you collect plastic, paper, glass and metal items and recycle these materials to make required things instead of synthesising or extracting fresh plastic, paper, glass or metal. In order to recycle, we first need to segregate our wastes so that the material that can be recycled is not dumped along with other wastes. Does your village/town/city have a mechanism in place for recycling these materials?

Even while making everyday choices, we can make environment-friendly decisions. For doing this, we need to know more about how our choices affect the environment, these effects may be immediate or long-term or long-ranging. The concept of sustainable development encourages forms of growth that meet current basic human needs, while preserving the resources for the needs of future generations. Economic development is linked to environmental conservation. Thus sustainable development implies a change in all aspects of life. It depends upon the willingness of the people to change their perceptions of the socio-economic and environmental conditions around them, and the readiness of each individual to alter their present use of natural resources.

### Activity 16.3

Check the pH of the water supplied to your house using universal indicator or litmus paper.

Also check the pH of the water in the local waterbody (pond, river, lake, stream).

Can you say whether the water is polluted or not on the basis of your observations?

### Activity 16.4

Have you ever visited a town or village after a few years of absence? If so, have you noticed new roads and houses that have come up since you were there last? Where do you think the materials for making these roads and buildings have come from?

Try and make a list of the materials and their probable sources.

Discuss the list you have prepared with your classmates. Can you think of ways in which the use of these materials be reduced?

### 16.1 - Why Do We Need To Manage Our Resources?

Not just roads and buildings, but all the things we use or consume-food, clothes, books, toys, furniture, tools and vehicles – are obtained from resources on this earth. The only thing we get from outside is energy which we receive from the Sun. Even this energy is processed by living organisms and various physical and chemical processes on the earth before we make use of it.

Why do we need to use our resources carefully? Because these are not unlimited and with the human population increasing at a tremendous rate due to improvement in health-care, the demand for all resources is increasing at an exponential rate. The management of natural resources requires a long-term perspective so that these will last for the generations to come and will not merely be exploited to the hilt for short-term gains. This management should also ensure equitable distribution of resources so that all, and not just a handful of rich and powerful people, benefit from the development of these resources.

Another factor to be considered while we exploit these natural resources is the damage we cause to the environment while these resources are either extracted or used. For example, mining causes pollution because of the large amount of slag which is discarded for every tonne of metal extracted. Hence, sustainable natural resource management demands that we plan for the safe disposal of these wastes too.

The present day global concerns for sustainable development and conservation of natural resources are of recent origin as compared to the long tradition and culture of nature conservation in our country. Principles of conservation and sustainable management were well established in the pre-historic India.

Our ancient literature is full of such examples where values and sensitivity of humans towards nature was glorified and the principle of sustainability was established at its best.

#### Activity 16.5

Observe various traditional practices for conservation of nature in your day-to-day life. Share within the peer group. Make a report and submit.

Indian texts such as Upanishads and Smritis contain many descriptions on the uses and management of forests, and highlight sustainability as an implicit theme. One hymn from *Atharva* *Veda* || 12.1.11||, later translated into English in the book *Atharva Veda*—*the Sanskrit Text with English Translation,* written by Devi Chand in 1997, reads:

yirayaste parvatā himavantoranyam te pṛthivi syonamastu babhruṃ kṛṣṇ­āṃ rohiṇiṃ viśvarūpām dhruvāṃ bhūmi pṛthivīmindraguptām ajitohato akṣatodhyaṣṭhām pṛthivīmaham ||12.1.11|| (*Atharva* *Veda*)

“O Earth! Pleasant be thy hills, snow-clad mountains and forests; O numerous coloured, firm and protected earth! On this earth I stand, undefeated, unslain, unhurt.”

Another hymn that reveals utilisation and regeneration principles from *Atharva* *Veda* || 12.1.35 || reads:

yatte bhūme vikhanāmi kṣipraṃ tadapi rohatu

mā te marma vimṛgvari mā te hrdayamarpipam ||12.1.35|| (*Atharva* *Veda*)

“Whatever I dig out of you, O Earth! May that have quick regeneration again; may we not damage thy vital habitat and heart.”

During the Vedic period, both productive as well as protective aspect of forest vegetation were emphasised. Agriculture emerged as a dominant economic activity during the later Vedic period. This was the time when the concept of cultural landscape such as sacred forests and groves, sacred corridors and a variety of ethno-forestry practices were evolved that continued to the post-Vedic period, besides a wide range of ethno-forestry practices were infused with the traditions, customs and rituals and followed as a means for protection of nature and natural resource.

#### Questions

What changes can you make in your habits to become more environment-friendly?

What would be the advantages of exploiting resources with short-term aims?

How would these advantages differ from the advantages of using a long-term perspective in managing our resources?

Why do you think that there should be equitable distribution of resources? What forces would be working against an equitable distribution of our resources?

### 16.2 - Forests And Wildlife

Forests are ‘biodiversity hotspots’. One measure of the biodiversity of an area is the number of species found there. However, the range of different life forms (bacteria, fungi, ferns, flowering plants, nematodes, insects, birds, reptiles and so on) found, is also important. One of the main aims of conservation is to try and preserve the biodiversity we have inherited. Experiments and field studies suggest that loss of diversity may lead to loss of ecological stability.

#### 16.2.1 - Stakeholders

##### Activity 16.6

Make a list of forest produce that you use.

What do you think a person living near a forest would use?

What do you think a person living in a forest would use?

Discuss with your classmates how these needs differ or do not differ and the reasons for the same.

We all use various forest produce. But our dependency on forest resources varies. Some of us have access to alternatives, some do not. When we consider the conservation of forests, we need to look at the stakeholders who are –

the people who live in or around forests are dependent on forest produce for various aspects of their life (see Fig. 16.2).

the Forest Department of the Government which owns the land and controls the resources from forests.

the industrialists – from those who use ‘tendu’ leaves to make *bidis* to the ones with paper mills – who use various forest produce, but are not dependent on the forests in any one area.

the wildlife and nature enthusiasts who want to conserve nature in its pristine form.

Let us take a look at what each of these groups needs/gets out of the forests. The local people need large quantities of firewood, small timber and thatch. Bamboo is used to make slats for huts, and baskets for collecting and storing food materials. Implements for agriculture, fishing and hunting are largely made of wood, also forests are sites for fishing and hunting. In addition to the people gathering fruits, nuts and medicines from the forests, their cattle also graze in forest areas or feed on the fodder which is collected from forests.

Do you think such use of forest resources would lead to the exhaustion of these resources? Do not forget that before the British came and took over most of our forest areas, people had been living in these forests for centuries. They had developed practices to ensure that the resources were used in a sustainable manner. After the British took control of the forests (which they exploited ruthlessly for their own purposes), these people were forced to depend on much smaller areas and forest resources started becoming over-exploited to some extent. The Forest Department in independent India took over from the British but local knowledge and local needs continued to be ignored in the management practices. Thus vast tracts of forests have been converted to monocultures of pine, teak or eucalyptus. In order to plant these trees, huge areas are first cleared of all vegetation. This destroys a large amount of biodiversity in the area. Not only this, the varied needs of the local people – leaves for fodder, herbs for medicines, fruits and nuts for food – can no longer be met from such forests. Such plantations are useful for the industries to access specific products and are an important source of revenue for the Forest Department.

Do you know how many industries are based on forest produce? A short count reveals timber, paper, lac and sports equipment.

Industries would consider the forest as merely a source of raw material for its factories. And huge interest-groups lobby the government for access to these raw materials at artificially low rates. Since these industries have a greater reach than the local people, they are not interested in the sustainability of the forest in one particular area. For example, after cutting down all the teak trees in one area, they will get their teak from a forest farther away. They do not have any stake in ensuring that one particular area should yield an optimal amount of some produce for all generations to come. What do you think will stop the local people in behaving in a similar manner?



**Figure 16.2** A view of a forest life

Lastly, we come to the nature and wildlife enthusiasts who are in no way dependent on the forests, but who may have considerable say in their management. The conservationists were initially taken up with large animals like lions, tigers, elephants and rhinoceros. They now recognise the need to preserve biodiversity as a whole. But shouldn’t we recognise people as forming part of the forest system? There have been enough instances of local people working traditionally for conservation of forests. For example, the case of Bishnois community living in western Rajasthan on the border of the Thar desert. Conservation of forest and wildlife has been a religious tenet for them. These nature-loving people have for centuries, been conserving the flora and fauna to the extent of sacrificing their lives to protect the environment. They are living with the basic philosophy that all living things have a right to survive and share all resources. The Government of India has recently instituted an ‘Amrita Devi Bishnoi National Award for Wildlife Conservation’ in the memory of Amrita Devi Bishnoi, who in 1731 sacrificed her life along with 363 others for the protection of ‘khejri’ trees in Khejrali village near Jodhpur in Rajasthan.

Studies have shown that the prejudice against the traditional use of forest areas has no basis. Here is an example – the great Himalayan National Park contains, within its reserved area, alpine meadows which were grazed by sheep in summer. Nomadic shepherds drove their flock up from the valleys every summer. When this national park was formed, this practice was put to an end. Now it is seen that without the regular grazing by sheep the grass first grows very tall, and then falls over preventing fresh growth.

Management of protected areas by keeping the local people out or by using force cannot possibly be successful in the long run. In any case, the damage caused to forests cannot be attributed to only the local people – one cannot turn a blind eye to the deforestation caused by industrial needs or development projects like building roads or dams. The damage caused in these reserves by tourists or the arrangements made for their convenience is also to be considered.

We need to accept that human intervention has been very much a part of the forest landscape. What has to be managed in the nature and what may be the extent of this intervention? Forest resources ought to be used in a manner that is both environmentally and developmentally sound – in other words, while the environment is preserved, the benefits of the controlled exploitation go to the local people, a process in which decentralised economic growth and ecological conservation go hand in hand. The kind of economic and social development we want will ultimately determine whether the environment will be conserved or further destroyed. The environment must not be regarded as a pristine collection of plants and animals. It is a vast and complex entity that offers a range of natural resources for our use. We need to use these resources with due caution for our economic and social growth, and to meet our material aspirations.



Figure 16.3 Khejri Tree

##### Activity 16.7

Find out about any two forest produce that are the basis for an industry.

Discuss whether this industry is sustainable in the long run. Or do we need to control our consumption of these products?

#### 16.2.2 - Management of forest

We need to consider if the goals of all the above stakeholders with regard to the management of the forests are the same. Forest resources are often made available for industrial use at rates far below the market value while these are denied to the local people. The *Chipko Andolan* (‘Hug the Trees Movement’) was the result of a grassroot level effort to end the alienation of people from their forests. The movement originated from an incident in a remote village called Reni in Garhwal, high-up in the Himalayas during the early 1970s. There was a dispute between the local villagers and a logging contractor who had been allowed to fell trees in a forest close to the village. On a particular day, the contractor’s workers appeared in the forest to cut the trees while the men folk were absent. Undeterred, the women of the village reached the forest quickly and clasped the tree trunks thus preventing the workers from felling the trees. Thus thwarted, the contractor had to withdraw.

Inherent in such a competition to control a natural resource is the conservation of a replenishable resource. Specifically the method of use was being called into question. The contractor would have felled the trees, destroying them forever. The communities traditionally lop the branches and pluck the leaves, allowing the resource to replenish over time. The *Chipko* movement quickly spread across communities and media, and forced the government, to whom the forest belongs, to rethink their priorities in the use of forest produce. Experience has taught people that the destruction of forests affected not just the availability of forest products, but also the quality of soil and the sources of water. Participation of the local people can indeed lead to the efficient management of forests.

**An Example of People’s Participation in the Management of Forests**

In 1972, the West Bengal Forest Department recognised its failures in reviving the degraded *Sal* forests in the south-western districts of the state. Traditional methods of surveillance and policing had led to a ‘complete alienation of the people from the administration’, resulting in frequent clashes between forest officials and villagers. Forest and land related conflicts in the region were also a major factor in fuelling the militant peasant movements led by the Naxalites.

Accordingly, the Department changed its strategy, making a beginning in the Arabari forest range of Midnapore district. Here, at the insistence of a far-seeing forest officer, A.K. Banerjee, villagers were involved in the protection of 1,272 hectares of badly degraded sal forest. In return for help in protection, villagers were given employment in both silviculture and harvesting operations, 25 per cent of the final harvest, and allowed fuelwood and fodder collection on payment of a nominal fee. With the active and willing participation of the local community, the sal forests of Arabari underwent a remarkable recovery – by 1983, a previously worthless forest was valued Rs 12.5 crores.

##### Activity 16.8

Debate the damage caused to forests by the following —

Building rest houses for tourists in national parks.

Grazing domestic animals in national parks.

Tourists throwing plastic bottles/covers and other litter in national parks.

#### Questions

Why should we conserve forests and wildlife?

Suggest some approaches towards the conservation of forests.

### 16.3 - Water For All

#### Activity 16.9

Villages suffering from chronic water shortage surround a water theme park in Maharashtra. Debate whether this is the optimum use of the available water.

Water is a basic necessity for all terrestrial forms of life. We studied in Class IX about the importance of water as a resource, the water cycle and how human intervention pollutes waterbodies. However, human intervention also changes the availability of water in various regions.

#### Activity 16.10

Study the rainfall patterns in India from an atlas.

Identify the regions where water is abundant and the regions of water scarcity.

After the above activity, would you be very surprised to learn that regions of water scarcity are closely correlated to the regions of acute poverty?

A study of rainfall patterns does not reveal the whole truth behind the water availability in various regions in India. Rains in India are largely due to the monsoons. This means that most of the rain falls in a few months of the year. Despite nature’s monsoon bounty, failure to sustain water availability underground has resulted largely from the loss of vegetation cover, diversion for high water demanding crops, and pollution from industrial effluents and urban wastes. Irrigation methods like dams, tanks and canals have been used in various parts of India since ancient times. These were generally local interventions managed by local people and assured that the basic minimum requirements for both agriculture and daily needs were met throughout the year. The use of this stored water was strictly regulated and the optimum cropping patterns based on the water availability were arrived at on the basis of decades/centuries of experience, the maintenance of these irrigation systems was also a local affair.

The arrival of the British changed these systems as it changed many other things. The conception of large scale projects – large dams and canals traversing large distances were first conceived and implemented by the British and carried on with no less gusto by our newly formed independent government. These mega-projects led to the neglect of the local irrigation methods, and the government also increasingly took over the administration of these systems leading to the loss of control over the local water sources by the local people.

#### More to know!

***Kulhs*** in Himachal Pradesh

Parts of Himachal Pradesh had evolved a local system of canal irrigation called *kulhs* over four hundred years ago. The water flowing in the streams was diverted into man-made channels which took this water to numerous villages down the hillside. The management of the water flowing in these *kulhs* was by common agreement among all the villages. Interestingly, during the planting season, water was first used by the village farthest away from the source of the *kulh*, then by villages progressively higher up. These *kulhs* were managed by two or three people who were paid by the villagers. In addition to irrigation, water from these *kulhs* also percolated into the soil and fed springs at various points. After the *kulhs* were taken over by the Irrigation Department, most of them became defunct and there is no amicable sharing of water as before.

#### 16.3.1 - Dams

Why do we seek to build dams? Large dams can ensure the storage of adequate water not just for irrigation, but also for generating electricity, as discussed in the previous chapter. Canal systems leading from these dams can transfer large amounts of water over great distances. For example, the Indira Gandhi Canal has brought greenery to considerable areas of Rajasthan. However, mismanagement of the water has largely led to the benefits being cornered by a few people. There is no equitable distribution of water, thus people close to the source grow water intensive crops like sugarcane and rice while people farther downstream do not get any water. The woes of these people who have been promised benefits which never arrived are added to the discontentment among the people who have been displaced by the building of the dam and its canal network.

In the previous chapter, we mentioned the reasons for opposition to the construction of large dams, such as the Tehri Dam on the river Ganga. You must have read about the protests by the *Narmada Bachao Andolan* (‘Save the Narmada Movement’) about raising the height of the Sardar Sarovar Dam on the river Narmada. Criticisms about large dams address three problems in particular –

Social problems because they displace large number of peasants and tribals without adequate compensation or rehabilitation,

Economic problems because they swallow up huge amounts of public money without the generation of proportionate benefits,

Environmental problems because they contribute enormously to deforestation and the loss of biological diversity.

The people who have been displaced by various development projects are largely poor tribals who do not get any benefits from these projects and are alienated from their lands and forests without adequate compensation. The oustees of the Tawa Dam built in the 1970s are still fighting for the benefits they were promised.

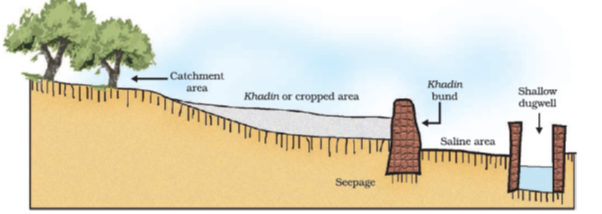
#### 16.3.2 - Water Harvesting

Watershed management emphasises scientific soil and water conservation in order to increase the biomass production. The aim is to develop primary resources of land and water, to produce secondary resources of plants and animals for use in a manner which will not cause ecological imbalance. Watershed management not only increases the production and income of the watershed community, but also mitigates droughts and floods and increases the life of the downstream dam and reservoirs. Various organisations have been working on rejuvenating ancient systems of water harvesting as an alternative to the ‘mega-projects’ like dams. These communities have used hundreds of indigenous water saving methods to capture every trickle of water that had fallen on their land; dug small pits and lakes, put in place simple watershed systems, built small earthen dams, constructed dykes, sand and limestone reservoirs, set up rooftop water-collecting units. This has recharged groundwater levels and even brought rivers back to life.

Water harvesting is an age-old concept in India. *Khadins*, tanks and *nadis* in Rajasthan, *bandharas* and *tals* in Maharashtra, *bundhis* in Madhya Pradesh and Uttar Pradesh, *ahars* and *pynes* in Bihar, *kulhs* in Himachal Pradesh, ponds in the Kandi belt of Jammu region, and *eris* (tanks) in Tamil Nadu, *surangams* in Kerala, and *kattas* in Karnataka are some of the ancient water harvesting, including water conveyance, structures still in use today (see Fig. 16.4 for an example). Water harvesting techniques are highly locale specific and the benefits are also localised. Giving people control over their local water resources ensures that mismanagement and over-exploitation of these resources is reduced/removed.

In largely level terrain, the water harvesting structures are mainly crescent shaped earthen embankments or low, straight concrete-and-rubble “check dams” built across seasonally flooded gullies. Monsoon rains fill ponds behind the structures. Only the largest structures hold water year round; most dry up six months or less after the monsoons. Their main purpose, however, is not to hold surface water but to recharge the ground water beneath. The advantages of water stored in the ground are many. It does not evaporate, but spreads out to recharge wells and provides moisture for vegetation over a wide area. In addition, it does not provide breeding grounds for mosquitoes like stagnant water collected in ponds or artificial lakes. The groundwater is also relatively protected from contamination by human and animal waste.

A traditional technology is helping India’s “waterman” save thousands of parched villages and transform the lives of thousands of villagers in one of India’s most arid regions. In “two decades of efforts of Dr. Rajendra Singh, 8,600 *johads* and other structures to collect water have been built in Rajasthan,” and “Water had been brought back to a 1,000 villages across the state.” In 2015, he won the Stockholm Water Prize. It is the most prestigious award which honours a person who contributes to the conservation and protection of water resources for the well-being of the planet and its inhabitants.



**Figure 16.4** Traditional water harvesting system — an ideal setting of the khadin system

#### Questions

Find out about the traditional systems of water harvesting/management in your region.

Compare the above system with the probable systems in hilly/mountainous areas or plains or plateau regions.

Find out the source of water in your region/locality. Is water from this source available to all people living in that area?

### 16.4 - Coal and Petroleum

We have seen some of the issues involved in the conservation and sustainable use of resources like forests, wildlife and water. These can meet our needs perpetually if we were to use them in a sustainable manner. Now we come to yet another important resource – fossil fuels, that is, coal and petroleum, which are important sources of energy for us. Since the industrial revolution, we have been using increasing amounts of energy to meet our basic needs and for the manufacture of a large number of goods upon which our lives depend. These energy needs have been largely met by the reserves of coal and petroleum.

The management of these energy sources involves slightly different perspectives from those resources discussed earlier. Coal and petroleum were formed from the degradation of bio-mass millions of years ago and hence these are resources that will be exhausted in the future no matter how carefully we use them. And then we would need to look for alternative sources of energy. Various estimates exist as to how long these resources will last if the present rate of usage continues. It is estimated that our known petroleum resources will last us for about forty years and the coal resources will last for another two hundred years.

But looking at other sources of energy is not the only consideration when we look at the consumption of coal and petroleum. Since coal and petroleum have been formed from bio-mass, in addition to carbon, these contain hydrogen, nitrogen and sulphur. When these are burnt, the products are carbon dioxide, water, oxides of nitrogen and oxides of sulphur. When combustion takes place in insufficient air (oxygen), then carbon monoxide is formed instead of carbon dioxide. Of these products, the oxides of sulphur and nitrogen and carbon monoxide are poisonous at high concentrations and carbon dioxide is a greenhouse gas. Another way of looking at coal and petroleum is that they are huge reservoirs of carbon and if all of this carbon is converted to carbon dioxide, then the amount of carbon dioxide in the atmosphere is going to increase, leading to intense global warming. Thus, we need to use these resources judiciously.

#### Activity 16.11

Coal is used in thermal power stations and petroleum products like petrol and diesel are used in means of transport like motor vehicles, ships and aeroplanes. We cannot really imagine life without a number of electrical appliances and constant use of transportation. So can you think of ways in which our consumption of coal and petroleum products be reduced?

Some simple choices can make a difference in our energy consumption patterns. Think over the relative advantages, disadvantages and environment-friendliness of the following –

Taking a bus, using your personal vehicle or walking/cycling.

Using LED bulbs or fluorescent tubes in your homes.

Using the lift or taking the stairs.

Wearing an extra sweater or using a heating device (heater or ‘sigri’) on cold days.

The management of coal and petroleum also addresses the efficiency of our machines. Fuel is most commonly used in internal combustion engines for transportation and recent research in this field concentrates on ensuring complete combustion in these engines in order to increase efficiency and also reduce air pollution.

#### Activity 16.12

You must have heard of the Euro I and Euro II norms for emission from vehicles. Find out how these norms work towards reducing air pollution.

### 16.5 - An Overview Of Natural Resource Management

Sustainable management of natural resources is a difficult task. In addressing this issue, we need to keep an open mind with regard to the interests of various stakeholders. We need to accept that people will act with their own best interests as the priority. But the realisation that such selfish goals will lead to misery for a large number of people and a total destruction of our environment is slowly growing. Going beyond laws, rules and regulations, we need to tailor our requirements, individually and collectively, so that the benefits of development reach everyone now and for all generations to come.

### What you have learnt

Our resources like forests, wildlife, water, coal and petroleum need to be used in a sustainable manner.

We can reduce pressure on the environment by sincerely applying the maxim of ‘Refuse, Reduce, Reuse, Repurpose and Recycle’ in our lives.

Management of forest resources has to take into account the interests of various stakeholders.

The harnessing of water resources by building dams has social, economic and environmental implications. Alternatives to large dams exist. These are locale-specific and may be developed so as to give local people control over their local resources.

The fossil fuels, coal and petroleum, will ultimately be exhausted. Because of this and because their combustion pollutes our environment, we need to use these resources judiciously.

### Exercises

What changes would you suggest in your home in order to be environment-friendly?

Can you suggest some changes in your school which would make it environment-friendly?

We saw in this chapter that there are four main stakeholders when it comes to forests and wildlife. Which among these should have the authority to decide the management of forest produce? Why do you think so?

How can you as an individual contribute or make a difference to the management of (a) forests and wildlife, (b) water resources and (c) coal and petroleum?

What can you as an individual do to reduce your consumption of the various natural resources?

List five things you have done over the last one week to —

conserve our natural resources.

increase the pressure on our natural resources.

On the basis of the issues raised in this chapter, what changes would you incorporate in your lifestyle in a move towards a sustainable use of our resources?

### Answers

**Chapter 1**

(i)

(d)

(a)

**Chapter 2**

(d)

(b)

(d)

(c)

**Chapter 3**

(d)

(c)

(a)

(c)

**Chapter 4**

(b)

(c)

(b)

**Chapter 5**

(c)

(b)

**Chapter 6**

(c)

(a)

(d)

(b)

**Chapter 7**

(d)

(b)

(d)

**Chapter 8**

(b)

(c)

(d)

**Chapter 9**

(c)

(d)

(a)

**Chapter 10**

(d)

(d)

(b)

(a)

(d)

(c)

Distance less than 15 cm; virtual; Enlarged.

Yes

16.7 cm from the lens on the other side; 3.3 cm, reduced; real, inverted.

30 cm

6.0 cm, behind the mirror; virtual, erect

m=1m\ = \ 1

indicates that image formed by a plane mirror is of the same size as the object. Further, the positive sign of m indicates that the image is virtual and erect.

8.6 cm, behind the mirror; virtual, erect; 2.2 cm, reduced.

54 cm on the object side; 14 cm, magnified; real, inverted.

–0.50 m\text{–}\text{0.50\ m}

; concave lens

+ 0.67 m\text{+\ 0.67\ m}

; converging lens

**Chapter 11**

(b)

(d)

(c)

(c)

−0.18m- 0.18\ m

;

+0.67 m\text{+0.67\ m}

Concave lens; −1.25D- 1.25\ D

Convex lens; + 3.0 D\text{+\ 3.0\ D}

**Chapter 12**

(d)

(b)

(d)

(c)

Parallel

122.7 M; ¼ times

3.33 Ω

4.8 kΩ

0.67 A

4 resistors

110 bulbs

9.2 A, 4.6 A, 18.3 A

8 W

8 W

0.73 A

250 W TV set in 1 hour

120 W

High resistivity of alloys

inversely.

**Chapter 13**

(d)

(c)

(a)

(d)

(c)

False

True

True

False

vertically downwards

The needle will move momentarily in one direction

The needle will move momentarily but in opposite direction to (i)

No deflection in the needle would be observed.

Right-hand thumb rule,

Fleming’s left-hand rule,

Fleming’s right-hand rule.

**Chapter 14**

(b)

(c)

(c)

**Chapter 15**

(a), (c), (d)

(b)

(d)