17

CONSERVATION OF SOIL AND LAND

Soil erosion and land degradation together, constitute one of the major problems that disturb the ecological balance of the world. In this lesson, we will discuss the causes of soil erosion and land degradation. You will also learn about remedial measures that can be taken to reduce or prevent soil and land degradation.

OBJECTIVES

After completing this lesson, you will be able to;

- *define soil erosion;*
- *describe the causes of soil erosion, its consequences and methods of control;*
- *explain the harmful effects of agrochemicals (chemical fertilizers and pesticides);*
- *describe various methods of soil conservation;*
- *define land degradation;*
- *list factors responsible for land degradation;*
- *describe the major consequences and control of land degradation.*

17.1 SOIL EROSION AND LAND DEGRADATION

Rapid increase in human population has placed a great strain on the land and soil resources resulting in land degradation and soil erosion. Fig. 17.1 shows the relative effect of soil degrading agents. Agents like air, wind and water erode the soil.

Soil is the uppermost layer of the earth's crust, which can be dug or ploughed, and in which plants grow.

Land is a solid, substratum which supports human and many other organisms.

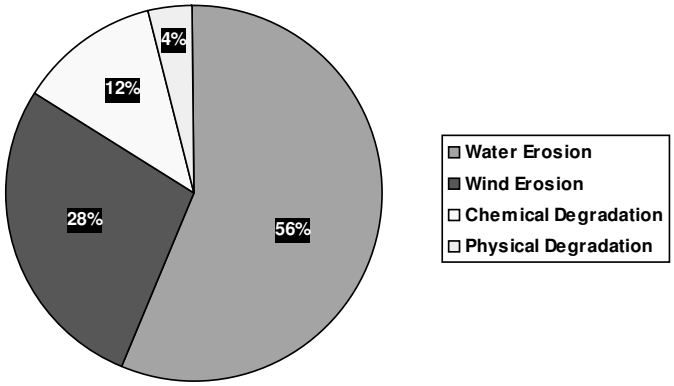

Fig. 17.1: *A pie-chart showing percentage of world wide soil degradation agents. (Modified from 'World map of the Status of Human –induced soil degradation 1990)*

On a worldwide basis more than 4.85 billion acres (1.96 billion hectares) or 17% of the earth under vegetation has been degraded by humans to various extent. Fig 17.2 shows that the soil of certain regions of the earth are in the danger of being degraded.

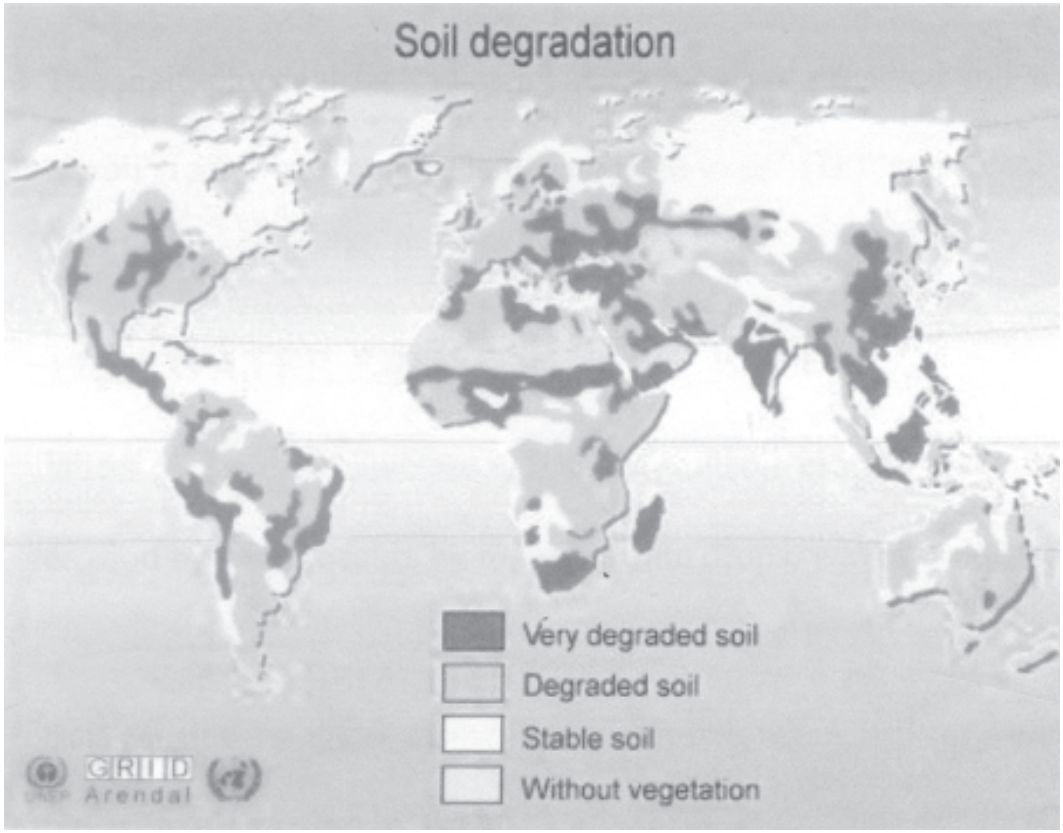

Fig. 17.2: *World map showing areas of concern for soil degradation (Source-World Resources 1992-1993-New York, Oxford University Press)*

Soil erosion

Soil erosion is the loosening and displacement of topsoil particles from the land. Soil erosion is a natural process that occurs on all lands. Soil erosion may occur at a slow or fast rate.

Land degradation

Land degradation is the deterioration in the quality of land. Degradation of land results in loss of crop production capacity of the land.

17.2 PACE OF SOIL EROSION

Soil erosion in nature may be (a) a slow process (or geological erosion) or (b) a fast process promoted by deforestation, floods, tornadoes or other human activities. These two processes are explained below:

(a) **Geological erosion**

Geological erosion (Geo: earth) is a slow process that continues relatively unnoticed and has been occurring for millions of years. The first phase of this soil forming process is called weathering which is a physico- chemical process that leads to the break down of rocks by wind and water into small fragments and formation of soil particles.

(b) **Accelerated (Speeded up) erosion**

Accelerated soil erosion occurs when the protective vegetation cover is destroyed. This may occur due to natural causes like flooding or due to human activities. One of the main human activitiy responsible for accelerated soil erosion is cultivation of land. Land under cultivation is more vulnerable to natural agencies like wind and water. Human activities accelerate removal of surface soil by wind and /or water at a faster rate. The rate and extent of accelerated soil erosion is much higher as compared to natural geological soil erosion.

17.3 TYPES OF SOIL EROSION

Soil erosion is classified on the basis of the physical agent responsible for erosion. The various types of soil erosion are consequently referred to as: (a) Water erosion (b) Wind erosion.

(a) **Water erosion**

Running water is one of the main agents, which carries away soil particles. Soil erosion by water occurs by means of raindrops, waves or ice.

Soil erosion by water is termed differently according to the intensity and nature of erosion.

(i) Raindrop erosion
(ii) Sheet erosion
(iii) Rill erosion
(iv) Steam banks erosion
(v) Erosion due to land slides
(vi) Coastal erosion.

(i) **Raindrop erosion**

Raindrops falling on land surface cause detachment of the soil particles. The loose soil particles are washed away by flowing water. Raindrops thus initiate water erosion. An average size of raindrop is approximately 5 mm in diameter falling through the air hits the soil at a velocity of 32 km/hr. Larger raindrops and gusts of wind hit the soil surface even at higher velocities. Raindrops behave like tiny bombs when falling on exposed soil, displace soil particles and destroy soil structure. Presence of vegetation on land prevents raindrops from falling directly on the soil thus erosion of soil in areas covered by vegetation is prevented.

With continued rainfall the displaced soil particles fill in the spaces between soil particles and so prevent water form seeping into the soil. After some time this result in accumulation of water called 'ponding' on the land. This water begins to flow. This flowing water is called **runoff** and is muddy due to the displaced soil particles in it. As the water moves in further erodes the soil surface. (Fig 17.3) Similarly, the melting snowdrops cause soil erosion.

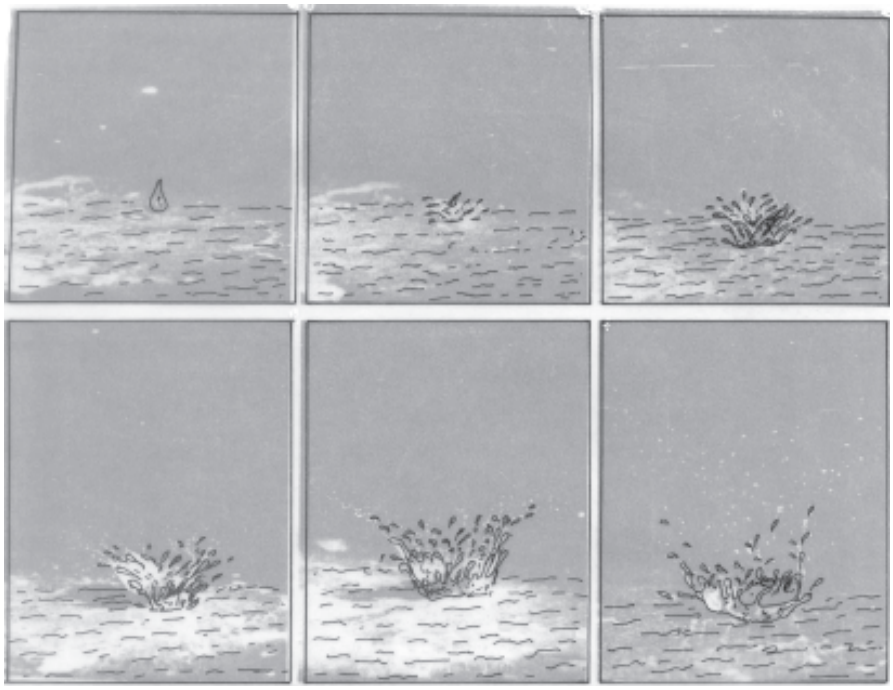

Fig. 17.3: *Process of soil erosion caused by rain drops*

(ii) **Sheet erosion**

The detachment and transportation of soil particles by flowing rainwater is called sheet or wash off erosion. This is very slow process and often remain not noticed (Fig. 17.4).

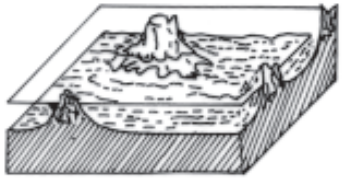

Fig. 17.4: *Sheet erosion*

(iii) **Rill erosion**

In rill erosion finger like **rills** appear on the cultivated land after it has undergone sheet erosion (Fig 17.5a). These rills are usually smoothened out every year while forming. Each year the rills slowly increase in number become wider and deeper. When rills increase in size they are called **gullies** (Fig. 17.5b). Ravines are deep gullies.

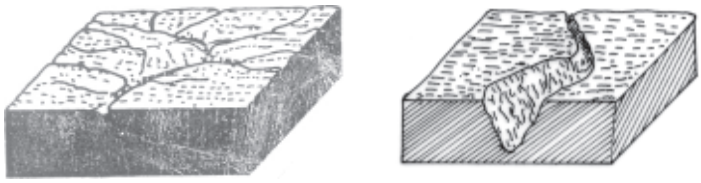

Fig. 17.5: *(a) Rill erosion, (b) Gully erosion*

(iv) **Stream bank erosion**

The erosion of soil from the banks (shores) of the streams or rivers due to the flowing water is called bank erosion. In certain areas where river changes its course, the river banks get eroded at a rapid rate. Stream bank erosion damages the adjoining agricultural lands, highways and bridges. Fig 17.6 shows the after effects of stream bank erosion.

Fig. 17.6: *Stream bank erosion*

(v) **Landslide:**

Sudden mass movement of soil is called landslide. Landslides occur due to instability or loss of balance of land mass with respect to gravity. Loss in balance occurred mainly due to excessive water or moisture in the earth mass. Gravity acts on such an unstable landmass and causes the large chunks of surface materials such as soil and rocks slide down rapidly.

(vi) **Coastal erosion:**

Coastal erosion of soil occurs along sea shores. It is caused by the wave action of the sea and the inward movement of the sea into the land (Fig. 17.7).

Fig. 17.7: *Coastal erosion due to wave action*

Consequences of soil erosion:

1. The fine particles of the topsoil which contain the bulk of nutrients and organic matter needed by the plants are lost from soil erosion. Erosion removes the most fertile part of soil. The less fertile subsoil is left.
2. Erosion may result in removal of seeds or seedlings so that the soil becomes bare. Bare soil is more vulnerable to erosion both by wind and water (Fig. 17.8).
3. Removal of seeds and seedlings reduces the ability of soil to store water.
4. Sheet, rill, gully and stream bank erosion also cause siltation of rivers, streams and fields. Deposition of silt results in damage of crops and pastures, and sedimentation of water bodies like streams, dams, reservoirs etc.
5. Sedimentation of water bodies deteriorate water quality and damage aquatic habitats and organisms.
6. Gully erosion also results in loss of large volumes of soil. Wider deep gullies sometimes reach 30 m and thus severely limit land use.
7. Large gullies disrupt normal farm operation.

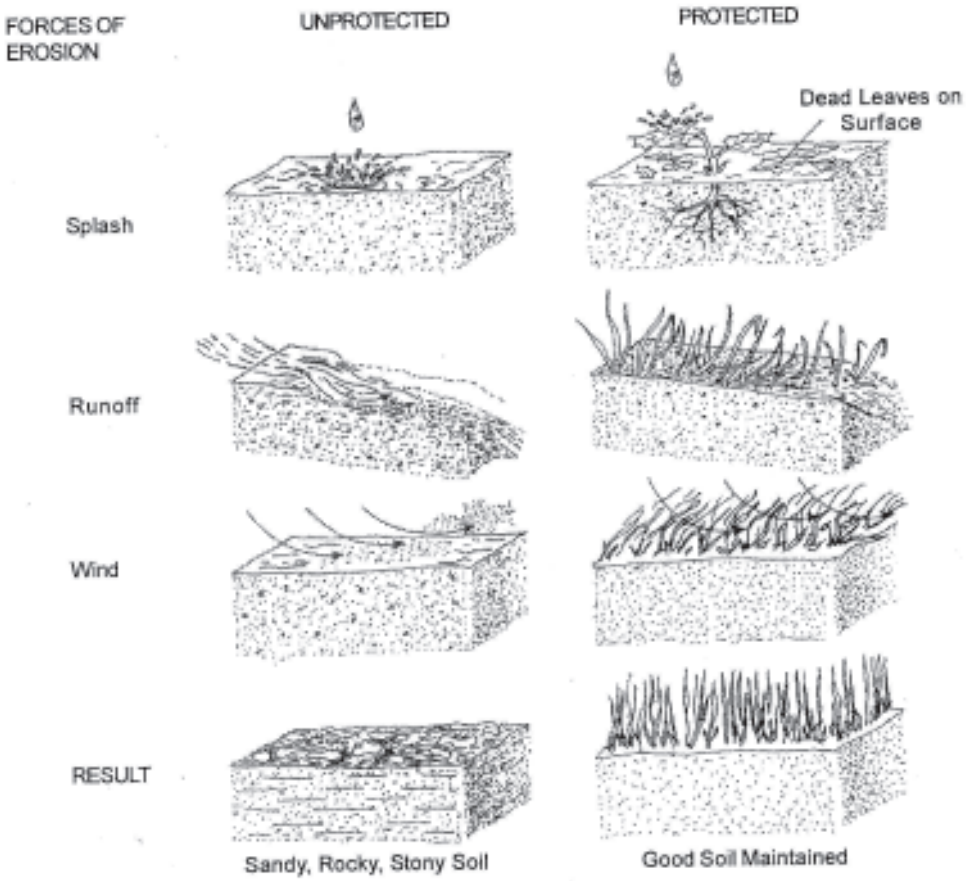

Fig. 17.8: *Vegetation protects soil from all forms of erosion*

8. Stream bank erosion not only causes loss of land, but also changes the course of a river or stream.
9. Stream banks erosion also damage public roads.
10. Mass movement of land or landslides also inhibits farm production and land use.
11. It also causes mortality in animals and humans.
12. Coastal erosion causes the adjourning land to become covered by sand.

Prevention of soil erosion

1. It is essential to retain vegetation cover that soil is not exposed to rain. Refer again to Fig. 17.8 vegetation cover is important because roots of plants hold soil particles together. Plants intercept rainfall and protect soil from direct impact of raindrops.
2. Cattle grazing should be controlled.
3. Crop rotation and keeping the land fallow (not planting anything in the soil for sometime) should be adopted.

4. Vegetation and soil management should be improved in order to increase soil organic matter.
5. To prevent stream bank erosion runoff water should be stored in the catchment for as possible by maintaining vegetation cover and as by constructing dams for storing water.
6. For prevention or reduction of coastal erosion, protective vegetation along the beaches should be re-established. The best method of controlling coastal dune erosion is not to disturb the dunes and the coastal system. Further, construction of buildings and other development should be located behind the dune system.

17.3.2 Wind erosion

Soil erosion by wind is more common in areas where the natural vegetation has been destroyed. Such conditions occur mainly in arid and dry areas along the sandy shores of oceans, lakes and rivers. The loose soil particles are blown and transported from wind by following three ways:

(i) **Siltation:** blown by wind in a series of short bounces.

(ii) **Suspension:** transported over long distances in the form of suspended particles.

(iii) **Surface creep:** transported at ground level by high velocity winds.

Consequences of wind erosion

1. Wind erosion removes the finer soil material including organic matter, clay and slit, in a suspension (colloidal) form and leaving behind coarser, less fertile material. See once again (Fig. 17.8).
2. Productive capacity of the soil is lost as most of the plant nutrients which remain attached smaller colloidal soil fraction are lost.
3. Wind erosion also damages roads and fertile agricultural fields by depositing large quantities of air blown soil particles.

Remedial strategies for prevention of soil erosion

1. The vegetation cover over sandy soils should be kept above 30%. Access of wind to the soil should be controlled by leaving the stubble or mulch on the soil. (Stubble is the remains of crop left after harvesting).
2. Wind speed can be broken or controlled by planting trees in form of a shelter belt.
3. The practice of leaving the land fallow (i.e. not planting anything in the field) and use of machinery should be modified. This can be done by using direct- drilling techniques (ploughing the field) and by using direct-drilling techniques.
4. Over grazing by cattle should be avoided.

INTEXT QUESTIONS 17.1

1. Define soil.

   _____

2. Name two natural agencies which cause soil erosion.

   _____

3. What is coastal erosion?

   _____

4. What is surface creep?

   _____

5. How wind erosion is damaged roads and agricultural fields?

   _____

17.4 SOIL EROSION CAUSED BY HUMAN ACTIVITIES

Certain human activities accelerate soil erosion.

- Deforestation
- Farming
- Mining
- Developmental work, human settlements and transport.

17.4.1 Deforestation

Deforestation includes cutting and felling of trees, removal of forest litter. Browsing and trampling by livestock, forest fires, also leads to cause deforestation etc. Deforestation leads to erosion. Deforestation further leads to land degradation, nutrient and the disruption of the delicate soil plant relationship.

17.4.2 Farming

Agriculture is a major human activity that causes soil erosion. Crops are grown, harvested, land reploughed, exposed to wind and rain intermittently. All this prevents replenishment of moisture. Agriculture also causes the worst type of soil erosion on farmland in the form of wash-off or sheet erosion. On the arid and semiarid areas, sand blows and sand shifts act in a similar fashion as sheet erosion does, where water is the chief agent. Consequently, a creeping effect of desertification sets in and the fertility of the land is lost progressively.

The following agricultural practices can lead to accelerated soil erosion:

1. **Tilling or ploughing** increases the chances of erosion because it disturbs the natural soil surface and protective vegetation.
2. **Continuous cropping:** Continuous cropping of the same land and extending of cultivation of marginal and sub-marginal lands encourages soil erosion.
3. **Cultivation on mountain slopes:** Cultivation on mountain slopes without appropriate land treatment measures such as bounding, terracing and trenching cause soil erosion and loss of soil nutrients.
4. **Monoculture:** Monoculture refers to the practice of planting of the same variety of crop in the field. Monoculture practices can lead to soil erosion in three ways.
   (i) A monoculture crop is harvested all at one time, which leaves the entire fields bare exposing it to both water and wind.
   (ii) Without vegetation natural rainfall is not retained by the soil and flows rapidly over the surface rather than into the ground. It also carries away the top soil which results in soil erosion and degradation.
   (iii) In the event any disease or pest invades the field , the entire crop is usually wiped out leaving the bare soil susceptible to water and wind.
5. **Overgrazing:** It means too many animals are allowed to feed on a piece of grassland. Trampling and grazing by cattle destroys the vegetation of the area. See Fig. 17.9. In the absence of adequate vegetative cover the land becomes highly susceptible to both wind and water erosion.

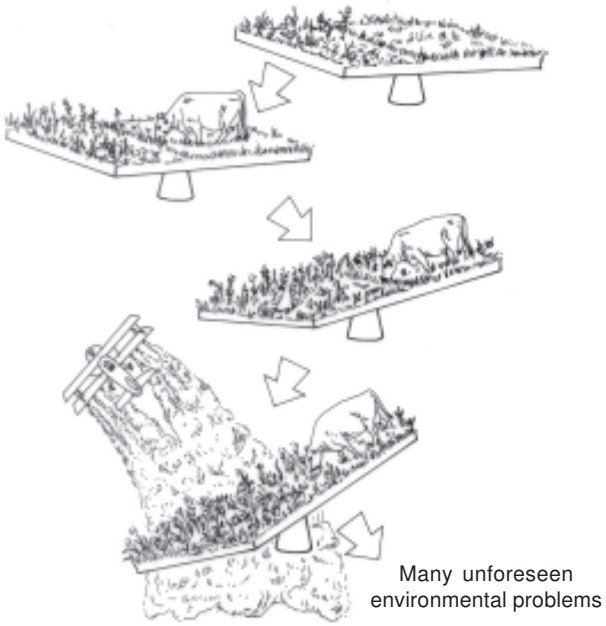

Fig. 17.9: *Effects of over grazing*

6. **Economic activities:** Soil erosion also occurs due to economic activities. The extraction of useful natural resources such as metals, minerals and fossil fuels etc., from the land causes serious disturbance to the land leading to soil erosion and drastic changes in the landscape.

7. **Developmental activities:** Soil erosion may also occur because of various developmental activities such as housing, transport, communication, recreation, etc. Building construction also promotes soil erosion because accelerated soil erosion takes place during construction of houses, roads, rail tracks etc.

The construction of such facilities causes massive disturbance to land, resulting in soil erosion and disruption of natural drainage system.

INTEXT QUESTIONS 17.2

1. Name any three human activities which cause soil erosion.

   _____

2. What is monoculture?

   _____

3. Why monoculture may lead to soil erosion? State one reason.

   _____

3. How does building construction soil erosion?

   _____

17.5 LAND DEGRADATION

Degraded land is classified on the basis of productive capacity of the land. Slight degradation refers to the condition that where crop yield potential is reduced by 10%. Moderate degradation refers to 10-50% reduction in yield potential and in severely degradation means that the land has yield potential is lost more than 50% of its potential yield capacity (productive capacity).

Some causes of land degradation are:

- use of agrochemical (chemical fertilizers and pesticides)
- excessive irrigation
- cultivation of high yielding plant varieties.

Notes

17.5.1 Agrochemical and their harmful effects on land

Agrochemicals are applied to the soil for two main reasons namely to:

(i) replenish or replace soil nutrients by using chemical fertilisers.

(ii) destroy plant pests by using toxic chemicals called pesticides.

(i) **The adverse effect of use of chemical fertilizer**

Plants take up nutrients from soil. Repeated crop cultivation depletes nutrients in the soil removed from it. Therefore, nutrients in soil have to be augmented periodically by applying chemical fertilizers. However, excess use of chemical fertilizers and pesticides leads to the following problems:

- **Widespread imbalance in the soil nutrients:** Most of the chemical fertilizers used in modern agriculture contains macronutrients like nitrogen, phosphorus and potassium (NPK). Excessive addition of NPK to the soil however causes the plants to absorb more micronutrients from the soil. As a result soil becomes deficient in micronutrients like zinc, iron, copper etc, and the soil productivity decreases.
- **Eutrophication of water bodies**: Fertilizer which is not used by plants is washed down with rainwater and carried into water bodies, resulting in eutrophication or algal bloom leading to death of aquatic life.
- **Health problems:** About one fourth of the applied fertilizer is not used by the crop plants and is leached down into the soil and underground water aquifer. The chemical which usually leaches down is nitrate whose increased concentration in the drinking water may cause serious health problems. Excess nitrates in water is harmful especially in bottle-fed infants in whom cause the disease, **methaemoglobinaemia.**

(ii) **The adverse affects of the use of plant protection chemicals**

Toxic chemical used to kill pests of cultivated crops (Fig. 17.10). Toxic chemicals like insecticides, herbicides, fungicides, rodenticides are generally used to kill insects, weeds, fungi and rodents in order to protect crop plants from their attack. These poisonous chemicals are collectively called biocides (agents that kill organism) they are not selective i.e., they not only kill the target pests but may also kill other non/not target and other useful organisms. Moreover, Biocides tend to remain active long after destroying the target organisms i.e. pests, weeds, fungi or rodents. It is persistence that makes these chemicals harmful to us.

Continued application of biocides cause various problems which are as follows:

1. They contaminate food materials and drinking water.

2. They disrupt the balance of the natural ecosystem by killing non-target often-useful organisms.
3. The continuous use of biocides results in a gradual increase of the immunity of the pest to these chemicals. The biocides after a period of time become ineffective against the pest leading to excessive multiplication of the pests.
4. Most of these chemicals are persistent and not biodegradable and so they persist in the plant or animal body once they enter the food chain. Their concentration in the organisms multiplies progressively through the food chain due to **biological magnification.**

Fig 17.10: *All organisms are natural part of the ecosystem, but any of them interfering with human needs is called a pest*

17.5.2 Problems due to excessive irrigation

Excessive irrigation of soil may leads to water logging and accumulation of salt in the soil. Both these degrade the soil.

(i) **Water logging:** Excessive irrigation of land without proper drainage raises the water table. This causes the soil to become drenched with water or water logged. This waterlogged soil cannot support good plant growth due to lack of air particularly oxygen in the soil, which is essential for respiration of plant roots. Water logged soils lack mechanical strength and cannot support the weight of plants which fell down and gets logged thus become submerged in the mud. This result in loss of productivity of the soil.

ii) Salt affectation: In areas of high temperature, excessive irrigation of land usually causes the accumulation of salt in the soil. This is because water evaporates fast leaving behind traces of salt in the soil. As cycles of irrigation are repeated the left over salt accumulated and forms a thick layer of grey or white effervescence on the surface. (Fig 17.11)

The productivity of salt affected soil is low. Plants in saline soil are unable to absorb nutrients and so face water stress (lack of water) even when moisture is abundant in the soil.

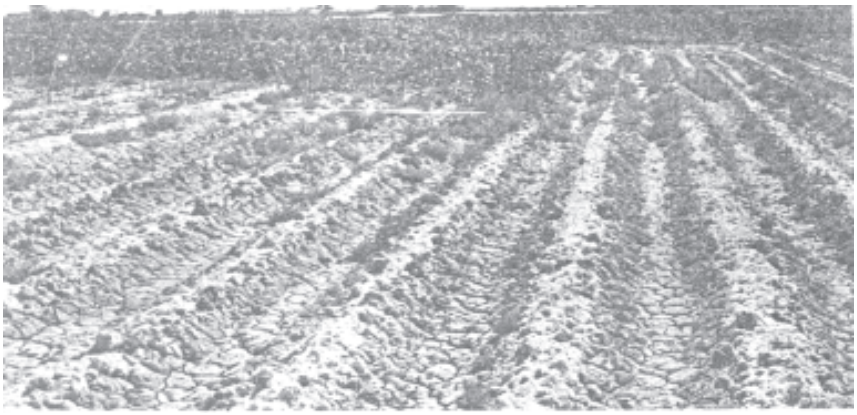

Fig 17.11: *Accumulation of salt on the soil surface*

17.5.3 Impact of high yielding plant varieties on leads to soil degradation

High Yielding Varieties (HYV) have helped to increase food production but at the same time they have greatly impacted to the environment are man made varieties of agricultural plants, fodder plants, forest trees, livestock and fishes. This means that the HYV have been raised and modified by us by means various breeding techniques in order to increase productivity. The HYVs require adequate irrigation and extensive use of fertilizers, pesticides to be successful. You have already learnt in 17.5.1, about land degradation due to agrochemical.

INTEXT QUESTIONS 17.3

Give one to three words for the following:

1. The loosening and displacement of top soil particles from land._____
2. The deterioration in quality of land resulting in reduction of crops productivity._____
3. The first phase of soil formation which is a physio-chemical process that leads to the breakdown of rocks into its mineral constituents._____
4. The erosion of soil from banks of rivers due to flowing water. Stream bank erosion._____
5. Man-made varieties of agricultural plants, fodder plants, forest trees, livestock and fishes that have been raised and modified by us by means of various breeding techniques in order to increase productivity._____

6. Toxic chemicals used to kill organisms that are pests._____

7. The progressively increased concentration of chemical in organisms through the food chain._____

17.6 AGRICULTURE TECHNOLOGIES FOR PREVENTING SOIL DEGRADATION

Conservation of cultivable land cause can be achieved not only through preventive and remedial measures in order to control land erosion and degradation about which you will read in section 17.7 but also by using innovative agricultural technologies which involve use of:

(i) organic farming or green manures

(ii) biofertilisers

(iii) biological pest control

17.6.1 Organic farming or green manures

Instead of applying chemical fertilizer for supplementing the nitrogen content of soil, we can use the natural process that involves the use of nitrogen fixing bacteria in the legume root nodules (Fig. 17.12). In addition to this, the use of organic forms of fertilizers such as cow dung, agricultural wastes also improves the nutrients status of soils. This may also help to reduce the excessive and prolonged use of chemical fertilizers and thus minimize their toxic effects.

Fig 17.12: *Root nodule*

17.6.2 Bio fertilizers

Micro-organisms are important constituents of fertile soils. They participate in the development of soil structure, add to the available nutritional elements and improve the physical conditions of soil. A large variety of micro-organisms are being used as biofertilisers for improving the nutritional status of crop fields.

17.6.3 Biological pest control (biological control)

The natural predators and parasites of pests play a significant role in controlling plant pests and pathogens. They are nowadays used by farmers to control or eliminate plant pests.

> The biological control agents of pests do not enter in the food chain or poison animals and so are not likely to harm mankind. Biological control of pests is an ecologically sound alternative to chemical pest control.

The cottony cushion scale pest (*Icerya purcahsi*) (Fig. 17.13a) is controlled biologically on a large scale by its predator, the lady bird beetle (Fig. 17.13b). At present some 15,000 naturally occurring micro-organisms or microbial byproducts have been identified as potentially useful biological pesticides.

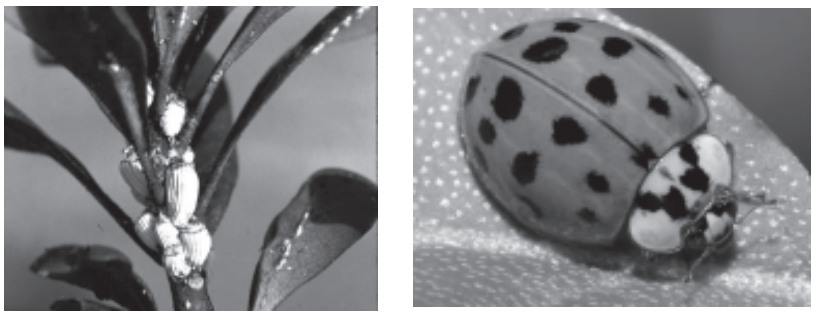

Fig. 17.13: *(a) Cottony cushion scale pest (b) the lady bird beetle*

17.7 MEASURES FOR PREVENTING SOIL EROSION AND LAND DEGRADATION

(a) Tree planting

To prevent wind erosion, trees should be planted in such a way so that they break the force of the wind. The trees not only cover soil from the sun, wind and water, they also help to hold the soil particles.

(b) Cultivation and farming techniques

Certain cultivation and farming techniques also reduce soil erosion. These include:

(i) Cultivation of land at the right angles to the direction of wind helps to reduce soil erosion by wind.

(ii) **Ploughing style:** The ploughing style substantially reduces the amount of erosion. (Fig. 17.14) Tilling the field at right angles to the slope called counter ploughing in soil

of the land helps prevent or reduce soil erosion. The ridges that are created act like tiny dams and hold the water and helps its seepage into the soil instead of let it run down freely the slopes causing soil pollution. Contour ploughing can reduce soil erosion by upto 50%.

(iii) **Strip Farming:** This method is another method of soil erosion. This involves planting the main crops in widely spaced rows and filling in the spaces with another crop to ensure complete ground cover. The ground is completely covered so it retards water flow which thus soaks down into the soil, consequently reducing erosion problems (Fig. 17.14)

Fig. 17.14: *Strip and contour farming combined. Strip of corn are separated by strips of grass for hay in photograph (SDA- Soil Conservation Service)*

(iv) **Terracing**: It is another method of reducing or preventing soil erosion on mountain slopes. In this method, terraces are created on the steep slopes. This is another way of preparing the fields for planting and preventing soil erosion. Terracing is usually done on slopes, by leveling off areas on the slope to prevent the flow of water down it. There are disadvantages to terracing however, in that the terraces themselves can be easily eroded and they generally require a lot of maintenance and repair.

(v) The time or season at which a field is tilled can also have a major effect on the amount of erosion that takes place during the year. If a field is ploughed in the fall, erosion can take place all winter long, however if the ground cover remains until spring, there is not as much time for the erosion to take place.

(vi) No-till cultivation is also used as a preventive method for soil erosion. Specialized machinery are available that can loosen the soil, plant seeds and take care of weed control all at once with minimum disturbance to the soil. Since all of these aspects are taken care of at one time there is less time for erosion to occur (Fig. 17.15). However there is an adverse effect due to this practice as weed and insect populations can

increase since they are not continuously being removed and so can compete or destroy crops.

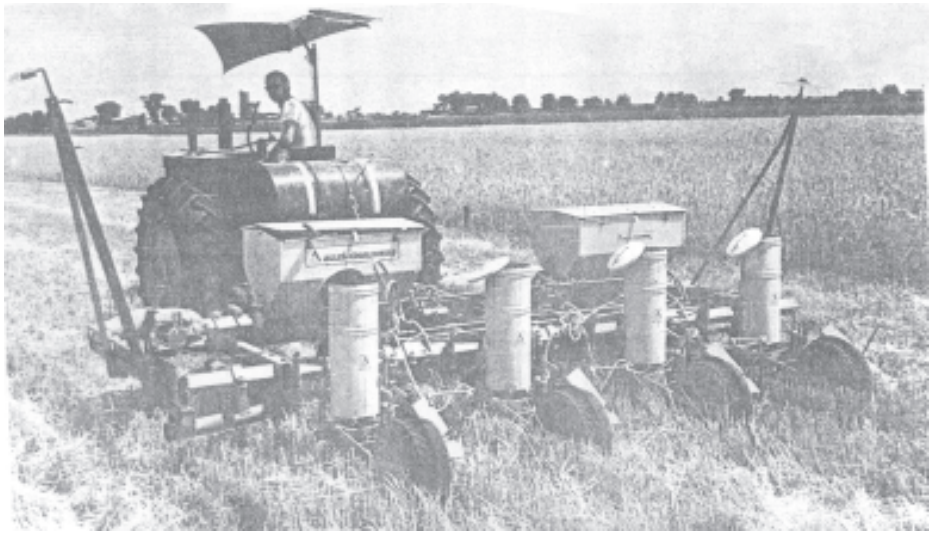

Fig 17.15: *No till farming*

(vii) Polyvarietal cultivation also helps in controlling soil erosion. In this method the field is planted with several varieties of the same crop. As the harvest time vary for different varieties of the crops they are selectively harvested at different time. As the entire field is not harvested at one time and so it is not bare or exposed all at once and the land remains protected from erosion.

(viii) Addition of organic matter to the soil is also an important method for reducing soil erosion. This is achieved by ploughing in crop residues or entire the crop grown specifically for being ploughed into the ground. Microbes in the soil decompose the organic matter and produce polysaccharides which are sticky and act in gluing in the soil particles together and thus help the soil to resist erosion.

INTEXT QUESTIONS 17.4

1. How does polyvarietal cultivation prevent soil erosion?

   _____

2. Out of the lady bird beetle and the cottony cushion scale (*Icerya purcahsi*), which is the pest and which the predator?

   _____

3. How do microbes resist soil erosion?

   _____

WHAT YOU HAVE LEARNT

- Land degradation is the deterioration in quality of land.
- Soil erosion is a natural process in which loosening and displacement of top soil particles occurs.
- Slow rate of erosion is generally a natural phenomenon and is termed as geological erosion.
- Fast or accelerated soil erosion may be due to (i) natural calamities like floods or tornados or (ii) human activities.
- Water and wind are natural agents that are responsible for soil erosion.
- Soil erosion by water is due to running water that carries away soil.
- Erosion of soil by water is due to (i) raindrop erosion, (ii) sheet erosion, (iii) rill erosion, (iv) stream bank erosion, (v) erosion due to shifting lands—land slides and (vi) coastal erosion.
- Erosion of soil due to water can be prevented by (i) retaining vegetation cover of soil, (ii) crop rotation and leaving the land fallow, (iii) controlling cattle grazing, (iv) improving organic matter content of soil.
- Erosion of soil by wind generally takes place when vegetation is inadequate and is unable to cover and hold the soil—this type of erosion thus occurs in dry and arid regions.
- Wind transports or removes soil and causes erosion by (i) siltation, (ii) suspension, and (iii) surface creep.
- Wind erosion can be prevented or reduced by (i) keeping ground vegetation cover of sandy soil above 30% and by not removing remains of cut crops from soil surface, (ii) controlled tree planting which from a shelter bed and thus help in breaking the wind speed, (iii) the practice of keeping the land fallow should be modified and (iv) grazing by cattle should be reduced.
- Land degradation is classified on the basis of land productivity and is termed: (i) **slightly degraded** when crop yield is reduced by 10%, (ii) **moderately degraded** when crop yield potential is reduced by 10-50%, (iii) **severely degraded** when land loses more than 50% of its potential yield.
- Agrochemicals are used for replacing lost micronutrients in the soil and plant protection chemicals collectively called biocides lead to various problems in the soil including land degradation.
- Excessive use of fertilisers cause: (i) depletion in the micronutrient of the soil and (ii) accumulation of nitrates in ground water and eutrophication of fresh water bodies including lakes and rivers.

- Application of biocides causes death of useful non-target organisms along with pests.
- Excessive irrigation of agricultural fields especially in regions where temperature is high, results in water logging and salinisation. Excessive irrigation also depletes ground water resources and raises the water table.
- Soil degradation can be prevented or controlled by innovative agricultural techniques
- Soil condition can be improved by remedial measures that include: (i) planting tree cover for reducing wind speed, (ii) adopting certain cultivation and farming techniques like cultivation at right angles to direction of wind, contour farming, strip farming, terrace farming, (iii) ensuring that field is covered with vegetation for as long as possible (iv) not tilling the field, (v) polyvarietal crop cultivation in fields and (vi) addition of organic matter to soil.

TERMINAL EXERCISE

1. Define soil erosion.
2. State the difference between geological and accelerated erosion with respect to (i) rate and (ii) cause.
3. What are the various ways by which water erosion takes place? Give details of any of three.
4. How can soil erosion by water be prevented?
5. What are the consequences of soil erosion due to wind?
6. Describe the several causes of soil erosion due to human activities.
7. In way does land get degraded by use of agrochemicals.
8. What are HYV? How do they degrade land.
9. How can soil erosion and land degradation be prevented?
10. Give an account of innovative agricultural techniques which prevent land degradation.

ANSWER TO INTEXT QUESTIONS

17.1

1. Soil is the uppermost layer of earth's crust in which plants grow.
2. Water and wind.
3. Erosion at sea shores.

4. Caused by high velocity winds.
5. Deposits soil on roads.

17.2

1. Deforestation / agriculture or farming/ mining/ transport/ human settlements (any three)
2. Raising one plant variety only on a piece of land.
3. Barren land left after harvest/rainfall does not seep into soil after harvest/ water or wind erodes soil of damaged by a pest.
4. Large chunks of earth mass dug out.

17.3

1. Soil erosion
2. Land degradation
3. Weathering
4. Sheet/ wash off erosion
5. High yielding varieties/ HYV
6. Biocides
7. Biomagnification

17.4

1. Entire field does not become bare as different varieties harvested at different times.
2. *Icerya purchasi*- pest

   Lady bird beetle- predator
3. Microbes decompose organic matter to produce polysaccharides which bind soil particles together and thus prevent from erosion.