# 1

# RURAL RESOURCES

**Unit Structure :**





## 1.0 OBJECTIVES

- To study the concept of Natural Resources.
- To study the factors of Natural Resources.
- To study the importance of Natural Resources.
- To understand the nature of conservation of natural resources.
- To study the benefits of conservation of natural resources in rural India.
- To get information about the programs implemented to conserve natural resources.
- To study the obstacles in the conservation of natural resources.

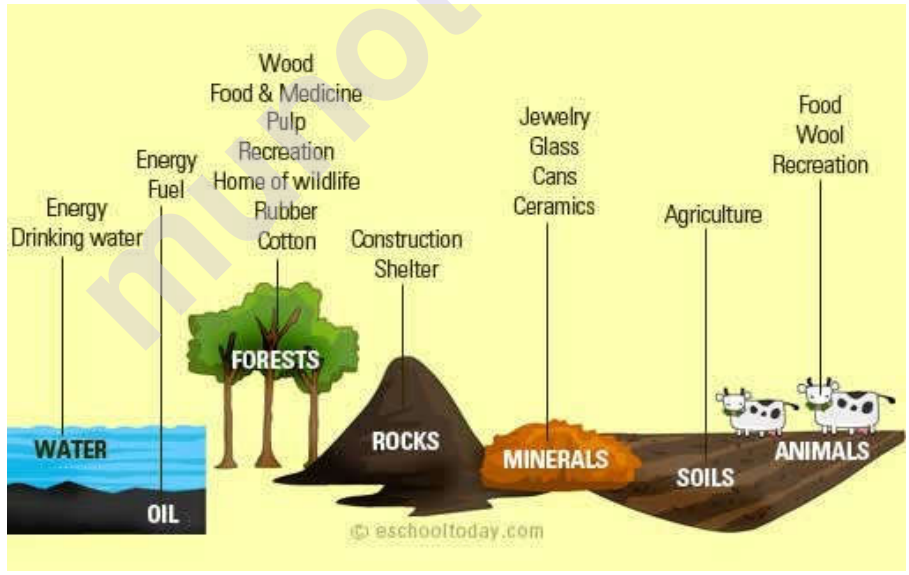
## 1.1 INTRODUCTION:

Since the creation of the world and the beginning of life on it, humans and other living forms have relied on natural resources to thrive. Sea, land, soils, rocks, forests, animals (on land and in the water), fossil fuels, and minerals are some of these things. Natural resources are what give life on earth its foundation. They supply us with what we need to live and work properly. Natural resources are all interrelated and linked in some way. So, if one is taken away, it will have an impact on the availability and quality of all the others.

In the course of development, natural resources are crucial. With the assistance of the natural resources, other supportive arrangements of a similar nature can function to their full potential. Economic, social, cultural, political, and environmental changes occur as a result of this development process.

Human beings are always looking for methods to better themselves, and they have always made an effort to improve their level of living by using the tools at their disposal, including technology, study, and hard labour. Developmental process is nothing more than the quantitative and qualitative improvements made to humankind's level of existence.

Following picture shows what natural Resources we get from Nature.




## 1.2 CONCEPT OF NATURAL RESOURCES

Natural resources are crucial to the development process. They are widely utilised in the constantly expanding population, industrialisation, and competition between nations to develop their economies. A significant issue the globe faces is how to maintain the amount and quality of natural resources while simultaneously maintaining the stability of the resources that are now accessible.

## 1.3 IMPORTANCE OF NATURAL RESOURCES

The extremely intricate relationship between living things and non-living things can be supported by natural resources. The benefits of this contact to humans are substantial. People use natural resources either directly or indirectly all across the world. More resources are consumed by industrialised nations than by less developed nations. The production of the goods and services that we all enjoy each year requires the utilisation of almost 60 billion tonnes of resources worldwide. A person in North America uses roughly 90 kg of resources each day, whereas a person in Europe uses about 36 kg, a person in Asia uses about 14 kg, and a person in Africa uses about 10 kg. The three main ways that people use natural resources are for food and drink, housing and infrastructure, and mobility. These three make up more than 60% of the resource use.

**Food and drink:** This include agricultural products as well as naturally available foods such as food-grains, fish from fresh water and seas, seeds and nuts, medicines, herbs and plants. They also include drinking water, as well as water for sanitation and household use.

**Mobility:** This includes automobiles, trains, water vessels, aeroplanes together with all the fuel from natural resources that power them.

**Housing and infrastructure:** The houses, public places, roads and constructed objects, all the energy for heating and cooling that we consume in our homes come from the wood, metals, stone and other materials. Beyond these three major areas of resource consumption, we consume much more resources from our environment on a daily basis. The role of natural resources in sustaining life on earth is extremely important and we must ensure that we protect the environment and also make it easy for it to replenish itself naturally.

**Natural resources are the bases of life.**

**1) Source of fresh air and water -** Life without air and water is impossible and natural environment is the source of fresh air, water necessary for all living and non-living things on earth. If these important sources are polluted, it will affect all the living beings on earth. Nature always seems to apply its natural processes to refine and purify them.

**2) Habitat -** Soil, forests and water are the habitat of different animals. Human beings use soil, water, minerals and forest resources for building houses, bridges and roads. Soil is the habitat of micro- organisms, insects, worms and plants. Water is habitat for aquatic animals. Forest is the living place of wild animals and it also purifies the environment by reducing the $CO_2$ level and other various harmful and poisonous gases in the atmosphere. Without forest and trees help in the increase in rainfall.

**3) Source of food -** The land and forest are important natural resources and good source of food to living beings.

**4) Natural beauty -** Natural beauty of a country attract tourists from different places and leads to the economic growth of the country. Tourism industry flourishes and develops contributing to the National Economy of the country. It also helps for the development of tourism industry by attracting tourists.

**5) Economic development -** Economic development of a nation depends on the availability and utility of its natural resources. Proper use of natural resources helps in the economic development. Agriculture and industrial development depends on the availability of these resources. Natural resources help for the tourism development and increase revenue.

**6) Area of study and research -** Nature is a vast and complex phenomenon. It is so wide that even a tiny part of it is enough for conducting study and research programs.

## 1.4 TYPES OF NATURAL RESOURCES

### Land

Land is an important factor of the natural resources. Man uses land for different purposes. Land is considered as an important factor of the production. Depending on the Ph value the fertility of the soil is decided and accordingly it is bought and put to use. Land value depends on the fertility of the soil. Weather and climate of the region, composition of land, type of soil, formation of soil, type of agricultural production and other factors affect the fertility of the soil. Classification of the soil can be done on the Ph factor of the soil. The quality and possible production of food grains can be estimated. We can increase the production capacity of the soil by making some technical changes and by using the biotic factors to increase the fertility of the sol.

Land is one of the factors of production. Land and soil are non- renewable sources and they cannot be produced. So a proper planning and management of the utilization of the usage of land is to be done.

Land is an important factor in the agricultural process. Out of the total land available in India 60% of the land is under agricultural sector. The geographical condition in different region is different. Depending on the type of soil it is used accordingly. To increase the fertility of the soil it has to be maintained and conserved. But due to industrial development in the rural areas land in the respective areas is utilized for setting up industries and for the infrastructure required. As a result percentage of the productive land is decreasing. Along with rural development infrastructural development, which includes water supply, electricity, transport and communication uses the productive land and the percentage of productive land is decreased. The usage of productive land for industrialization reduces the percentage of agricultural production.

Due to industrialization in the rural areas more land is required for setting up new industries. Agricultural land is used along with barren land for setting up industries has resulted in the decrease in the land under crops.

Saline soils are also used for industrial projects. The problem of employment of the labourers working in the agricultural fields has come in light due to rural industrialization. While acquiring land for industries problems like increasing population, land conservation should be considered.

Fertility of the soil is decreased due to water logging in the fields, use of chemical fertilizers in an unorganized manner, wrong methods of agricultural operations and overall usage of land or industrial purpose. Out of the total geographical land 40% is barren and is unused, but if maintained can be used for agricultural purpose. For example: for horticultural plantations - mango plantation.

**Water**

Water factor depends on many other factors as it is a limited natural resource and conservation of it is very essential. Underground water level can be increased by means of water saving methods like percolating the water in the ground, by building bunds to stop flowing water and equal distribution of water, digging trenches to store water and thereby increase underground water level and most important is to plant more and more trees to increase the water level. This water can be utilized during the non-rainy seasons.

Water conservation methods are implemented everywhere to deal with the water storage problem. Available water is related to the various factors like soil conservation, afforestation, and bunding on the mountain slopes. The more conservation of water the more availability of water. Konkan region receives heavy rainfall during the season still they suffer the problem of water shortage. Nature gives us water in abundance but it is we who are responsible for this water shortage problem and not the nature. We should take more efforts to conserve water through bunding and making the water percolate in the soil to increase the surface water and the underground water level. So planning is essential so that we don't face the water problem.

More water will be required due to increasing industrialization, population, urbanization and other reasons. To fulfill these needs millions of rupees have been invested on various schemes for the same. Water facilities were provided to the urban areas through the water schemes from the rural areas. But the fact is that no measures were taken for water conservation in the rural areas, which is the greatest demerit of our planning. Because of this even after 71 years of independence we are not able to solve the water problem of our country.

There is consistency of rainfall in our country with increase or decrease in the proportion of rainfall. If the rain -water is conserved and harvested at the time of rainfall we won't ever face drinking water problem in future. This gift of nature must be preserved and conserved and utilized in an organized manner.

## Weather

Weather is one of the important dominant factors. It is not possible for us to control weather as it is beyond the capacity of human beings. But it is possible to study it and use it to increase our agricultural production. Plants, trees, fruits, flowers, vegetables grow in the region having favourable climate for it. We can study the effects of climate and weather in a region and the crops related to it will help us to take agricultural production on a large scale.

Another profession depending on weather and climate is fishery. A detailed study of weather and climate provides necessary information to the people depending on the agriculture and other occupations related to it. This will help to increase the production in agriculture, fishery and other occupations subsequently raising their standard of living.

## Forests Resources



Plants and trees are also important factors of natural resources. Land under forest is important like the land under agriculture. Forest includes dense cluster of trees, dispersed trees, pastures, shrubs, grass, creepers. These different factors protect and conserve the forest. Forest resources stop soil erosion due to the rain and fertility of the soil is improved with the help of different byproducts of trees like fallen leaves, flowers, fruits, stems, twigs and other byproducts. Trees slow down the force of flowing water and help to percolate the flowing water in the soil. Trees help to reduce the pollution created by the growing industries by inhaling carbon dioxide and exhaling oxygen. Major solution to solve the pollution problem is to grow more trees. Trees and plants help to make the human life happier.

Forest is the home for many birds and animals and other wild animals. It provides food, fodder and shelter to the animals and birds and also protects the plant species and animals on the verge of extinction. It provides medicines and medicinal herbs for human beings. Fruits, flowers, leaves, stems, twigs, barks of the tree is used for making different types of medicines, organic fertilizer and compost fertilizer.

Forest help in the human development but still man has deteriorated the forest to a large extent. Forests have been destroyed for urbanization and industrialization and industrialization doesn't mean development. To fulfill the needs of growing industrialization and urbanization trees are cut down on large scale, and forests are destroyed. Forest resource is renewable but it also requires time. As a result we are facing the problems like pollution of all the resources, disturbance in ecological balance, global warming and other natural disasters. If thisdeterioration problem is not taken note of seriously in the nearby years it will be a great threat to human life in the coming years. The rate at which deforestation is taking place in India, many birds and animal species are going to become extinct forever. Destruction of natural balance of ecosystem will destroy our only home planet earth much sooner than you think. Some countries and people have understood the demerits of deforestation and have implemented programs like Afforestation, Vanamahotsav, plant more trees, social forestry. Various Non- governmental and governmental organizations have implemented various programs related to the benefit of the ecological balance.

**Animal Resources**

Rural economy of India depends on agriculture and the animal resources required for doing agricultural operations. Rearing animals is also one of the allied activities and subsidiary occupation of the farmers. Animal husbandry, poultry, piggery, goat and sheep rearing duck rearing, honeybee keeping, sericulture, fish farming are undertaken as subsidiary occupations along with agriculture. In some places these occupations are practiced as main occupations. Transport facilities like trucks and tractors cannot reach the farms in the remotest areas of rural India. So animal resources are used for cultivating land, transport of goods and other related works.

Allied activities and subsidiary occupations help to solve the food problem in both rural and urban areas. We get food, milk and dung from animals and also use them for transport. Animals have significant importance in the rural economy. Integrated Rural Development program was implemented to solve the poverty problem in the rural areas. This program utilized the available animal resources in the rural areas. The families not having agricultural land for cultivation use barren land for rearing animals and can earn some income for their living. Out of the total available animal resources in the world 1/6 of it is in India. Food, fodder, health and hygiene, shelter, cleanliness of the animal shelter and the surrounding area along with medical facilities are the essential things to betaken care of.

White revolution increased the milk production by using cross breeding techniques. But this led to negligence of pure breed animals. It is very essential to preserve our animal wealth so that the good quality breeds can improve their production capacity and can increase the employment opportunities in the rural areas. For this a proper planning and implementation of the program for the animal resources is necessary. As of now people have understood the benefits of pure breed animals and

have again started taking care of and breeding pure original breeds of animals for milk purpose.

**Fisheries**

Fish available in the sea is also a natural resource. Fish has high protein content useful for human beings and nowadays fishing is done on large scale with the help of mechanized boats. The net used in this type of fishing not only catches big fishes but also small fishes that are not grown properly resulting in the decrease of population of fishes in the sea. Mechanized boats have not only minimized the fish catch in the sea but also the problem of employment and source of living has aroused. Fish food is also available from rivers and ponds from which the need is fulfilled. To increase the production of fishes in the sea fishermen should be taken into confidence to accept the idea of marine-park, so the problem of fishermen employment and income can be increased in turn raise their standard of living.



**Energy resources**

Energy resources have a greater significance in the development process. It is necessary for agricultural processes, transport, in industries, cooking process, for domestic use. In India traditional sources of energy like wood, coal, cow-dung, kerosene, diesel and petrol are used to fulfill the need for energy. As these sources of energy are available naturally they are limited. The unlimited use of these limited natural resources (i.e. non-renewable source of energy) by human beings is on the verge of extinction resulting in an imbalance in the nature. A solution to this problem is to find an alternative source of energy. In other words we can say we have to use renewable source of energy like solar energy, wind energy, tidal energy, hydroelectricity, nuclear power for peaceful purpose. In rural and urban areas bio-waste collected from animals and human beings can be used to prepare biogas or methane gas for fuel purpose and the slurry can be used as a fertilizer in the fields which increases the fertility of the soil, food waste can be decomposed to form manure and can be used for gardens, kitchen gardens and also be supplied to rural farms. Using biogas and other appropriate technology has reduced the cutting of wood for fuel in rural areas to a great extent.

Human brain and human power is also a natural resource that has to be utilized with the help of science and technology to balance the ecology for a better future for all the living things on earth.

## 1.5 PROBLEMS ASSOCIATED WITH NATURAL RESOURCES

Even though natural resources are the basic support structures of life, too much or too little offit can come with a lot of trouble and conflict.

**Too little Natural Resources :** In many regions of the world a mix of limited resources, overpopulation and environmental degradation, ecological imbalance, has produced extreme poverty and income inequality in the society which in turn have fuelled grievances, rebellions, conflicts and communal wars in the society resulting in the destruction of the available natural resources.

**Too much Natural Resources:** This problem is much bigger in regions with excess natural resources. Greed, corruption, and conflict from revenue distribution, resource ownership, decision making, management, and access has fuelled local and international conflict.

## 1.6 THREATS TO NATURAL RESOURCES

**A) Overpopulation:** This is probably the most significant, single threat that natural resources face. Increasing population at a faster rate puts more pressure on the available natural resources.


**1) Land Use:** Increasing population leads to more demand for food and in turn this leads to more land under cultivation to increase food production and more land for building houses for the increasing population. Green revolution fulfilled the need for food for the increasing population by making use of hybrid seeds, chemical fertilizers, pesticides, insecticides and fungicides. This technology used small piece of land giving more agricultural production. Many forest or vegetative lands

converted to settlements for people, roads and farms. These have serious repercussions on natural resources.

**2) Forests :** Forests were cut to a large extent to fulfill mainly the demand for wood for human settlements and for fuel purpose resulting in deforestation.

**3) Fishing:** Fishery occupation is also on the verge of being destroyed slowly due to mechanization in this business. Fishing for subsistence by fishermen at local level did not harm the water ecology. But big companies with big trolleys have created big problems not only for the local fishermen but also to the seafood chain in the sea and oceans. The big trolleys catch fish overall not leaving the next generation small fish to survive. Big and small fish are caught together which results in the decrease in the number of fishes to lay eggs and thereby destroying the fish and other creatures in the sea.

**4) Need for more:** Human's demand for a comfortable and luxurious life. For this more the development more the destruction of ecology and the surrounding habitat in the environment. Human settlements, transportation, communication, entertainment, recreation are some of the demands, which are fulfilled by destroying mother earth. If all this is done without harming the nature it is more beneficial or else the destruction is for sure by facing the problems of rainfall, drinking water, soil erosion, air pollution, water pollution, sound pollution, ecological imbalance, natural scenic beauty, etc.

**B. Climate Change**

The changes in climate pattern as a result of excessive anthropogenic $CO_2$ is hurting biodiversity and many other biotic and abiotic natural resources. Species that have acquainted to their environments might perish and others will have to move to more favourable conditions to survive.

**C. Environmental Pollution**

Land, water and air pollution directly affect the health of the environments in which they occur. Pollution affects the chemical composition of soils, rocks, lands, ocean water, freshwater and underground water, and other natural phenomena. This often has disastrous consequences in the environment and the living and non-living things on earth.

## 1.7 B. RENEWABLE AND NON RENEWABLE RESOURCES

Natural resources come in many forms. It may be a solid, liquid or gas, organic or inorganic, metallic or non-metallic, renewable or non-renewable.

Natural Resource can be divided into two types:

1) Renewable source of energy can be regenerated -Plants, animals, air, water etc.

2) Non-Renewable source of energy cannot be regenerated. Metal minerals are available in the natural form. If used its shape and form can be changed but its existence is not destroyed. But if mineral oil is used they cannot be regenerated. It takes years and years for the formation of mineral oil again. So they have to be used very carefully as they are extinct.

Natural Resources

Renewable Source of Energy | Non-Renewable Sources



**Renewable resources**-Renewable resources are those that are constantly available or can be reasonably replaced or recovered, like vegetative lands. Animals are also renewable because with a bit of care, they can reproduce

off springs to replace adult animals. Even though some renewable resources can be replaced, they may take many years for example soil, forest. Renewable resources come also from non-living things like solar energy from sun, tidal energy tidal waves, hydro - electric power from water and geothermal energy.

**Non-renewable resources -**Non-renewable resources are those that cannot easily be replaced once they are destroyed for example fossil fuels. Minerals are also non-renewable because even though they form naturally, it takes thousands of years to be renewed thus making it non-renewable. Some animals can also be considered non-renewable, because if people hunt for a particular species without ensuring their reproduction, they will be extinct. So we must ensure that we protect resources that are endangered. Non-renewable resources include, minerals, wind, land, soil and rocks. Some non-renewable resources come from living things - such as fossil fuels.

**Metallic and Non-metallic Resources**- Metallic minerals are those that have metals in them. They are harder, shiny, and can be melted to form new products. Examples are iron, copper and tin. Non-metallic minerals have no metals in them and they are softer and do not shine. For example: clay and coal.


Man started making use of natural resources to make progress in the industries and technology long back by using the available natural resources. In other words we can say that, "The developmental process is meant to raise the standard of living of human beings". In this process contribution of plants has great importance. Therefore it is essential to study rural development and natural resources in totality.

Robert Macnmara has defined rural development as - "Rural Development means an overall development of the rural areas by giving stress on the development of the weaker sections of the society like small farmers, landless agricultural laborers and rural artisans".

Rural development is a process and natural resources are essential for this. These natural resources are available in the form of land, weather, forest, animals, oceans, energy, human resource and waste material. This resources are not available equally everywhere. It is available in different forms and in different quantity in different places and is used as per its availability. So the available natural resource in different places more or less is to be used very skillfully. If developmental planning is done taking into consideration the availability of natural resource then the desired objectives can be achieved.

## 1.8 RESOURCE RECOVERY

Now-a-days waste is viewed as a potential resource and not something that must end up in the landfill. From paper, plastics, wood, metals and even wastewater, experts believe that each component of waste can be tapped and turned into something very useful. All these waste can be recycled and reused. Wastewater can be treated and used for kitchen gardens, agricultural purpose, in industries. Plastic also can be recycled and reused, paper is recycled, metals also can be recycled and reused for different purposes. Fossil fuel used by the pulp and paper industry largely through energy efficiency measures, power recovery through co-generation and increased use of biomass.

**Resource recovery** is the separation of certain materials from the waste we produce, with the aim of using them again or turning them into new raw materials to be used again and again. Preparing compost manure and recycling of materials that are used for the purpose of leveling the land. Wet organic waste such as food and agricultural waste is considered waste

after food consumption or after an agricultural activity. Traditionally, it is collected and sent to a landfill. In Resource Recovery, it is collected and diverted to composting or anaerobic digestion to produce bio-methane or biogas. We can also recover nutrients through regulator-approved use of residuals.

The concept is applied in household settings too. The residents can drop off waste that they have already sorted in their homes, which makes it easy for waste recovery organizations to pick them up for further processing. Recovering waste will give us many environmental and economic benefits if taken seriously but it involves good planning for waste management, educating people about the benefits of sorting the waste and recycling it, making people understand to participate in this cause and most important making use of appropriate technology.

Resource recovery benefits us by reducing our need to search for new raw materials, thereby saving the environment. For example, by separating and collecting all waste paper products that are generated, we can recycle them to reduce the need for new pulp, from timber. Less energy is required in recycling old materials than new raw materials. □

The demand for potable water can be greatly reduced if we can divert all wastewater for treatment and re-use. We can use it for gardening, agriculture, sanitation and flushing in toilets (cleaning) and also can be reused for industrial purpose.

## 1.9 SUMMARY

Human beings always strive for their development. For this he makes use of the different factors available in the nature for ex- animals, land, plants etc. his progress and prosperity depends on the available natural resources. But in the developmental process man has started destroying the natural resources available to him, which has created problems of environmental imbalance and global warming. So it is very essential for man to make use of the available natural resources very carefully. For the survival of human being man has to conserve these available natural resources. Human being is always in search of way to develop him-self and with the available technique & technology, research and hard work he always has tried to raise his standard of living.Now-a- days waste is viewed as a potential resource and not something that must end up in the landfill. From paper, plastics, wood, metals and even wastewater, experts believe that each component of waste can be tapped and turned into something very useful.

## 1.10 SELF STUDY

1. What are natural resources and explain the factors of it?
2. What are natural resources and give its classification?
3. Explain the importance of natural resources in rural development.
4. Explain in detail the factors of natural resources.

5. Write in short the problems associated with natural resources.
6. What are the threats associated with natural resources?
7. Natural resources are the bases of life - explain.
8. Write short notes on:
    - Concept of natural resources
    - Renewable resources
    - Non-renewable resource
    - Metallic and Non-metallic resources
    - Resource recovery

## 1.11 C. NEED OF CONSERVATION OF RESOURCES

Natural resources (land, water, biodiversity and genetic resources, biomass resources, forests, livestock and fisheries) – the very foundation of human survival, progress and prosperity, have been degrading fast, and the unprecedented pace of their erosion is one of the root causes of the agrarian crisis that the country is facing. The demographic and socio-economic pressures notwithstanding, the unmindful agricultural intensification, over use of marginal lands, imbalanced use of fertilizers, organic matter depletion and deteriorating soil health, extensive diversion of prime agricultural lands to non-agricultural uses, misuse and inefficient use of irrigation water, depleting aquifers, salination of fertile lands and water logging, deforestation, biodiversity loss and genetic erosion, and climate change are the main underlying causes. Air, water, soil, minerals, fuels, plants and animals are the natural resources on earth. Food, water, air and shelter coming from natural resources are essential for our survival. But people often waste natural resources. Animals are hunted very cruelly for their tusk, skin, horns, etc. Forests are cleared for human settlements and other luxurious life thus exposing land to wind and water damage. Fertile soil is washed away in the absence of trees and plants.

Wrong techniques of farming practices resulting in the loss offertility of soil, water-lodging problems, use of chemical fertilizers in excess, soil erosion, wind erosion, water erosion in the absence of trees aresome of the reasons for depletion of natural resources. Fuel supplies are also on the verge of extinction if not diverted to the appropriate technology. Water and air are polluted to a great extent. Natural resources are often wasted knowingly and unknowingly. If resources are managed carelessly, they will be used up very soon letting us in critical condition. Ifused wisely, efficiently and appropriately the natural resources will last much longer. Renewable resources can be replaced quickly or take long time for replacement for example plants and trees, but the non-renewable resources cannot be replaced at any cost for example - fossil fuels.

Conservation is the practice of caring for the natural resources usedby all living things in the present and future. People should be made awareof the depletion resources and it is through conservation of natural resources our future can be secured. The increasing population on earth is using the available natural resources very much speedily. People very wellknow that continuation of life on earth depends on the careful use of natural resources but knowingly it is ignored to some extent.

## 1.12 CONCEPT AND DEFINITIONS OF CONSERVATION OF NATURAL RESOURCES

Nature has provided the three basic natural resources soil, water and vegetation as assets to the human beings. The survival of the human beings depends on the natural resources on the earth. Apart from soil, water and vegetation biodiversity and genetic resources, biomass resources, forests, fisheries, livestock, flora and fauna are also considered as natural resources.

"One of the basic problems associated with economic development, poverty alleviation and maintaining human environment is how to prevent depletion of natural resources such as water, forests, wildlife, minerals and the like. People of the developed world being conscious of the various problems associated with over exploitation of natural resources are

making efforts to evolve appropriate strategies in terms of norms, institutions and policies for the conservation of natural resources. People are now increasingly aware of the consequences of depletion of natural resources and environmental degradation like global warming ozone layer depletion, acid rain, famines, droughts, floods, scarcity of fuel, firewood fodder, ill health, starvation and many others." (Eugen P. Odum and Gary W. Barrett)

Conservation is referred to the management of valuable natural resources used by living beings on earth. The term conservation was used in the late 19th century. It is now used in a broader concept i.e. to conserve the earth itself by protecting its capacity for self-renewal. Conservation is defined as "The protection, preservation, restoration and rational use of all resources in the total environment."

Development and conservation can coexist in harmony if the environment is used in such a manner that it ensures to have the resources for the future. This is called as sustainable development. To live sustainably we have to conserve so many different resources. Managing natural resources and conserving and preserving the ecological balance arethe seen today as the essential elements of rural development. The ministry of environment is intended not only to correct the damages resulting from rapidly increasing urbanization and industrialization, but also to address the degrading ecosystem. While taking into account the various categories from rural areas rural development projects shouldensure the protection of the environment and the surrounding ecology. New techniques have been developed so as to minimize the damage to the natural resources by understanding the functioning of agricultural operations.

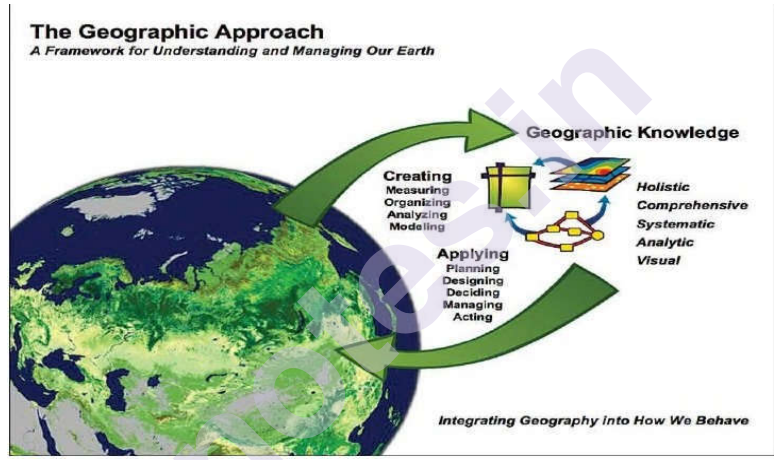
## 1.13 IMPORTANCE OF NATURAL RESOURCES

The ecological balance on earth is a very important issue as the survival of mankind depends on it. Overuse of natural resources has caused a serious imbalance. Factors like deforestation leading to environmental imbalance and global warming, depletion of oil and natural gas creating fuel shortage & price hike and increasing number of vehicles on road creating air pollution to its maximum level, shortage of water due to water erosion as the flow of running is not blocked and allowed to percolate in the soil to increase the underground water level, power generation requires fuel which is on the verge of extinction, soil erosion due to many factors like soil washed away by running water, wind erosion as there are very few trees to block the speed of wind all contribute to environmental issues such as global warming and environmental pollution.These environmental issues in turn are creating the future shortage of natural resources. In short it is vicious circle that we are entangled in. As some of the natural resources are nonrenewable they are on the verge of extinction and have put a question mark in front of us what next. Therefore it is very important to conserve the natural resources as our survival totally depends on it. Alternatives for the nonrenewable resources are found like solar energy, tidal energy, wind energy, hydroelectricity, geo-thermal energy. These alternative sources are not only eco friendlybut are also can control

the ecological imbalance. They help to conserve the natural resources to a great extent. So in short to control the air, water, soil and sound pollution it is important that we conserve the natural resources and use the alternative sources to save mother earth.

## 1.14 CONSERVATION OF NATURAL RESOURCES

Conservation of natural resources is referred to as the sustainable utilization of natural resources, like soils, water, plants, animals, minerals, timber, fish, topsoil, pastureland, and also to the preservation of forests & forestry, wildlife & wildlife refuge, sanctuaries, parkland, and watershed areas. In broad concept conservation of natural resources is to protect its ability for self-renewal. Present thinking as well favors the protection of the whole ecological regions by the production of "biosphere reserves."




### Methods of Conservation

Consumption of natural resources has been increasing year by yearwith an increase in human population and their standard of living. Confrontation of conservation means comprehending the complicated connections amongst the natural resources and creating a balance between resource utilization and protection to ensure a sufficient supply for potential generations. A variety of conservation methods are used to achieve this goal. Reducing consumption of resources, protecting them from pollution, recycling and preserving the resources.

Global natural resources are interconnected in a complex and little understood web and are preserved in many ways by using fundamental conservation methods and each resource has a unique set of conservation problems and solutions for the same. If one thread of the entire web is damaged the whole web structure will be weakened. Therefore it is important that this connectivity of natural resources be addressed in the search for solutions to the resource shortages. For example it would be waste of work to conserve soil without considering the needs and effects of nearby water and vegetation resources.

Balance in nature is disturbed if we continue to overuse the natural resources, which can cause a great threat to the survival of living things on earth. Deforestation, depletion of oil and gas, shortage of water and power, soil erosion leading to lack of agricultural growth, all contribute to the serious environmental issues such as global warming and environmental pollution. These environmental issues further lead to shortage of natural resources trapping us in the vicious circle of imbalance of natural resources. If we continue to deplete these natural resources at the present rate the environmentalist have predicted that there would be major shortages or even complete extinction of them in the near future. As a result conservation of natural resources is essential for our survival.

## 1.15 DIFFERENT WAYS OF CONSERVING NATURAL RESOURCES

Depending on the natural resources has made their conservation a menacing task but not impossible. Here are some ways by which we can conserve our precious natural resources and do a bit to save the environment.

### a) Conserving the Trees

To conserve trees the indispensable natural resource we have to go green at home and wherever possible.

- As it takes lot of trees to make a small amount of paper and to save trees recycled paper products can be used whether writing on it or printing on it.
- Unnecessary use of paper should be avoided. Stop printing every information and sign up for e-billing and net banking services to avoid bank statements and paper bills, bank forms, other unnecessary paper work in banks, offices, schools, etc.
- Every person should plant a tree in his name and taking care of it for lifetime means doing a bit for the environment. In short planting and adopting a tree can be a solution for the loss done to the environment by human beings.
- Participate in tree conservation projects organised in the locality, town or city, state or in the country or wherever you are in the world.

### b) Conserving Water

Water being the basic resource is used for many purposes. But due to lack of proper planning it is wasted a lot as a result many parts of the world are facing problem of water shortage. It is very important to conserve water as it is of prime importance for the stability of the environment. Following are a few methods to conserve water:

- Harvesting of rainwater is one of the solutions for this problem. Harvested water can be used for the all year round if stored effectively and in proper manner and good storage system.

- Flowing rainwater can be stopped by building bunds in the path of running rainwater so that water-flow is slowed down and the water is percolated in the soil thereby increasing the ground water level.
- Planting more and more trees also helps to increase the ground water level in any area. Roots of the trees go deep into the soil thus by making path for the water to be stored underground.
- Cleaning the riverbanks and riverbeds also help the water to percolate and increase the water level.
- Making use of appropriate technology to water the plants and fields like sprinklers, jet sprays or any other simple methods by making use of locally available things.
- Stop leakage of taps by repairing them in time, use bucket of water instead of using shower for taking bath, use stored water for washing and cleaning, find methods to be slightly old and arduous, but it is something that you must do if you wish to leave behind at least a little of these resources for the coming generations.

Stop dumping things in the seas and rivers and lakes. Not only does marine life get affected, the water becomes polluted and dangerous for use thereafter.

**Conserving Energy**

Oil, natural gas, minerals and fossil fuels are the resources from which we get energy. As these sources are non-renewable sources ofenergy, due to overuse they are on the verge of extinction if we don't find any alternative source of energy. Fuel used in the vehicles; create lot of air and soil pollution creating hazardous and severe health problems. Thereare many ways to conserve these resources and provide a healthy environment to the living beings on the earth.

**Fossil Fuels:**

Fossil fuels are formed over millions of years and are produced from the remains of ancient plants and animals. Once we us them up, they cannot be replaced as they are non renewable. We need to conserve fossil fuels so we don't run out of them. Burning of fossil fuels release carbon dioxide and carbon monoxide gases in the atmosphere, thus contributing to Global warming. There is a change in the ecosystem resulting in the warming of oceans and becoming more acidic - a threat to sea life. Sea levels are rising which is a threat to the people living on coastal areas. Some areas suffer from floods and some have droughts. So scientist are exploring alternatives to fossil fuels. They are trying to produce renewable biofuels. Alternative sources for energy are solar energy, wind energy, tidal energy, hydroelectricity, geo-thermal energy. Everyone can help conserve fossil fuels by using them carefully.

**Minerals:**

They include coal, petroleum (oil), and natural gas. People rely on fuels to power vehicles like cars and airplanes, to produce electricity, and to cook and provide heat. Many of the products used are petroleum based for example:- Plastics, Synthetic rubber, fabrics like nylon, medicines, cosmetics, waxes, cleaning products, medical devices, and even bubblegum. Electronic products contribute to a lot of E-Waste containing minerals as well as petroleum-based plastics. Many of them also contain hazardous materials that can leach out of landfills into the soil and water supply. Promoting sustainable mining methods and recycling of materials can help to conserve mineral resources to a great extent. Recycling not only keeps the hazardous materials out of landfills, but also reduces the energy used to produce new products. For e.g. recycling aluminum saves 90 percent of the energy that would be required to mine new aluminum.

Turn off lights and other electronics when not using them. Purchase energy-efficient appliances and weatherproof the home. Walk or ride a bicycle if living close to work place as it would save the environment

and healthy also, carpool, and use public transportation whenever possible the best way to conserve naturalresources. Turn off electronic and electrical devices when not in use as they consume electricity even though they are on standby mode. Use energy star ratings electrical devices as they consume less electricity and reduce the effects of global warming. Solar energy is the best option to conserve energy as it saves electricity and natural gas to a great extent. Solar heaters, solar cookers, solar driers are the common appliances whichsave electricity.

**c) Conservation of Forests**

A forest is a large area covered with trees grouped so their foliage shades the ground. Forests make available a lot of social, economic, and environmental benefits and possess fantastic biodiversity. Forests provide habitats for animals and plants, recreational opportunities, store carbon, help in reducing global warming, protect soil by reducing water runoff and thereby reduce soil erosion, add nutrients to the soil through leaf litter, provide people with lumber and firewood. Forests are home to more than two-thirds of all known land species. Forests play the role of crucial defense against global climate change. Through the process of photosynthesis, they create life-giving oxygen by making use of enormous amounts of carbon dioxide, the atmospheric chemical majorly responsible for global warming. Forests may decrease the effects of global warming by reducing the carbon dioxide proportion in the atmosphere. Irrespective of this large areas of thickest forests in the world have been cleared for wood fuel, timber products, agriculture, and livestock.

Deforestation is the process of clearing away forests by cutting them down for wood or burning them to make way for farming or development. Deforestation destroys wildlife habitats and increases soil erosion, releases greenhouse gases into the atmosphere, contributing to global warming. Deforestation also harms the people who rely on forests for their survival, hunting and gathering, harvesting forest products, or using the timber for firewood. Sustainable forestry practices are critical for ensuring we have these resources well into the future.

d) **Conservation of Soil**

Soil is a vital ingredient for food production. High quality soilhelps to grow good crops for humans and animals. Many of the conservation efforts depend on each other. For example plant and animal conservation depend on soil conservation. Poor farming methods, such as repeatedly planting the same crop in the same place, deplete nutrients in the soil. Water and wind erode the soil to a large extent by wrong methods of farming. If the crop is taken by consulting the agriculturist it might slow down the process of soil erosion. For instance taking different crops having different root systems and leaves help in the process of soil conservation. Clear cutting method increases the chances of losing productive topsoil to wind and water erosion. But selective harvesting leaves other trees standing to anchor the soil.

e) **Conservation of Biodiversity**

Biodiversity is the variety of living things that populate the Earth. The products and benefits we get from nature rely on biodiversity. We need a rich mixture of living things to provide foods, building materials, and medicines, as well as to maintain a clean and healthy landscape. But people through hunting, pollution, habitat destruction by way of deforestation contribute to global warming and are speeding up the loss of biodiversity at an alarming rate.

We need to protect biodiversity to ensure we have plentiful and varied food sources. Biodiversity is important for more than just food but also for medicine. Government has established parks and preserves to protect wildlife and their habitats. Abolishing hunting and fishing practices that may cause the extinction of some species is a step taken towards the conservation of biodiversity.

## 1.16 NATURAL RESOURCE MANAGEMENT (NRM)

Natural Resources Management (NRM) refers to the sustainable utilization of major natural resources, such as land, water, air, minerals, forests, fisheries, and wild flora and fauna. Over- exploitation of natural resources by growing population has resulted in various severe problems like Destruction of vegetation has resulted in land degradation, denudation, soil erosion, landslides, floods, drought and unbalanced ecosystems. A balanced ecosystem is an urgent need as the natural resources (land, water, biodiversity and genetic resources, biomass resources, forests, livestock and fisheries) – the very foundation of human survival, progress and prosperity, have been degrading fast, and the unprecedented pace of their erosion is one of the root causes of the agrarian crisis that the country is facing. The demographic and socio- economic pressures notwithstanding, the unmindful agricultural intensification, over use of marginal lands, imbalanced use of fertilizers, organic matter depletion and deteriorating soil health, extensive diversion of prime agricultural lands to non- agricultural uses, misuse and inefficient use of irrigation water, depleting aquifers, salination of fertile lands and water logging, deforestation, biodiversity loss and genetic erosion, and climate change are the main underlying causes. It is true that

nature takes care of its resources through natural process over a period of time and maintains them. But ever- increasing population, developmental activities and technological modernisation have over- exploited available resources without taking into consideration the damage and consequences for coming generations. Vegetation plays an important role in protecting land and water. These resources are being depleted at an alarming rate because of human intervention.

A vast effort is now needed to understand the economic, social, and cultural functions of customs and practices of different social groups involved in agricultural development and territorial management in order to prioritize problems and arrive at a consensus of all those affected concerning environmental protection. Social science research is needed into marketing of agricultural products, circulation of cooking fuels, village-town relations, and migration in order to determine the effects of these phenomena on management and conservation of natural resources in rural areas. Experimental research should be directed toward finding practical solutions to problems encountered by rural cultivators. Different research organizations should coordinate their programs to avoid duplication of effort, and developing countries should be furnished access to new techniques resulting from research conducted by developed countries. Local populations must be involved in reforestation, water conservation, and other projects at every stage from preliminary planning to execution, if such plans are to succeed. Local populations themselves should be able to care for equipment and infrastructure involved in these efforts. Improved techniques of environmental protection must also be developed at the micro level of individual farms and pastures. National governments must redefine their role so that they become facilitators of local action without coercively imposing programs from above.

**Effective methods to conserve natural resources in short -**

Use of alternative sources of power such as solar and wind energy, Planting trees to prevent soil erosion, practicing of judicious ways to conserve water in our homes, Use pipelines to transport oil, Growing of vegetation in catchment areas, Treatment of industrial wastes and sewages

before they are released in the water bodies, Rain harvesting, Practice of in-site or on site conservation of wildlife, Practice Ex-situ or offsite conservation of wildlife, Formulation of policies to regulations to curb poaching, Practice judicious ways of conservation energy, Use of biogas in our homes, Use of bio-fuels, Ensure the recycling of wastes, Planting trees in home compounds, Make use of electronic mails, Purchase hybrid cars instead of the conventional cars, Use earth-bags instead of plastic and paper bags, Use energy saving fluorescent bulbs, Industries can ensure the make production efficient to reduce wastage, Use ceramic cups to consume the daily cup of coffee rather than using disposable mugs, Water the lawns and farms in the evening, Reuse old furniture, Practice crop rotation, Practice crop rotation, Encourage the use of drip and sprinkler irrigation, Establish special schemes to preserve endangered plant and animal species, Constructions of reservoirs, Formulate regulations to stop over fishing, Control the number of cattle in a household to prevent overgrazing and Constructing terraces and gabions in sloping land.

## 1.17 SUMMARY

In India, close to 275 million rural people depend largely on natural resources for their livelihoods. However, over the last few decades, the equilibrium between natural resources and livelihoods has been under increasing pressure, threatening both the ecological security of the country and increasing the vulnerability of rural communities. Rural populations are, therefore, the primary stakeholders in biodiversity conservation and sustainable use of natural resources. Through centuries of co-existence, communities living in the proximity of biodiversity- rich areas have acquired invaluable traditional knowledge that has shaped their culture and livelihoods. Community-based natural resource management is a key approach to conserving biological diversity and supporting local livelihoods. Natural resources conservation can be done in several other ways too. Simply making an effort to spread the word is a great way of doing your bit for the world you live in. Set an example for others to follow when it comes to the conservation of natural resources, that is so fundamental for the survival of mankind in these trying times.

## 1.18 SELF STUDY

1) Give the concept and definitions of natural resources?
2) What is the importance of natural resources?
3) What is conservation of natural resources and different ways to conserve it?
4) What is Natural Resource Management (NRM)?
5) Write short notes on :
    a) Natural Resources
    b) Conservation of Biodiversity
    c) Conservation ofForest
    d) Conservation of Soil e) Conservation of Trees

❖ ❖ ❖ ❖

# 2

# LAND

**Unit Structure :**



## 2.1 OBJECTIVES

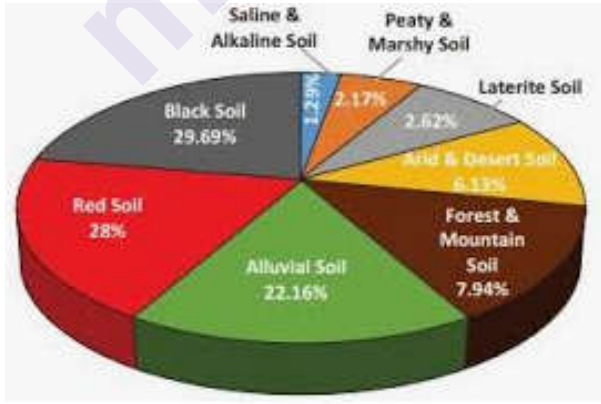
- To understand the nature of soil
- To study the characteristic features of the soil
- To understand the types of soil
- To study the use and usage of soil
- To study process of formation of Land
- To study the process of conservation of Land
- To understand the measures of Land Development

## 2.2 INTRODUCTION

The most important natural resource that nature has provided to society is soil. It is an element required for plant development. In fact, it keeps life on the globe alive since it is essential to both the living process and the ecosystem of the planet. According to the definition, "the upper layer of soil in which plants grow is a black or dark brown material that frequently consists of a mixture of organic wastes, clay, and rock pieces."

Soil is produced by a process called weathering. Rocks are removed during this process as a result of the force of the wind, water, and environment. The features of soils depend on the type of rock from which it has been formed and the type of plants growing on it. Each and every layer of soil is different in color, texture, thickness and its chemical composition

A section known as soil profile shows different types ofsoil in India.




The uppermost layer of the earth's surface is known as the soil, which is composed of minuscule fragments of broken rocks, minerals, organic materials, and microorganisms. When natural factors like temperature, rain, wind, waves, animals, and plants operate on rocks and break them into tiny bits over time, this is how soil is created. Everywhere throughout the nation, the depth of the soil varies. In some locations, it may just be a

few millimetres deep, while in others, it may reach a depth of up to 30 metres. The Deccan Plateau in India has black and red soils in addition to the lush alluvial soils of the Indo-Gangetic lowlands. Different types of soil are advantageous to various crops. nDifferent crops are benefited by different types of soils through their unique physical, chemical and biological properties.

## 2.3 A. FORMATION OF LAND

**Formation of Land**

In order for life to continue on Earth, soil must be present. Soil is a vital component of the biosphere. Soil is essential to both the biosphere and the spread of life on earth. Soil is a dynamic, complex natural body that acts as a medium for plant development. Parent material, climate, location, biota, and time are some of the factors that have an impact on how soil is formed. Due to the diversity of the components that make up soil, each kind has its own characteristics and structure. The interactions between soil's physical, chemical, and biological characteristics make it an effective substrate for plant development with additional uses. However, silt is created as soil erodes off the ground and pollutes the environment. But as soil is eroded off the land, it forms silt, which pollutes water sources.

The weathering process, which results in the physical and chemical degradation of the earth's rocks due to air factors, is what creates soil. Rock's natural physical and chemical properties are altered as a result of the weathering process, which chips away rock pieces. It can also create new minerals that are necessary for the creation of soil.

The two main pathways of weathering physical disintegration and chemical decomposition are essential for soil formation and act differently and simultaneously on the parent material creating recognizable features. Physical disintegration occurs mainly in dry and cold environments where the heating and cooling of the exposed rocks create physical stress and cracking. It breaks down the rock into smaller pieces and eventually into sand, silt and clay particles. Other forms of physical weathering come from abrasion by water, ice or wind which, are just as significant to the origin of soils and sediments. Simultaneously chemical processes release soluble materials and minerals and alters the structure of the parent

material by chemical reactions. Chemical decomposition occurs in hot and wet climatic regions. As this form of weathering is impacted by geological and biological processes it is also known as biogeochemical weathering. Water is an essential component for each of these forms of chemical weathering reactions.

Nutrient cycling, plant growth, gas exchange, carbon storage and waste disposal are some of the crucial functions of soil. For instance, chemical properties control nutrient availability and transformations. Physical properties influence plant growth, micro-organisms and water transport while biological properties contribute to the structure of soil, development and productivity.

**Soil Composition**

Soil composition is an important aspect of nutrient management. Soil minerals and organic matter hold and store nutrients while, soil water readily provides nutrients for plant uptake. Soil air plays an integral role in nutrient management, since many of the microorganisms living in the soil need air to undergo the biological processes that release additional nutrients into the soil. The basic components of soil are minerals, organic matter, water and air. The typical soil consists of approximately 45% mineral, 5% organic matter, 20-30% water, and 20-30% air. These percentages are only generalizations but in reality, the soil is very complex and dynamic. The composition of the soil can fluctuate on a daily basis, depending on numerous factors such as water supply, cultivation practices, and/or soil type.

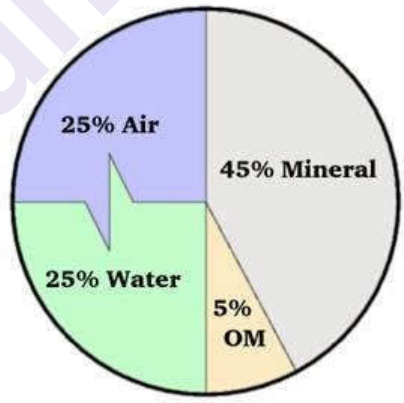



**Figure 1.** Approximate composition of soil.

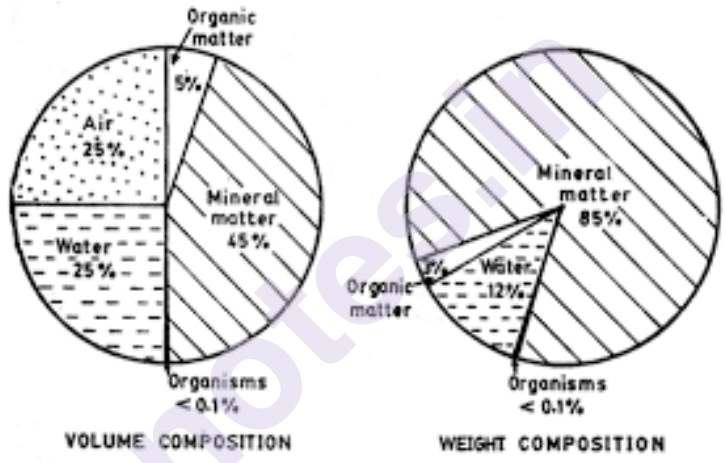
The solid phase of soil is generally stable in nature and they include minerals and organic matter. If the organic matter in the soil is not managed properly, it may get depleted. The liquid (water) and gas (air) phases of the soil, are the most dynamic properties of the soil. The relative amounts of water and air in the soil are constantly changing as the soil wets or dries.

Solid particles in the soil can be inorganic or organic. The inorganic particles are mainly minerals – silicates, oxides and hydroxides of iron, aluminum, manganese, etc. are classified into skeleton and fine earth,

which are then divided into sand, lime and clay. The particlesderived from the alteration of rocks into smaller and incoherent material accumulates to form superficial deposits and can occur in the same place as the rock was disintegrated.

The degradation processes of vegetal residues (leaves, fruits, dry branches or whole plants) and dead animals lead to the creation of organic fractions of the soil. Organic compounds can be kept unaltered for long periods (non-humic compounds) or be subjected to deep and fast changes in their original chemical structure (humid compounds or humus). Water and air occupy the free spaces between the solid particles (pores), and form a thick and extended network that allows water to move in the ground.

Soils are composition of mineral particles 45%, organic matter 5%, air 25% and water 25%.




**Mineral Particles:**

They are the largest ingredient and make up approximately 45% ofsoils. They are formed from the parent rock or the original rock that got broken down by weathering and erosion to form the basis of soil. This broken rock has minerals like calcium, phosphorous and potassium in the soil on which the plants feed. The soil colour, depth, texture and Ph value are influenced by the parent material.

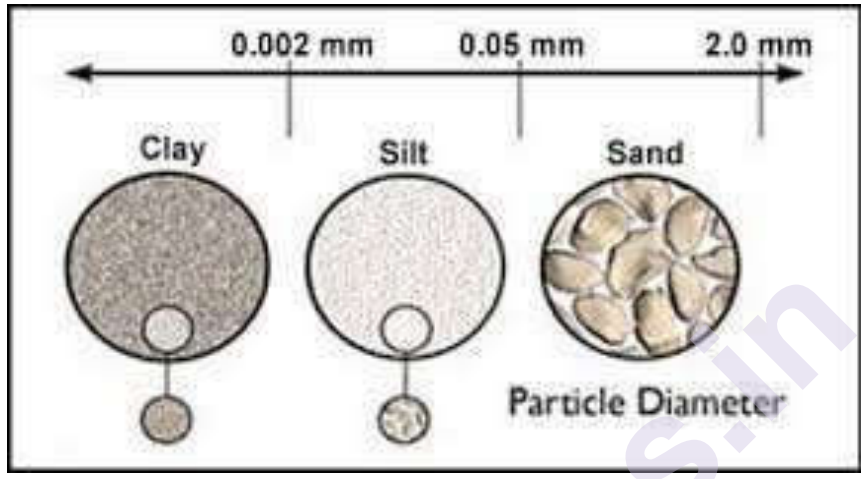
**Organic Matter:**

It is the decayed vegetation that is broken down by the micro- organisms in the soil to form Humus. Humus is a dark jelly like substance which, binds the soil together, improves its texture and increases theability of the soil to retain moisture. Brown soils are found in area of deciduous forest areas where there is abundance of plant litter available to decay. The colour of the soil indicates the percentage of organic content init. Darker soils have more organic content. There is lot of Humus in dark soils.

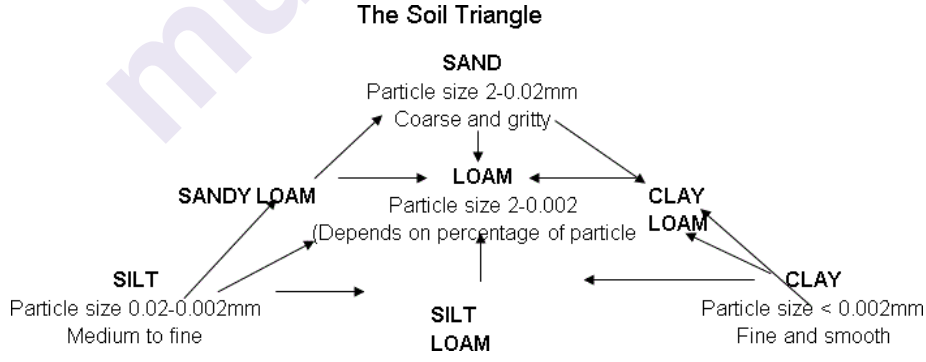
**Air and Water:**

Air is very much essential for the survival of micro-organisms. There would be a shortage of humus due to lack of air. The granular structure of dark soils allow for good aeration. Without water in the soil plants cannot survive. As mineral particles dissolve in water the roots of plants can absorb the nutrients of them.

**Texture :**




Texture is the feeling you get when you touch the soil**.** It is determined by the proportions of sand, silt and clay present in the soil. It isthe texture that determines how well can the moisture and roots penetrate the soil and how well can the excess moisture drain away from the soil. The ideal combination for soil texture is approximately 40% sand, 40% silt and 20% clay forming a loam soil.

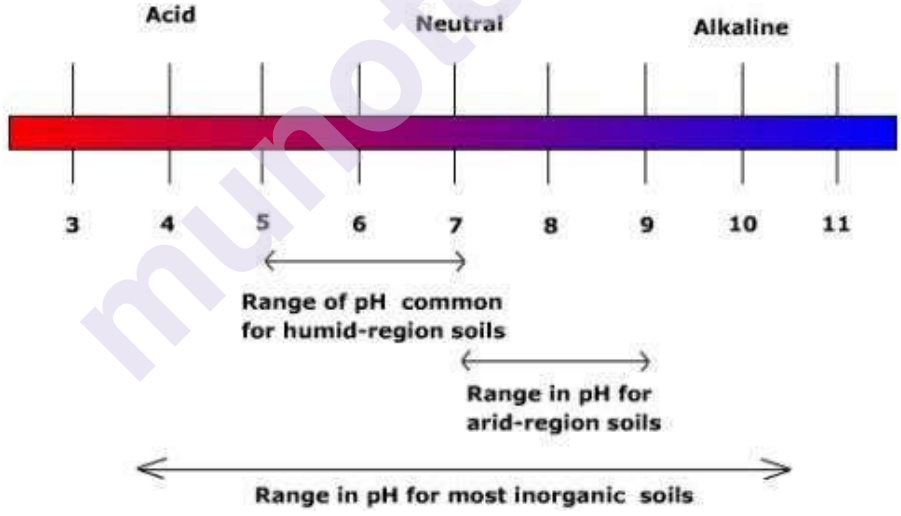



This type of soil has a well-developed crumb structure which allows water, air and organisms to pass through it easily, and even roots can spread out easily. Water and nutrient retention is very good as it is soaked up by the crumbs of the soil. Loam soils (dark soils) are ideal for cultivation as they have good drainage and aeration properties.

**Colour :**


The colour of the soil also matters a lot. Light coloured soils deflect sunlight while dark soils absorb more sunlight which, allows the soil to heat up quickly and boost seed germination and crop growth effectively. Heat is an important component in the humidification process. The humus content in the loamy soil is very high which makes the soil darker thus supporting for good crop growth.

**PH Value :**




PH scale is used to measure the acidity of a substance and the ideal PH value for agricultural soil is 6.5 a little bit acidic. High acidic soil lacks calcium and potassium essential for the growth of plants and crops. It has low levels of organisms vital for humidification. Soils having PH value less than 4 is mainly found in the mountainous areas and are less acidic. Brown soils have PH value between 5 – 7 which support a wide variety of plantlife as it is very fertile.

## 2.4 FACTORS RESPONSIBLE FOR THE FORMATION OF LAND

Major factors responsible for the formation of soil are the parent material, climate, vegetation and other life forms along with the human activities. These factors are separated but independent as the soil profile of any region around the world is dependent on them.

a) **Parent Material:** it is deposited by streams or derived from in-situ weathering wherein the soil acquires properties like the mineral composition, colour, size of the particle and the chemical elements from the weathered rocks.

b) **Climate:** It is considered as the important factors in the formation of soil as it affects the rate of weathering of the parent rock.

c) **Role of precipitation:** The composition of the soil is modified by the variability in the precipitation. For instance, the areas having little rainfall,but the rate of evaporation is high leads to the accumulation of salts in the soil. The intensive leaching due to heavy rains make the soil underlying the tropical rain forests poor in nutrient.

d) **Role of Temperature:** The fluctuations in temperature causes shrinking and swelling, frost action and general weathering in soils. So, it also plays an important role in the formation of soil.

e) **Biota (Flora & Fauna and Microorganisms):** Biota modifies parent material to produce soil in association with climate. For example – Leguminous plants have nitrogen fixing bacteria which, improves the fertility of soil by fixing atmospheric nitrogen to ammonia or ammonium. Leguminous plants like beans, peas and groundnuts take the nitrate ions directly from these nitrogen fixing bacteria.

f) **Topography (Altitude, Slope and Relief):** It affects the soil processes, soil distribution and the type of vegetation. So, it is treated as a passive factor that modifies the effects of climate.

g) **Time:** It takes many years to form a layer of soil. The younger soils gain some characteristics from their parent material. But after some years as they age factors like addition of organic matter, exposure to moisture and other environmental factors may change the features of soil.

**Features of soil:**

1) Fertile soil is rich in nutrients as it contains the necessary nutrients like nitrogen, phosphorous and potassium essential for basic plant nourishment.

2) PH of soil ranges between 6.0 to 6.8.

3) Fertile soil contains adequate minerals like boron, chlorine, cobalt, copper, iron, manganese, magnesium, molybdenum, sulphur and zinc

promoting plant nutrition.

4) The soil organic matter in the soil improves the soil-structure which enables the soil to retain more moisture and result in well-drained soil.

5) Fertile soil contains large amount of topsoil and also has a variety of micro-organisms supporting plant growth.

## 2.5 LAND UTILIZATION PATTERN IN INDIA

Land being a scarce resource, its supply is fixed for all practical purposes. With the increase in human population and economic growth the demand for land for the different competing purposes is increasing continuously. Several factors like size of human & livestock population, demand pattern, technology in use, cultural traditions, location and capability of land, institutional factors like ownership pattern & rights and state regulation determine the land use pattern at any given time. If the economic implications and ecological dimensions of land use pattern are ignored, they can have adverse effect.

**Table 6.1: Land utilisation in India**

**(Million hectare.**

| Use | Area |
|---|---|
| (1) Area under non-agricultural uses | 23.57 |
| (2) Barren and uncultivable land | 19.26 |
| (3) Net sown area | 141.10 |
| (4) Forest lands under good tree cover | 69.41 |
| (5) Miscellaneous tree crops and groves | 3.37 |
| (6) Cultivable wastelands | 13.66 |
| (7) Current fallow(i.e. land currently left unutilised) | 14.80 |
| (8) Old fallow | 10.39 |
| (9) Permanent pastures and grasing grounds | 10.90 |

Land utilization pattern is shown in the above table. The available land is classified in two parts on the basis of its use.

1) Agricultural Land

2) Non-Agricultural Land

**1) Agricultural Land:**

Agricultural land accounts a little over 50% of the total geographical area in the country and it means the land that is suitable for agricultural production includes both crops including net sown area, current fallows and land under miscellaneous tree crops & groves and livestock.

**2) Non-Agricultural Land:**

This includes –

i. Land under forests and permanent pastures,

ii. Land under other non-agricultural uses (towns, villages, roads, railways, etc.) and

iii. Land classified as cultivable waste as well as barren and uncultivated land of mountain and desert areas.

The total effective area of the country (304.6m Ha) as per records has been put to different categories of land use. Classification of land in India has its roots in agricultural statistics. After independence land in India was classified into five categories.

i. Area under forests,

ii. Area not available for cultivation,

iii. Uncultivated lands excluding current fallow,

iv. Area under current fallow, and

v. Net area sown.



It was seen that this classification did not give a clear picture of theactual area under different categories of land use, that was required by agricultural planning. So, after March 1950 land in India was reclassified under nine different categories, viz., i) forests; ii) barren and uncultivable land; iii) land put to non-agricultural uses; iv) cultivable wastes; v) permanent pasture and other grazing land; vi) miscellaneous tree crops and groves not included in the net area sown; vii) current fallows; viii) other fallows; and ix) net area sown.

**Changing trends in Land Use Patterns:**

Geographical and Physical changes had taken place in all parts of India in the land use pattern after the green revolution. In 1951-52, the net area sown was 119.4 million hectares and by 2006-07, it was more than 141

million hectares. Forest cover increased from 14% of land cover in 1951-52 to more than 23.5% in 2006-07. There was an increase in the area that was doubled cropped and multiple-cropped. The area under wheat andrice increased significantly but, pulses, millets and fodder reduced.

| | 1950-51 | 2006-07 |
|---|---|---|
| **Net sown area** | **43.77** | **48** |
| **Not available for cultivation** | **14.92** | **13.5** |
| **Forests** | **14.23** | **19** |
| **Fallow land** | **9.89** | **6** |
| **Other Uncultivated land** | **17.39** | **9.5** |

**Table India's land use pattern in 1950-51 and 2006-07(Percentage of total reporting area of 304 mHa hectare)**

As the economy had grown changes in the land use pattern were seen, resulting in the land being used for purposes other than agriculture. It is increasingly used for building purposes especially in and around urban areas which, has resulted in the decline in the pastureland due to pressure from agriculture.

## 2.6 TYPES OF LAND USE IN INDIA

The important types of land use in the country are:

i) Forests area

ii) Land not available for cultivation

iii) Cultivable wasteland

iv) Fallow land

v) Net area sown

**i) Forest area:**

According to the National Forest Policy 1952, the reporting forest area should be 33.3% of the total land. The area under forest after Indian independence i.e. during the period 1950-51was only 40.48 million hectares which accounts to only 14.2%.but now as per the report it has increased to 80.20 million hectares accounting to 24.39% in the year2017-18. The forest area is unevenly distributed in India. Due to heavy rainfall and relief features the states reporting more area under forest cover are Madhya Pradesh, Arunachal Pradesh, Orissa, Maharashtra, Andhra Pradesh, Andaman & Nicobar Islands. While, Dadra & Nagar Haveli, Punjab, Haryana and Goa states have less forest cover.

**ii) Land not available for cultivation:**

Human settlements, transport routes, mountains, deserts, marshy places, canals, quarries etc. come in this category accounting to 12.11% of the total land in India. States of Arunachal Pradesh, Rajasthan, Gujrat and Madhya Pradesh having more area come under this land use pattern. Dadra and Nagar Haveli, Chandigarh, Andaman and Nicobar Islands and Sikkim have less area fall in this land use pattern.

**iii) Cultivable waste land:**

This category of land use pattern covers about 8.6% of the country's total reporting land. It includes permanent pastures, other grazing areas, land under miscellaneous trees, crops, groves and cultivable waste. States of Rajasthan, Himachal Pradesh and Madhya Pradesh have more area under permanent pastures and other grazing lands but have less area in Manipur, Dadra & Nagar Haveli, Goa and Andaman & Nicobar Islands. Cultivable waste land is more in Rajasthan, Madhya Pradesh and Maharashtra but, very less in Tripura, Manipur, Sikkim and Punjab states.

On one hand the land under miscellaneous tree crops and groves is found high in the states of Uttarakhand, Uttar Pradesh, Odisha and Andhra Pradesh and on the other hand Chandigarh, Goa, Delhi and Puducherry reported very less area under this category.

**iv) Fallow lands:**

Fallow land is the land not utilized for cultivation for the last 3-5 years but, in future it can be cultivated. It accounts for about 8.13% of India's total land in this land use pattern. States of Rajasthan, Andhra Pradesh and Jharkhand have more land in this category while, Tripura, Dadra and Nagar haveli, Puducherry and Andaman & Nicobar Islands have less land under this category.

**v) Net Area Sown:**

Out of the total reporting land in India 46.2% comes under net sown area and there has been a phenomenal increase in it during last few decades. The reason behind this is the reclamation of barren land, uncultivable land, pastureland etc.

As per the land use statistics 2013-14, the total geographical areaof the country is 328.7 million hectares, of which 141.4 million hectares is the reported net sown area and 200.9 million hectares is the gross cropped area with a cropping intensity of 142 %.Net sown area has reached its maximum level in Haryana while, Punjab, Uttar Pradesh, Himachal Pradesh, Jammu and Kashmir, Meghalaya, Nagaland, Mizoram and Arunachal Pradesh are reporting less than 30% of net area sown.

## 2.7 SUMMARY

Soil is one of the most important natural resources provided by nature to mankind. It actually sustains life on the planet as it is an essential ingredient for growing plants. Soil is a dynamic natural body with a complex structure that serves as a medium for plant growth. Soil is essential for the propagation of life on earth and therefore is an integral part of the biosphere. The physical, chemical and biological properties of soils are interrelated, making soil an effective medium for plant growth with additional functions. Soil composition is an important aspect of nutrient management. The soil flora and fauna play an important role in soil development. Soil is composed of both organic and inorganic matter, and it is essential for life on earth to exist.

## 2.8 SELF-STUDY

1) Give the concept and formation of soil.

2) Discuss the different land utilization patterns in India.

3) Give the types of land in India?

4) What factors are responsible for the formation of soil?

5) Answer in detail the soil composition

6) Write short note on : Soil Composition

## 2.9 TYPES OF SOIL IN INDIA

Soil may look like dirty stuff that simply holds plants in the ground, but it is the basis of thousands of food chains. Our way of living depends on the soil. It is a multi-layered, complex system holding nutrients for plants, providing a home for invertebrates &vertebrates. It is the soil that helps us to grow crops and feed for the living beings on earth.

Different layers of soil perform different functions or have different purposes. The top layer of the soil is rich in organic matter and nutrients and is called Humus. Below lies the Topsoil containing Humus ideal for plant growth. Subsoil is next level down to it containing lots of minerals and some solid rock pieces. But it is less nutrient rich. Below this is the weathered rock fragments containing very little organic matter. Finally, below is the bedrock, the solid rock on which all the above said layers lie upon.

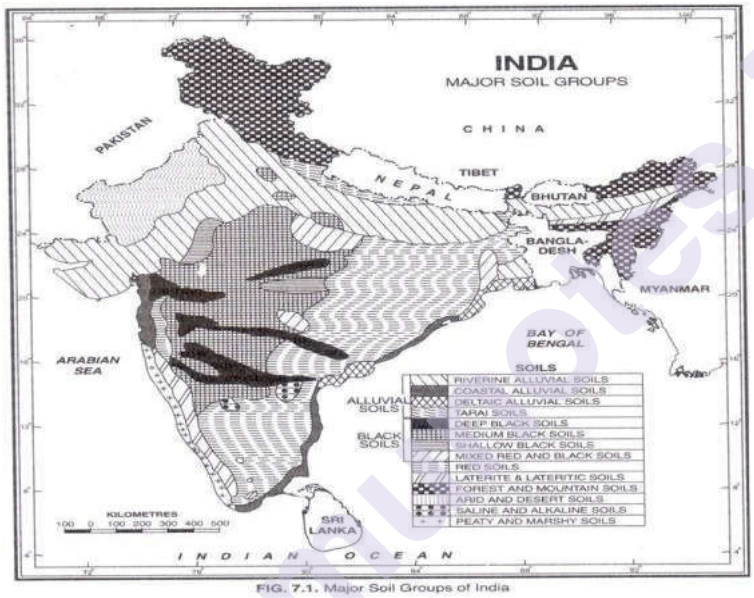


FIG. 7.1. Major Soil Groups of India

Soil is formed when rocks are broken down by the action of wind, water, weather and climate. The quality of soil also depends upon the rocks from which it has been formed and the kind of plants that grow in it.

Different types of soil are formed based on the size of the soil grains, the larger the soil grains the muddier the soil when it gets wet. Clay, sand, silt, chalk, peat and loam soils have different consistencies, allowing the growth of different plants. pH of the soil also is an important factor as it decides the alkalinity and acidity of the soil. It is difficult for a plant species to get established if the soil is more acidic or alkaline.

Soil is formed of different layers of particles which, are in different sizes, in thickness, in texture, colour and chemical composition. There are 8 different types of soils found in India and they are as follows:

## 1. Alluvial soils:

Alluvial soil is the largest and most important soil group of India. It covers an area of about 15 lakh sq. km accounting to about 45.6% of the total land area of the country. It contributes the largest share of our agricultural wealth and supports massive India's population. The parent material of this soil is of transported origin. Much of the alluvial soil is derived from the sediments deposited by the rivers in the Indo-Gangetic plain. Some of the alluvial in the coastal areas have been formed by the sea waves. The streams bring the produce of weathering of rocks from mountains and deposit them in the low-lying areas. The alluvial soils are immature with weak profiles and differ in consistency from drift sand to rich loams and from silts to stiff clays and kankar beds are also present occasionally. Chemical composition of alluvial soils makes this type of soil as one of the most fertile soil in the world. Alluvial soil has low nitrogen. The proportion of potash, phosphoric acid and alkalies is adequate, while iron oxide and lime vary within a wide range. Alluvial soil are easily renewed by the recurrent river floods supporting un-interrupted crop growth. Even the porosity and texture contribute to good drainage and other favourable conditions for prolific growth.

Alluvial soils occur widely in the Great Indo-Gangetic plains from west to east. It starts from Punjab to West Bengal and Assam. Further they also occur in deltas of the Mahanadi, the Godavari, the Krishna and the Cauvery and are called deltaic alluvium. Also called as coastal alluvium along the seacoast. Northern parts of Gujarat have some cover of alluvial soils and some are found in the Narmada and Tapi valleys.

Alluvium of the great Indo-Gangetic plain of India is divided into new or young Khadar and old Bhangar soils. The khadar soils are found in the low-lying areas of the valley bottom that are flooded almost every year. These soils are pale brown, sandy clays and loams, are very dry, leached, are less calcareous and carbonaceous means they are less Kankary. Old bhangar soil is found on high places 30 meters above the flood level. It is dark in colour and have more clay. A few meters below the surface of

the Bhangarlie the beds of lime nodules known as Kankar. There are alluvial fans having coarse, often pebbly soils along the foothills of Shiwalik and this zone is called Bhabar. There is a long narrow strip of swampy lowland with silty soils to the south covering an area of 56,600 sq. km which is called Tarai. Tarai soils are rich in nitrogen and organic matter, but deficient in phosphate. They are usually covered by tall grasses and forests. These soils are well suitable for crops such as wheat, rice, sugarcane, jute and soyabean. The alluvial soils are best suited to irrigation – canal, well and tube-wells due to the softness of the strata and fertility. With proper irrigation alluvial soils yield more crops of paddy, wheat, cotton, jute, maize, sugarcane, oilseeds, vegetables & fruits and tobacco.

**2) Black Soils:**

Black soil is also called as Regur soil or black cotton soil as cotton is the major crop taken in this soil. It is believed by the pedologists that black soil is formed thousands of years ago due to the solidification of the lava spread over large areas during volcanic activities in the deccan plateau.



Black soils are mainly derived from two types of rocks the deccan and the raajmahal trap which are sufficiently deep, and ferruginous gneisses and schists generally shallow that occur in Tamil Nadu.

The origin of black cotton soils is attributed to old lagoons inwhich the rivers deposit the materials brought down from the interior of Peninsula covered with lava in some parts of Gujarat and Tamil Nadu. Black soils are spread over 5.46 lakh sq km (16.6 % of the total geographical area of the country) lying between 15°N to 25°N latitudes and 72°E to 82°E longitudes. Area lying between these latitudes and longitudes have high temperature and low rainfall. Therefore, this is a soil

type of the dry and hot regions of the peninsula. Black soil is mainly found in Maharashtra, Madhya Pradesh, Karnataka, Andhra Pradesh, Gujrat and Tamil Nadu. According to some scientist the black colour of the soil is due to the presence of a small proportion of titaniferous magnetite or iron and black constituents of the parent rock. It may be even derived from

crystalline schists and basic gneisses in Tamil Nadu and some parts of Andhra Pradesh. Different shades of the black colour are found in this group of soils like deep black, medium black, shallow black or even a mixture of red and black. Black soil retains moisture, swells and becomes sticky in rainy season. As a result, it is difficult to plough the field as the plough gets stuck in the mud.

But in hot dry season the soil becomes dry as the moisture evaporates, the soil compresses and is seamed with broad and deep cracks 10 -15 cm wide and a meter deep. Because of this the flow of oxygen inthe soil is very good and is extraordinarily fertile. This soil is used for growing variety of crops for many centuries without the addition of manures and fertilizers, without fallowing. Black soil is highly argillaceous with 62% or more clay without gravel or coarse sand. It also contains 10% alumina, 9-10% iron oxide and 6-8% of lime and magnesium carbonates. Potash is less than 0.5% and is variable. Humus, nitrogen and phosphates percentage is low.

In all the regur soils and ferromagnesian schist there is a layer rich in kankar nodules which, is formed by the segregation of calcium carbonate at lower depths. In general, black soils in the uplands are less fertile and black soils in the valleys are darker, deeper and richer. Black soils are widely used to produce many important crops due to their high fertility and moisture retention capacity. Major crops grown on the black soils are cotton, wheat, jowar, linseed, Virginia tobacco, castor, sunflower and millets. Wherever irrigation facilities are there, two important crops rice and sugarcane are taken. Also, many varieties of fruits and vegetables are successfully grown on black soils.

**3) Red Soil:**

Red soils are formed due to weathering of ancient crystalline and metamorphic rocks. The main parent rocks are acid granites and gneisses, quartzitic and felspathic. The colour of these soils is generally red which, is due to the wide diffusion than to high percentage of iron content and are often graded into brown, chocolate, yellow, grey or even black. Red soils

are spread in a vast area of about 3.5lakh sq. km accounting to 10.6% of the total geographical area of the country. It is found in Tamil Nadu, parts of Karnataka, south-east Maharashtra, eastern parts of Andhra Pradesh, Chhattisgarh, Orissa and Chota Nagpur in Jharkhand, large parts of south Bihar; the Birbhum and Bankura districts of West Bengal; Mirzapur, Jhansi, Banda and Hamirpur districts of Uttar Pradesh; Aravallis and the eastern half of Rajasthan, parts of Assam, Nagaland, Manipur, Mizoram, Tripura and Meghalaya.

Red soils are rich in potash but poor in lime, magnesia, phosphates, nitrogen and humus. They are mainly siliceous and aluminous by chemical composition with free quartz as sand and are rich in potassium. Red soils texture vary from sand to clay as the majority are loams. They are thin, poor and gravelly, sandy or stone and porous in the uplands, but are rich, deep dark and fertile in the lower areas. It responds very well to the proper use of fertilizers and irrigation by giving excellent yields of cotton, wheat, rice, pulses, millets, tobacco. Oil-seeds, potatoes and fruits.

**4) Laterite and Lateritic Soils:**



Majority of people have the opinion that the laterite soil is formed under conditions of high temperature and heavy rainfall with alternate wet and dry periods. Such climatic conditions promote leaching of soil wherein lime and silica are leached away leaving behind the soil rich in oxides of iron and aluminium compounds. There are many varieties of laterite soils which have bauxite on one side and an indefinite mixture of ferric oxides at the other. All laterite soils have very less lime and magnesia and also are deficient in nitrogen, potash. The phosphate contentmay be high in the form of iron phosphate and in some places high contentof humus.

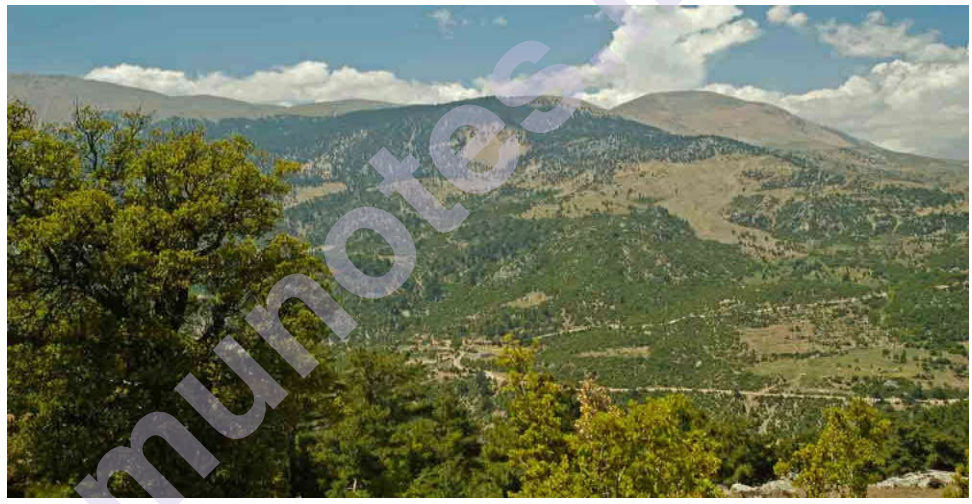
Laterite and lateritic soils cover an area of 2.48 lakh sq.km. they are mainly found on the summits of Western Ghats at 1000-1500 m above mean sea level, the Vindhyas, the Satpuras, the Eastern Ghats, the Malwa Plateau and the Rajmahal Hills. Laterite soils are also found in the low-lying areas and in valleys in several other parts of the country. They are well developed in southern part of Maharashtra, some parts of Karnataka,

Andhra Pradesh, Orissa, West Bengal, Kerala, Jharkhand, Assam and Meghalaya.

Typical laterite soils lack fertility due to intensive leaching and low base exchange capacity. So, they are of little use for crops. But when they are manure and provided irrigation facilities, some of the laterite and lateritic soils are suitable for growing plantations like tea, coffee, rubber, cinchona, areca nut, coconut, etc. Paddy is also grown in some of the low- lying areas. Laterite soils respond very well if supplied with nitrogen, phosphorous and potassium in the states of Karnataka, Kerala, Chota Nagpur in Jharkhand, Orissa and Assam. It also supports grazing grounds and scrub forests in some areas of the country.

Laterite and lateritic soils are used for building material due to their distinctive quality. They can be easily cut with spade but whenexposed to air it hardens like iron. It cannot be weathered more further asit is the end end-product of weathering and is indefinitely durable.

**5) Forest and Mountainous soil:**





It is mainly found on the hill slopes covered by forests occupying about 2.85 lakh sq. km accounting to 8.67 % of the total land area of India.These soils are formed by the characteristic depositions of organic matter derived from forest growth. Being heterogeneous in nature the character ofthis soil changes with the parent rocks, its ground configuration and climate. The soils differ immensely even though they occur in close proximity to each other. Such soils are majorly found in valley basins, depressions and less steeply inclined slopes. The forest soils occur on Western and Eastern Ghats as well as in some parts of the Peninsular

plateau along with the Himalayan region. They are deficient in potash, phosphorus and lime but rich in humus as a result they need good portion of fertilizers to gain high yields. These soils are more suitable for tea, coffee plantations, spices and tropical fruits in Karnataka, Tamil Nadu and Kerala. Soils in Jammu and Kashmir, Himachal Pradesh and Uttaranchal are suitable for crops like wheat, maize, barley and temperate fruits.

**6) Arid and Desert Soils:**

A large part of the arid and semi-arid region in Rajasthan and the adjoining areas of Punjab and Haryana lying between the Indus and the Aravalisis affected by the desert conditions. It receives annual rainfall of less than 50 cm and covers an area of 1.42 lakh sq. km accounting to 4.32

% of the total area. Rann of Kuchchh in Gujarat is an extension of this desert. As this area is covered by a mantle of sand it suppresses the growth of soil. Sandy soil is originated from the mechanical disintegration of the ground rocks or is blown from the Indus basin and the coast by the prevailing south-west monsoon winds. Barren sandy soils without clay factor are also common in coastal regions of Orissa, Tamil Nadu and Kerala. The desert soil contains Aeolian sand (90-95 %) and clay (5-10%).

Some of these soils are poor in organic matter, are alkaline and vary in the percentage of calcium carbonate and contains high percentage of soluble salts. In certain areas the subsoil has ten times calcium compared to the topsoil. In many areas the calcium content increases downwards. The phosphate content of these soils is high as that in normal alluvial soils. This soil is deficient in nitrogen, but it is to some extent fulfilled in the form of nitrates. As a result, wherever there is moisture available and the presence of phosphates and nitrates make the soil fertile. With proper irrigation facilities there are possibilities to regenerate these soils. Drought resistant and salt tolerant crops like cotton, barley, wheat, millets, maize, pulses and rapeseed are grown in this soil.

**7) Saline and Alkaline Soils:**

Saline and Alkaline soils are accountable to saline and Alkaline efflorescences. They are known by different names like reh, kallar, rakar, chopan, thur, karl, usar. These soils are found in Andhra Pradesh, Karnataka, drier parts of Maharashtra, Rajasthan, Uttar Pradesh, Punjab and Haryana occupying area of 68,000 sq. km. many decomposed rock and mineral fragments on weathering liberate sodium, magnesium and calcium salts and sulphurous acid. While some salts are transported by the rivers thus percolating in the sub soils of the plains. The accumulation of these salts makes the soil infertile which is unfit for agricultural purpose. In canal irrigated areas and high subsoil water table by capillary action the harmful salts are transferred from below the topsoil as a result of evaporation in dry season.

In Gujrat, the area around the Gulf of Khambat is affected by the sea tides carrying salt-laden deposits. Due to this the vast areas that comprise the estuaries of the Narmada, the Tapi, the Mahi and the Sabarmati areas have become infertile. It has been approximated that about 1.25 million hectares of land in Uttar Pradesh and 1.21 million hectares of land in Punjab is affected by Usar.

**8) Peaty and Marshy Soil:**

Soils originating in humid regions as a result of accumulation of large amounts of organic matter in the soils are the Peaty soils. They contain considerable amount of soluble salts and 10-40 % of organicmatter. These soils called Kari and are found in Kottayam and Alappuzha districts of Kerala. Peaty soils are black, heavy and highly acidic in nature. They are deficient in potash and phosphate. Peaty soils are under water in the rainy season. But as soon as the rain ceases, paddy cultivation is done on it. Marshy soils having high proportion of vegetation occur in the coastal areas of Orissa and Tamil Nadu, Sunderbans of West Bengal, Bihar and Almora district of Uttaranchal.

Soil is a valuable ecosystem covering the earth's surface. As soil is made up of minerals, nutrients, water, air, organic matter and micro-organisms. Therefore, this soil is used in a variety of products in various industries.

## 2.10 LAND OF MAHARASHTRA

Land of Maharashtra are derived from the igneous basalt rock and are residual. The soil in the river basins of Godavari, Bhima, Krishna and Tapi has a deep layer of fertile black basalt soil and is rich in humus and isbest suited for cotton. It is often called as black cotton soil. The remaining semi-dry plateau of Deccan has a medium layer of black regur soil. It is clayey and moisture retentive, rich in iron but is poor in nitrogen and organic matter. Higher plateau region has murmad soils containing gravel. Reddish laterite soil locally called as jambhi is found on the peaks of the Sahyadri Mountains, in districts of Ratnagiri and Sindhudurgand the western regions of Kolhapur and Satara. The konkan coast has a sandy loam soil. North Konkan and Bhandara, Gondia and Gadchiroli districts of eastern Vidharba region have reddish and yellowish soil. Towards the east in Vidharbha region the morand soils having good mixture of lime are ideal for kharif crops.

Maharashtra the third largest state Indian state can be divided into three natural regions the Maharashtra plateau, the Sahyadri range and the Konkan coastal strip according to its geographical features. Though the dominant physical trait of the state is its plateau character the soil and vegetation of Maharashtra are related to the climate and the geology. Many small plateaux and river valleys imprint the deccan plateau region and rivers like Narmada, Krishna, Godavari, Wardha, Tapi mold the valleys in between intervening highlands. The clayey type of soil in the semi dry Deccan Plateau is mostly black basalt soil retains moisture and is rich in humus. It is also called 'black cotton soil' or 'regur soil' as it is best suitable for cotton cultivation. These igneous rocks break down to form fertile black soil suitable for rabi crops. The old crystalline rocks and saline soil make the Wardha-Wainganga river valley infertile. As this soil is granular, can retain moisture and rich in iron content. It has natural resistance to wind and water. This makes the soil very reactive to irrigation.

The pather soil containing more gravel is seen in the hilly high lying terrain. The laterite reddish brown soil is well suited for rainfedcrops like rice, ragi, jowar, gram, groundnut, sugarcane etc. it is also productive under forest cover and mango, cashew, jackfruit and jamun are also can be grown here.

Sahyadri hills also called Western Ghats run parallel to the seacoast. Most of the rivers in Maharashtra originate from the sahyadris. The soils in the western ghats vary from reddish brown to black and are rich in nitrogen. The tableland called Mawal is dominated by vegetables like potato, onion, chillies, brinjal and tomatoes and kharif cereals, sugarcane and groundnuts. Fruits like mango, banana, guava, grapes and cashew are also grown.

On the plains the soil is greyish black and moderately alkaline in nature, well drained and good for irrigation. Is mainly suitable for kharif and rabi crops like jowar, bajra, wheat, groundnuts, urad, etc.

The konkan area is a 50km wide belt between the Arabian sea and the Sahyadri. It is a lowland plateau with steep valleys and vegetation mainly consists of forest in the eastern region and the Sahyadri ranges, the Satpura ranges and the Chandrapur region. Shrub jungles predominate the plateau. Vegetation grown in this region is paddy and the coastal belt consists of eminent trees like the mango, coconut and shrubs.

Thick evergreen deciduous forests cover 17% of the land in Maharashtra and they have high value as they yield teak, bamboo, myrobalan etc. The areas having good annual rainfall have rich vegetation.

## 2.11 SUMMARY

Shallow, medium and deep-black soils are mostly found in the state of Maharashtra. Black cotton soil is mainly found in Deccan plateaus. Soils found on hill tops are composed of sandy and stony material with murum. Alluvial soils are formed by alluvium found at upstream region or nearby relief. The Eastern Maharashtra especially Wainganga basin consists of varieties of rocks such as granitic, gneissic and sediment resulting in formation of different soils. Soils are light to pale yellowish to in red color. Various types of basaltic rocks are found in Western part of Maharashtra. Lateritic soil is formed by lateritic rock in high elevation. Red soil is formed by laterite rock erosion by heavy rain fall. Coastal saline soil is formed by erosion of sand bar-sand sedimentary platform rock by water wave, tide and heavy rain fall. In semiarid climate of Maharashtra such as, Sangli, Satara, Solapur and Ahmednagar saline, alkaline and saline-alkaline soils are found.

## 2.12 SELF-STUDY

1) Answer in detail the different types of soils in India.

2) Write short notes on:

a) Soils of Maharashtra

b) Alluvial Soils.

c) Black soil

d) Red Soil.

e) Laterite and Lateritic Soils

f) Forest and Mountainous Soil

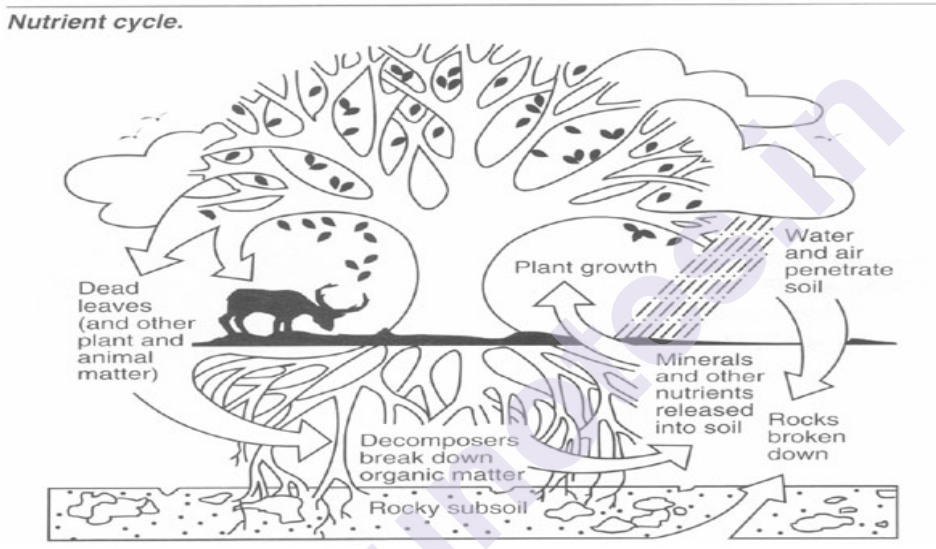
g) Arid and Desert soil

h) Saline and Alkaline soils

i) Peaty and Marshy Soils

## 2.13 B. CONSERVATION AND QUALITY OF LAND

The capacity of a soil to perform functions for specific land uses orwithin ecosystem boundaries is termed as soil quality. It is an inherent characteristic of soil varying from soil to soil. Indicators like salinity, tilth, compaction, organic- matter content, available nutrients and rooting depth help to measure the quality of soil in the given place. The ability of a soil to store and cycle nutrients for plant growth is decided from the organic-matter content, acidity, salinity and the biological activity. Available water capacity, compaction and soil tilth cast the ability of a soil to regulate the flow of water. Texture, like loam and clay, also is an important property of soil in the support of buildings and roads.




**Benefits of soil quality:**

High-quality soils assure that the primary agricultural lands are sustained for the future generations. Soils of high quality are essential for the production of a plentiful supply of safe food and fiber for the living things on earth. Healthy food converts to a healthy people and a healthy nation. High-quality soils are a foundation for: storage of green house, clean water, healthy plant growth and clean and healthy air.

- Storage of greenhouse gases like carbon dioxide in the form of organic matter in the soil.
- Clean water transforms harmful substances and chemical toxins to nontoxic forms, by cycling nutrients and partitioning rainfall to keep sediments and chemicals out of lakes, streams and rivers.
- Healthy plant growth as it stores nutrients and water and also provides structural support to the plants through a receptive rooting medium.
- Clean and healthy air keep dust particles out of the air and cycles other gases.

Enhanced soil quality protects the finite resource. Maximum efficiency in crop productivity is maintained by the maintenance and enhancement soil quality. It also protects water and air quality and preserves the beneficial functions of the soil in specific ecosystem. Soil and soil quality are closely associated with the other natural resources. Caring the land in a way improves the soil quality by better filtering the water, maintaining or improving productivity, reducing airborne particles, use of less chemicals, increasing plant, animal and micro-organism diversity.

**Factors reducing soil quality:**

a) Lack of knowledge about soil types and their properties as they relate to soil quality and land use

b) Extreme use of available soil resources by the human being has forced him to use more fragile and erodible lands for food and fodder.

c) Unable to understand the ability of the soil and impact of management activities on individual soils.

## 2.14 SOIL EROSION

Soil erosion is the major cause of reduced soil quality. Though soilerosion is a natural geologic process but is often stimulated by cultivation and resource development to fulfill the increasing human demands. Soil condition is degraded by soil erosion wherein the content of organic - matter, the root depth and the available water capacity is decreased. The product of erosion the sediment pollutes streams, lakes and other water bodies by depositing soil particles, chemical and plant nutrients. The air is polluted due to soil erosion by wind damaging the plants through a sandblasting effect.

Accumulation of salts, excess nutrients and chemicals, toxic substances, pesticides increase the potential for nutrients and chemicals to leach from soil in percolating waters and eventually pollute ground and surface waters. Soil erosion is a process in which the top fertile layer of soil is lost which, makes the soil infertile or less fertile. Soil erosion is the removal of topsoil by the natural forces. Factors like wind, water, deforestation, overgrazing, etc. cause soil erosion.

**Factors of Soil Erosion:**

1) **Wind**

Strong winds blow the topsoil along with the organic matter more often in an area of having less plantation or grasses like desert and semi- desert regions where strong winds blow very frequently.

2) **Water**

Soil in the hilly areas gets washed away towards the plains when it rains in the hilly areas. The running water over the years deposits the mineral rich soil in the riverbed. This deposition can change the course of the river leading to floods causing harm to life and property. Water erosion leads to loss of agricultural potential.

3) **Overgrazing**

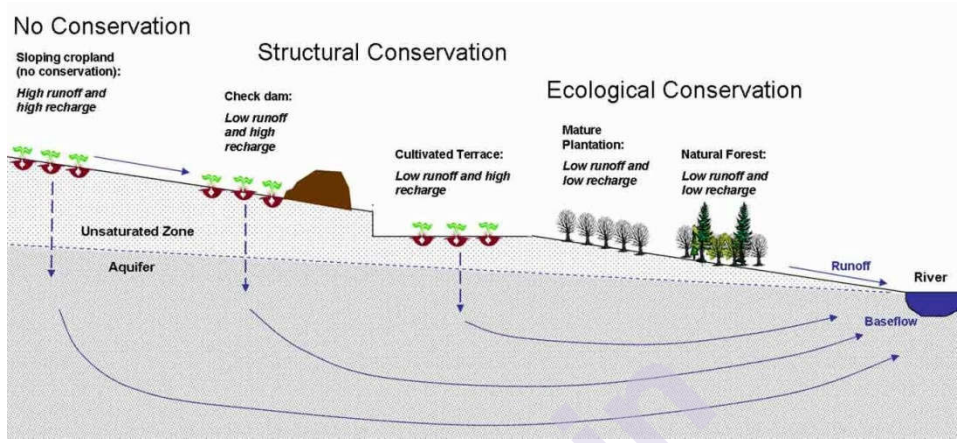
This happens when the cattle are allowed to graze on the same placeor field repeatedly. The cattle eat the available grass including the roots which makes the topsoil loose and is blown by wind and flowing water, leading to soil erosion.

4) **Deforestation**

The roots of trees hold the soil together to prevent the soil from getting loose. Clearing the forests for agricultural purposes to feed the ever - increasing population, to build houses, for industrial purposes etc. has led to deforestation.

## 2.15 C. MEASURES TO LAND DEVELOPMENT

Preventing the soil from getting eroded is called conservation of soil. The soil erosion can be prevented in many ways. Soil conservation includes all those measures which help in protecting the soil from erosion and exhaustion. Some of them are discussed below.




According to Prof. S.P. Chatterjee, "Soil erosion is the greatest single evil to Indian agriculture and animal husbandry". Soil is the most precious asset we have on earth and productive soil alone can ensure prosperous agriculture, industrial development, economic prosperity leading to a higher standard of living. G.T. Renner has defined conservation as "the greatest good to the largest number for the longest time." According to S.I. Kayastha, "With soil conservation people rise and with its destruction they fall."

It is estimated that about two thirds of our arable land needs conservation measures on an urgent basis for the prosperity of mankind. Neglect of soil means killing the hen laying golden eggs.

**Following methods are normally adopted for conserving soil:**

**1. Afforestation:**

Afforestation means planting new trees and plants. Plants and trees are very essential for the survival of living beings on earth. New trees should be planted in place of the cut trees and planting trees in hilly areas are most effective for conservation. The best way to conserve soil is to increase area under forests. Indiscriminate cutting of trees must be stopped, and efforts should be made to plant trees in new areas. A minimum area of forest cover in the country that is healthy for soil and water conservation should be between 20 – 25%. In the second five-year plan it was raised to 33%. The proportion of forest cover in general should be 20% for the plains and 60% for hilly and mountainous regions.

**2. Free movement of cattle to be controlled:**

The animals moving freely in the fields spoil the soil by their hoofsleading to soil erosion. There should be separate grazing grounds and fodder crops should be grown in large quantities especially for the cattle and other grazing animals.

**3. Building Dams:**

Dams help to check the speed of water thus saving soil fromeroding. Soil erosion by river floods can be stopped by constructing dams across the rivers.

## 4. Changing Agricultural Practices:

Certain changes in agricultural practices can save our precious soil from degrading. Some of the outstanding changes are suggested

### i) Crop Rotation:

Sowing a particular crop in the same field year after year takes away certain elements from the soil, making it infertile unsuitable for that crop. Rotation of crops is a method in which different crops are cultivated on a piece of land every year. Soil fertility is conserved as different crops require different demands on the soil. Leguminous plants is a good option as they add nitrogen to the soil. Rotation of different crops in successive years helps to maintain the fertility of the soil naturally.

### ii) Strip Cropping:

Different crops may be cultivated in alternate strips, parallel to oneanother as they ripen at different times of the year and are invested at intervals ensuring no time of the year the entire area is left bare or without crops. Some strips may be allowed to lie fallow while in others different crops may be sown e.g., grains, legumes, small tree crops, grass etc. The tall growing crops act as wind breaks and the strips parallel to the contours help to increase water absorption by the soil by slowing down run off.

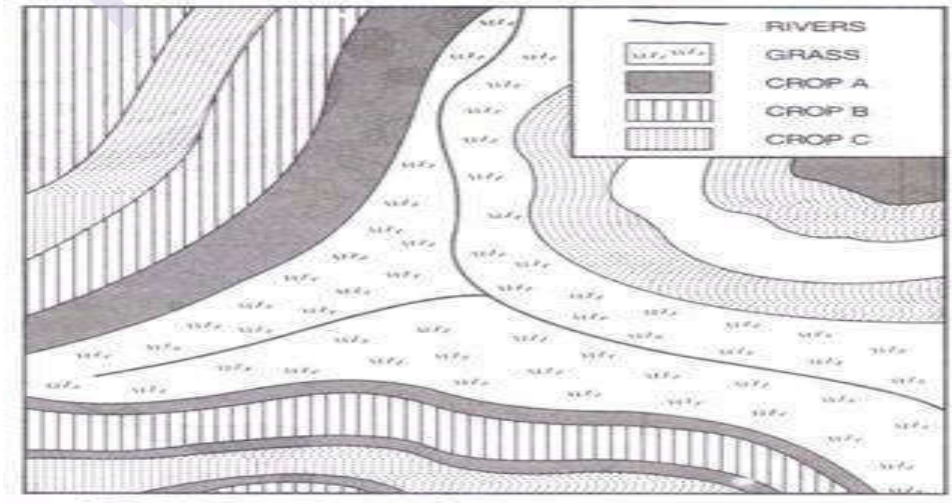



FIG. 7.6. Strip farming following the contour pattern

**iii) Use of Early Maturing Varieties:**

Early maturing varieties of crops take less time to mature thus putting lesser pressure on the soil and reduce the soil erosion.

**iv) Contour Ploughing:**

Ploughing done at right angles to the hill slope, following the natural contours of the hill, the ridges and furrows break the flow of water down the hill thus preventing excessive soil loss as gullies are less likely to develop and also reduce run-off so that plants receive more water. Growing crops in contour pattern allows the plants to absorb maximum rainwater and minimizing the soil erosion.

**v) Terracing and Contour Bunding:**

Terrace farming is done in the hilly areas. It is done by cutting stepson the slopes of the hills which slows down the flow of water and also the soil that has been removed from one step is deposited on the next step. Terracing and contour bunding across the hill slopes, is a very effective and one of the oldest methods of soil conservation. Hill slopes are cut into a number of terraces having horizontal top and steep slopes on the back and front. Terracing and contour bunding divide the hill slope into numerous small slopes, checks the flow of water, promotes absorption of water by soil and saves soil from eroding. Retaining walls of terraces control the flow of water and help in reducing soil erosion.

**vi) Stop Shifting Cultivation:**

Stopping and reducing shifting cultivation by persuading the tribal people to switch over to settled agriculture is a very effective method of soil conservation. It is done by making arrangements for their resettlement which involves the provision of residential accommodation, agricultural implements, seeds, manures, cattle and reclaimed land.

**vii) Ploughing the Land in Right Direction:**

Ploughing the land in a direction perpendicular to wind direction reduces wind velocity and protects the top soils from erosion.

**5. Shelterbelts**

Shelterbelts is the cover of plants and trees around the fields to break the speed of strong winds to prevent and protect the soil from being blown away.

**6. Embankments**

Embankments are in a way hurdles build along the banks of the river to protect fields from the floods. These strong hurdles prevent the fast overflowing rivers and rainwater from washing away a large amount of rich fertile soil.

**7. Van Mahotsav and maintaining soil quality**

It is a tree plantation program initiated by the Indian government to create awareness to conserve forest and soil.

For long term benefits, the perfect method to maintain and improve soil quality is to select the crops best suited in a particular soil and use it according to its capacity. We should not only solve soil quality problems but also the problems related to water and air. To develop technologies that can maximize the ability of soils to function for specific land uses. The development of technologies should be in the fields like soil specific nutrient and pesticide management, other crop residue management technologies, conservation management systems and appropriate use of urban and animal wastes. Public awareness and concern for quality soil should be developed and making the people understand the effects of polluted soil on their day to day lives.

## 2.16 SUMMARY

The capacity of a soil to perform functions for specific land uses or within ecosystem boundaries is termed as soil quality. It is an inherent characteristic of soil varying from soil to soil. Indicators like salinity, tilth, compaction, organic- matter content, available nutrients and rooting depth help to measure the quality of soil in the given place. Soil erosion is the major cause of reduced soil quality. Though soil erosion is a natural geologic process but is often stimulated by cultivation and resource development to fulfill the increasing human demands. Factors like wind, water, deforestation, overgrazing, etc. cause soil erosion. Preventing the soil from getting eroded is called conservation of soil. The soil erosion can

be prevented in many ways. Soil conservation includes all those measures which help in protecting the soil from erosion and exhaustion.

## 2.17 SELF-STUDY

1) Explain soil quality

2) Which factors reduce the soil quality?

3) What is soil erosion?

4) What are the factors of soil erosion?

5) Explain soil conservation

6) Which methods are adopted for conserving soil?

7) Write short notes: Future approaches to maintain soil quality.

# 3

# WATER RESOURCES

**Unit Structure**



## 3.1 OBJECTIVES

1) To study the natural sources of water, its importance and distribution.
2) To find remedies on scarcity of water.
3) To know the methods to conserve water.
4) To study the government schemes and special projects undertaken for conservation of water.

## 3.2 INTRODUCTION

Only 3.5% of the water on Earth is fresh water, with 96.5% of the water on Earth existing in the form of oceans. Nearly 70% of the world's fresh water supply, or ice sheets and glaciers, are found in Antarctica, Greenland, and mountainous regions, while the other 30% is held in the planet's aquifers as groundwater. India's entire renewable water resources are thought to be 1,897 square kilometres per year. India receives around 4% of the world's precipitation and is ranked 133rd in the world in terms of water availability per person per year.

There are several water-related difficulties that the Indian economy and society must overcome. Rapid urbanization and industrialization need for a greater water supply, but difficulties with availability, water table decline, and water quality have become more prominent. As water wells are dug deeper and deeper, fluoride and arsenic are introduced into the groundwater.

By dumping untreated effluents and sewage into rivers and groundwater, pollution is caused. The hydrological cycle is impacted by climate change as well. The number of disputes between rival water consumers and usage is increasing daily. According to predictions, several parts of India may join other nations or areas that experience perpetual water scarcity by 2025. Next to air, water is also an important constituent of life-support system. As water is vital natural resource, we depend on it for irrigation, industry, domestic needs, shipping sanitation and for disposal of wastes. Water bodies like ponds, lakes, streams, rivers, sea, oceans have become polluted due to industrial growth, urbanization and other problems created by mankind.

## 3.3 A. CONCEPT OF WATER RESOURCES

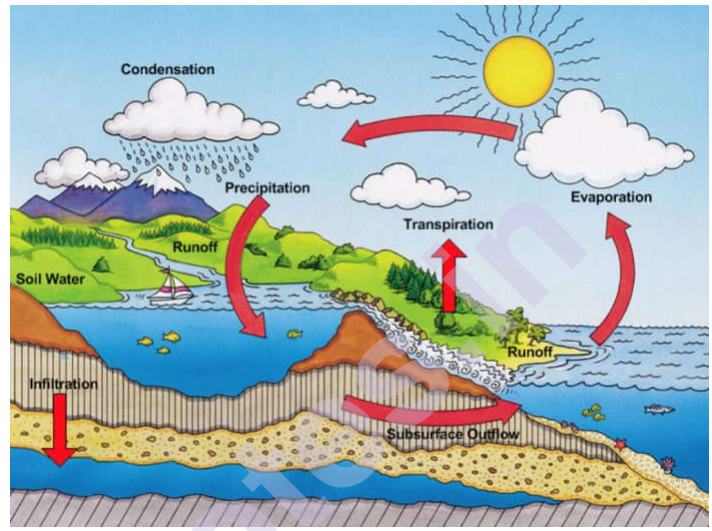
Without water, life on earth is unimaginable. Since 60% of our body is made up entirely of water, all living creatures require water to survive. In order to support other biological activities and control body temperature, water is present in all of our body's cells, organs, and tissues. It is crucial to rehydrate and replenish lost water by drinking fluids and consuming meals high in water content since our bodies lose water through breathing, sweating, and digesting. Our needs for water are influenced by the local temperature and ecology. It also depends on how physically active you are and whether you have any health conditions, illnesses, or other problems.

## 3.4 SOURCES OF WATER

Water is absolutely essential to life. It contributes to the wonder and majesty of the natural world, whether through the babbling of a small brook or the vast ocean. There are several key sources of water related to one another through the working of water cycle.

## Water Cycle

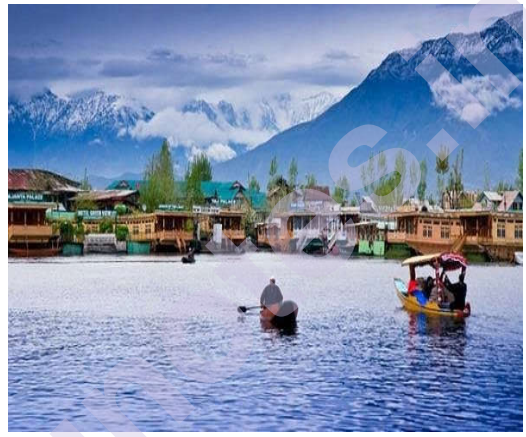
Water vapour rising from the ocean surface starts the cycle. These droplets are gathered by clouds until they attain saturation. When a cloud gathers too many particles, it reaches saturation and must release the weight as rain. Rain, ice, or snow can occur as clouds pass over a land mass, depending on the weather. To enter lakes, rivers, and streams, this water source descends to the earth. Droplets replenish the groundwater by being absorbed into the soil. This water supply is moved into our lakes, rivers, and streams by runoff from the land, and it finally returns to the ocean to start the cycle all over again.




## Natural springs

Earlier we could drink water from the springs without treating it. But now a days water from springs has to be tested to make it sure it isfree from chemical toxins and biological organisms. Ozone is added to purify the water as it reduces to ordinary oxygen normally suspended in

water or released into the atmosphere. This ozone purified water is then bottled to make bottled spring water. And if it is naturally carbonated it is sparkling water.



Water from rivers and lakes is used as a standard source of water for human consumption. These sources are restored regularly by the actions of weather. But this water cannot be used directly for drinking purpose. It has to be treated to make it fit for consumption. Water treatment plants pump water into their facilities, filtering and adding chemicals to purify the water. Lakes and rivers are the source of tap water. It is purified and disinfected usually with chlorine, but sometimes fluoride is added. It is then supplied to the homes across the area for individual homes for consumption and other uses of water.

## Groundwater

Groundwater lies in pockets beneath the surface of the earth typically existing between layers of rocks. Those living in rural areas or those who don't have access to municipal corporation water supply often use this ground water source for wells. The water cycle replenishes groundwater tables at a relatively predictable rate based on climate. The ground water levels can be affected during drought conditions. Wells can be either near the surface or they can draw up water from very deep. They need to be tested for purity. But some wells offer pure, drinkable water.

### Desalination

Desalination is a process in which the seawater is treated to remove salt from it. But in this process additional minerals from this water are removed. Huge processing plants around the world convert seawater to potable water suitable for human consumption. This type of

natural water source conversion requires extensive treatment and the expensive use of electricity to run the water processing plants.

**Harvested Rainwater**

Rainwater harvesting is a common practice in the more arid regions of the world. Typical rainwater harvesting setups include a barrel attached to the downspouts on the roof a perfect opportunity to collect and store rainwater for use around the exterior of homes in different places. More sophisticated collection devices are used like flat, sloped sections of the roof designed to collect more rainwater per square inch. The rainwater runs at an angle toward a collection point, funneling water into a catch basin. This non-potable source of water helps to minimize the costs of using a potable water supply for watering crops and general landscape maintenance. Rainwater is actually pure. It has to be purified as it may get dirty and contaminated by the roof or surface where it is caught, gutters or pipes, and storage.

## 3.5 PROPERTIES AND IMPORTANCE OF WATER

Water an essential nutrient plays a key role in the human body. We can survive for several weeks without food, but not without water. Every system in human body needs water for its functioning from cells and tissues to all the vital organs of the body. Water helps to regulate body temperature, it flushes out toxins out of the body, it carries nutrients to all the cells in human body and oxygen to the brain, it acts as a lubricant for joints and muscles and also allows the body to absorb and incorporate minerals, vitamins, glucose, amino acids and other substances. Water is a constant reminder that life repeats. It's the only element that has a visible cycle.

We cannot imagine earth without water and nothing growing on it. It would be lifeless, dead and would appear collapsed into dust, sand, clay or rock. The earth used to be like a sponge, but wherever the ground water has been sucked almost dry, the earth has hardened and has collapsed. This process of hardening and collapsing of earth is called 'Subsidence'.

Clouds provide a buffer from the heating power of the sun. Without them it would pour down with no mercy. Dry air would suck out whatever moisture it could find, wherever it could find it, and the noses and soft tissues of any living being would shrivel. If there is no moisture there would be no sweet scents.

The composition of the air would change. Temperatures would swing from extreme to extreme, getting hotter as time went on. The sun, pouring down without mitigation, would beat on the earth and heat it up. Any carbon-based thing would burn up during the day. At night it would freeze.

There would be nothing to soften the effect of volcanoes or to put out fires. The cushioning effect against earthquake would not be there.The rubbing of tectonic plates against each other would create massive rock slides and crumbling. The earths surface would burn and would be grinded into dust.

**Water Stabilizes Temperature of the Earth**

Water keeps the temperature of the earth even. It cools the earth when heated and warms up when it cools down. When the temperature rises up water evaporates taking the heat with ii thereby cooling the hot air. When the temperature falls down water freezes and releases its own heat to warm the frigid air. The moisture released from burning vegetation forms clouds which cool the air and thereafter releasing rain. This cools the heating effect of volcanoes and wildfire. Ground water cools the earth during the day and warms it at night. Water is the cooling medium for air and earth. If there is no water the temperature would either be extreme hot or extreme cold all over the world, with a gradual increase in the temperature as time passes by. Global warming is the consequence of this in a way as the land water is used to maximum extent and allowing the rain water to fall in the sea.

**Water acts as Cushions**

Water softens the soil making it easier for the rain water to percolate inside the earths surface to increase the ground water level. If the

groundwater level decreases to a great extend after it is used and not refilled the soil gradually becomes hard. This hard soil does not allow the water to be absorbed or to be percolated in the soil and it slides off the top and is wasted. As a result, the earth loses its place to store water and its

shock protector. In other words, we can say where the earth is receptive, rainwater sinks down through it to be stored in the aquifer.

Water has a cushioning effect if it is stored under the ground. It is like the water in the waterbed giving a cushioning effect with any movement done on it. It is good if the groundwater level is high as it provides good protection during an earthquake as it slows down seismic waves and minimizes their effects.

The softening effect of water prepares the seeds to grow. Water softens the seed cover enough for the little shoots to break out. The soft soil, mixed with organic matter, provides a perfect medium for the shoots to grow into full-fledged plants. It would be difficult for most of the seeds to grow without water, as the ground would be too hard or sandy to absorband hold the rain water. Without water storage on the surface and underground there will be severe droughts killing most of the living species on earth and also the earthquakes would be very severe.

**Waterways a mode of Transportation**

Water is the media to transport both the nutrients and wastes for allliving things on earth. Nutrients and rich soils from the mountains to the lower altitudes on the way to the sea are transported by water on land while, in oceans water currents transport nutrients throughout the world. Water ways help to transport people and goods.

**Water Cleans and Breaks Down the Waste Matter**

Water plays an important a role in breaking the waste matter on earth and living beings. Flowing rain water carries along with it all the dirt, debris, minerals and toxins into the sea. The algae and other microbes in the ocean break down the waste matter (except plastic) into basic food components used to support life under the sea. Water plays an important role in the life of human beings as it plays a cleansing role. It carries the waste to the kidneys to be separated and thereby throwing out of the body in the form of solid and liquid waste.

**Water a Key Component of Reproduction**

Water is a key component of birth the reproductive cycle of all animals.

**Water Home for many lives in water**

Ocean and other water bodies is home for more life than what liveson land. Mammals, fish, birds, insects, trees, plants, algae, krill, and many other forms of life either live directly in water or are wholly dependent upon it for survival. Without water life would lose its primary food source.

**Water Essential Component for Human Beings**

Plants prepare their food with the help of water, carbon dioxide and sunlight the important components of the photosynthesis process of preparing food for plants, which eventually is the food for animals and human beings also. Every living creature on earth uses water in one or the other way. Without water, plants and many insects and arthropods could not survive, nor would humans have developed the foods and industries.

**Conservation of water**

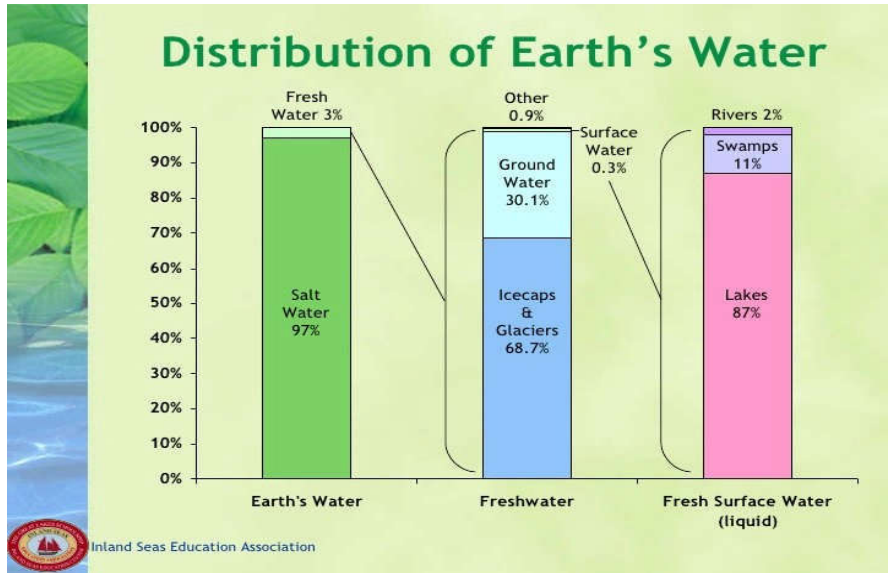
We use water in many ways and its cycle reminds us of that our life also works in cycles. We will end up destroying ourselves if we don't care for it and preserve it. Plants, trees, all types of forests, mountains, rivers, lakes, marshy places, the estuaries, icebergs, snow tops and water in all its natural forms for the survival of living things.

If, instead of **controlling** it, we see ourselves as a partner or an intelligent component of water's own rain and storage cycle, it might encourage us to be more respectful towards water and be more careful of the way we utilize it. We know that there is no life without water and we cannot survive without it. So, we should learn to value, conserve and take care of the water resources we have been provided by nature.

## 3.6 DISTRIBUTION OF WATER

Water a unique natural resource available on earth is essential for all the important activities like food production, industries like energy, production and manufacturing. It plays an important role in economic development and the general well-being of the country. Water is notmerely an economic commodity but also a social and cultural good as per United Nations.

Out of all the water available on the Earth, 97 % of water is saline and is in oceans, 3% of water is freshwater available in rivers, streams and glaciers. There is enough freshwater available on the planet but it is distributed unevenly. Following graph shows the Earth's water distribution.




Detail estimate on global water availability;

| Water source | Water volume, in cubic miles | Water volume, in cubic kilometres | Percent of fresh water | Percent of total water |
|---|---|---|---|---|
| Oceans, Seas, & Bays | 321,000,000 | 1,338,000,000 | 0 % | 96.5 % |
| Ice-caps, Glaciers, & Permanent Snow | 5,773,000 | 24,064,000 | 68.7 % | 1.74 % |
| Groundwater | 5,614,000 | 23,400,000 | 0 % | 1.7 % |
| Fresh | 2,526,000 | 10,530,000 | 30.1% | 0.76 % |
| Saline | 3,088,000 | 12,870,000 | 0 % | 0.94 % |
| Soil Moisture | 3,959 | 16,500 | 0.05 % | 0.001 % |
| Ground Ice & Permafrost | 71,970 | 300,000 | 0.86 % | 0.022 % |
| Lakes | 42,320 | 176,400 | 0 % | 0.013 % |
| Fresh | 21,830 | 91,000 | 0.26 % | 0.007 % |
| Saline | 20,490 | 85,400 | 0 % | 0.006 % |
| Atmosphere | 3,095 | 12,900 | 0.04 % | 0.001 % |
| Swamp Water | 2,752 | 11,470 | 0.03 % | 0.0008 % |
| Rivers | 509 | 2,120 | 0.006 % | 0.0002% |
| Biological Water | 269 | 1,120 | 0.003 % | 0.0001 % |
| **Total** | **332,500,000** | **1,386,000,000** | **100 %** | **100 %** |

Source: Gleick, P. H., 1996: Water resources. In Encyclopaedia of Climate and Weather, ed. by S. H. Schneider, Oxford University Press, New York, vol. 2, pp.817-823.

**Indian Scenario**:

**Surface water resources:**

Water resources including rivers, lakes or fresh water wetlands are known as surface water resources. Precipitation the natural recharging source for the surface water resources also maintains the hydrological cycle. Rivers are the major source of water in India. The annual surface water in the rivers of the country that can be utilized is 690km$^3$. Artificial dams, reservoirs also have the capacity to increase utilization of water.

**Groundwater resources:**

Subsurface water or water within aquifers are known as ground water resources. Ground water resources are recharged from the precipitation in the monsoon season in India. The other contributors to the recharging of the ground water are canal irrigation and other forms of irrigation systems.

## 3.7 B. SCARCITY OF WATER

**Water Availability in India:**

Water is available only for a few hours in most Indian cities and the quality is also not up to the mark. Water woes are also because of insufficient or low pressure and erratic supplies. The rural population suffers from low water quality but the urban and semi- urban areas are most prone to water shortage. The water quality should be safe and sound at the microbiological level and mere continuous supply is not enough. Another aspect is the water wastage in terms of leakages and illegal connections.

**Water Scarcity**

Millions of people all over the world don't have access to waterand if at all they have that water is not usable. About 70% of the Earth's surface is covered with water and 3% of it is actually fresh water that is fit for human consumption. Around two-thirds of that is tucked in frozen glaciers and is unavailable for our use. Clean drinking water is scarce and there are millions of people in this world who spend their entire day searching for it. People who have access to safe, clean drinking water take it for granted and don't use it wisely. Water scarcity involves water crisis, water shortage, water deficit or water stress. Water scarcity can be due to physical water scarcity and economic water scarcity. Physical water scarcity is where natural water resources are unable to meet a region's demand and economic water scarcity is a result of poor water management resources.

**Water crisis in India**

Water an existential need for humans is one of the most under prioritized but misused commodity. Though it is fundamental need to our lives it has never been the main point of focus in our planning even when we rapidly evolve into an urban society. Our ancestors understood the importance of water and planned their living accordingly. History says civilizations were born and lost on account of water, still we fail to value it. The world's oldest civilization grew around the Indus and the Ganges and is still thriving. In the post-independence period more importance was given to utilizing water by way of controlling and storing it through large dams which, was the need of the hour. As far as urbanization is concerned our towns and cities have consequently grown without planning for water need vs water availability.

**Causes of water scarcity in India**

Following are the main reasons for water scarcity:

**1) Inefficient use of water:**

India being one of the highest agricultural producer in the world consumes maximum amount of water for irrigation for agriculture purpose. Traditional methods of irrigation causes maximum water loss due to evaporation, drainage, percolation, water conveyance and excess use of groundwater. More and more area under traditional irrigation techniques more the stress for water availability for other purposes will continue. Extensive use of micro-irrigation techniques like drip and sprinkler irrigation is the solution for this.

**2) Traditional water recharging areas need to be reduced:**

The traditional water bodies that have acted as ground water recharging mechanism need to be revived on an urgent basis while implementing the new ones.

**3) Old sewage and waste water drainage system to be changed:**

Government intervention is urgently required to tackle the problem of old sewage and waste water drainage system.

**4) Release of toxic substances:**

Strict monitoring action and implementation of laws by the government, NGO's and social activists is necessary on the problem of release of chemicals and effluents into rivers, streams and ponds.

**5) De-silting operations to be done on time:**

Lack of initiative of on-time de-silting operations in large water bodies have become an issue. If this de-silting is done on time and taken up on priority basis as annual practice it can enhance the water storage capacity during the monsoon season. This can significantly add to the water storage levels.

**6) Lack of efficient water management:**

Inefficient water management and improper distribution of water between urban consumers, agricultural sector and industrial sector is creating problems. It is the need of the hour that government enhances its investments in technology and include all stakeholders at the planning level to ensure optimization of existing resources.

**7) Urbanization a serious problem:**

Urbanization has created serious problems. Concretization due to urban development has choked ground water resources. Water is neither being recharged nor is stored in such a manner that will optimize its use while retaining its natural ingredients. Dumping of sewage and industrial waste

into the water bodies (rivers) is severely affecting the potable water. Marine life also has been affected. If we don't understand the root cause of the problem we never will be able to find the sustainable solutions to these problems.

**8) Overuse of Water:**

Overuse of water on people, animals, land, recreational activities and many other things is a big problem many people are dealing with. They don't care about the effects that it may have on the world around them.

**9) Conflict:**

It may be difficult to access the water if there is conflict over an area of land. This can lead to a variety of other issues including pollution.

**10) Distance:**

Many areas throughout the entire world suffer from water scarcity just because they not in the vicinity of areas having water. Desert areas or areas having very low rainfall are such areas.

**11) Drought:**

Droughts are common all over the world. They occur in places getting low rainfall which is not enough to sustain life residing in that region. Some areas are in recurring droughts and some areas have occasional droughts.

**12) Governmental Access:**

Governments using water as a source of control causing a scarcity to those in the nearby locations, can be a big issue.

**Effects of Water Scarcity**

**a) Lack of Access to Drinking**

Due to scarcity of water the people are not able to get fresh and clean drinking water. Less water consumption leads to many diseases and problems as living things cannot live long without water.

**b) Poverty**

Scarcity of water also leads to poverty. People are not able to get water the natural resource for their survival a basic need are facing many problems due to this.

**c) Hunger**

Without water crops cannot be grown as a result living things would suffer from hunger. Water scarcity causes starvation for both humans and animals in that particular area.

**d) Diseases**

If there is no access to clean water people would be effected with waterborne diseases with the dirty and polluted water. Unhygienic conditions would prevail constantly.

**e) Sanitation issues**

No clean water means no cleanliness either food, utensils or living beings. Improper sanitation leads to diseases, also causes mental health issues including depression and anxiety.

**f) Lack of Education**

Water scarcity may lead to illiteracy in the areas having water scarcity problems. As people drink unhygienic water they fall sick frequently and cannot go to school regularly or they are struggling to get some clean water for their family resulting in the absence in schools.

## 3.8 MEASURES ON WATER SCARCITY

**1) Recycle Water:**

New technologies have been developed to recycle water and rainwater. It not only prevents scarcity of water but also saves money from spending it on medicines, hospitals and to the doctor.

2) **Advance Technology Related to Conserve Water:**

Though a lot of work has been done in conserving water still more is to be done in-order to ensure that the rest of the world is able to conserve water. Investing money and efforts into conservation of life saving things could save the life on earth.

3) **Improve Practices Related to Farming:**

The main culprits of water scarcity are the methods of farming and irrigation. Improving agricultural practices using new techniques that use less water and also those methods using water to its fullest potential.

4) **To Improve Sewage Systems:**

A good sewage system provides good drinking water. Without proper sanitation water in those specific areas becomes polluted and laden

with water borne diseases. By improving sewage system water scarcity can be prevented from becoming worse.

1) **Education:**

Educating people about the proper use of water in day to day use, agricultural purpose and many more uses should be done on priority basis. There is a need to change in our utensils washing system and minimize the habit of keeping the tap water running while washing clothes or utensils.

Every independent home, flat and housing societies should have rain harvesting facility. low cost technologies for waste water treatment and recycling for non-drinking purposes should be used. If we see water leaking anywhere simply close the tap or immediately repair the leakage.

2) **Support Clean Water Initiatives:**

Giving support to the organizations working to conserve water will not only help them to save water but also educate the people about conservation of natural resources. By donating time, skills or money will help them to save the earth.

A small step can make significant saving in water consumption and conservation. A small steady water leak can cause a loss of 226,800 litres of water per year. So, we have to be aware and conscious of water wastage or else we will not be able to avail the basic quantity of water that we need to carry on with our normal lives. The time to take initiative has arrived.

## 3.9 C. CONSERVATION & MANAGEMENT OF WATER RESOURCES

If we do not wisely use and conserve our water resources a situation will come where there will be water everywhere but not a single drop to drink. Research shows that by 2025, many countries in the world along with India will face a deliberate scarcity of water. At present many regions in our country are currently undergoing the process of water stress. Falken Mark a Swedish expert on water in his research has noted that 'Water Stress' happens when the water availability falls below 1000 cubic meters per person per day.

Though India is blessed with large rivers like the Ganga, Yamuna, Godavari, Narmada and other big rivers, India's socio-economic development have contributed more to decreasing water resources. The main reasons behind shortage of water in India are rising population of India, modernization, industrialization, urbanization, modernization of agriculture. Due to this most of our prominent rivers, especially the smaller ones are full of toxics with waste products and pollution.

Water is indeed an essential resource for life on earth and it must be conserved. Humans had learned to conserve the available water resource by building dams in the past only.

Dams are nothing but simple hydraulic structures that act as a barrier between the source of water and destination of flowing water. In olden days dams were small and made by hand. But now-a-days engineering techniques and methods are used to construct most of the dams. The water flow can be obstructed, redirected or slowed down with the help of a dam, depending on the need. The barrier many a times create a small reservoir or a lake, collecting the excess flow of water.

Dams are mostly used for irrigation, while some are used for generating hydroelectricity. Though dams help in conserving water resources, they can also cause over sedimentation of the river beds.

**Rainwater Harvesting:**

Rainwater harvesting is more like the recycling of natural water. It is one of the most efficient and effective way of conserving water.

Rain water harvesting is a common practice in states like Rajasthan, West Bengal, Meghalaya and major parts of South India, where rainfall is usually heavy. In this system people connect PVC pipes to a drain on their roof and the rainwater is collected below in large storage tanks. This stored water is then used for daily needs even after the rainy season.

**Bamboo Drip Irrigation**

This indigenous method is practiced in the north eastern states of India since 200 years. It not only helps to conserve the region's water resources but also helps in the irrigation of local farms and fields. Bamboopipes are used to tap waters of streams and springs. About 18020 litres of water flow through a network of pipes and end up as drips on the farmlands.

## 3.10 GOVERNMENT SCHEMES FOR WATER CONSERVATION

The Government of India has established National Water Mission as one of the eight National Missions under the National Action Plan on Climate Change. The Union Cabinet approved the comprehensive Mission Document for National Water Mission (NWM) on 6th April, 2011. The main objective of NWM is "conservation of water, minimizing wastage and ensuring its more equitable distribution both across and within States through integrated water resources development and management". NWM has identified five goals as under:-

1) Comprehensive water data base in public domain and assessment of the impact of climate change on water resource;
2) Promotion of citizen and state actions for water conservation, augmentation and preservation;
3) Focused attention to vulnerable areas including over-exploited areas;
4) Increasing water use efficiency by 20%; and
5) Promotion of basin level integrated water resources management.

Various strategies for achieving the goals have been identified which lead to integrated planning for sustainable development with active participation of the stakeholders. In pursuance to the approval accorded by the Union Cabinet to the National Water Mission, a Mission Directorate was established in the Ministry of Water Resources, River Development & Ganga Rejuvenation. Eight Advisory Groups/Committees as envisaged in the NWM Mission document have been constituted.

**Major Programs of the Department**

The programs/schemes implemented by the Department include both Centrally Sponsored Schemes as well as State Plan Schemes.

**A. State Plan Schemes**

1) Soil & Water Conservation in General Areas.

2) Watershed Management Program.

**B. Centrally Sponsored Schemes**

1) Integrated Wasteland Development Program (IWDP).

2) Integrated Watershed Management Program (IWMP).

**C. Additional Central Assistance**

1) Watershed Development project in Shifting Cultivation Areas (WDPSCA)

2) Accelerated Irrigation Benefits Program (AIBP)

**D. NABARD Loan**

Rural Infrastructure Development Fund (RIDF)

**E.Other Government of India Schemes**

1) Soil Conservation for enhancing the productivity of degraded lands in the catchment of River Kopili in Jaintia Hills District under Macro-Management Mode of Agriculture Department, Meghalaya.

2) Rastriya Krishi Vigyan Yojna (RKVY)

**F. Special Plan Assistance**

1) Cherrapunjee Ecological Project- Restoration of Degraded Lands Under Sohra Plateau.

**A) State Plan Schemes**

**1. Soil & Water Conservation in General Areas**

This scheme covers the general areas outside those not specifically covered by other packages of schemes of the Department. Its main objective is to reduce soil erosion hazards and land degradation and conservation of water, where individuals/groups of farmers are targeted. Activities taken up under this Scheme include terracing and reclamation, erosion control, water conservation and distribution, a forestation, cash/horticulture crops development works water harvesting works, farm ponds, conservation works in urban areas, etc.

### 3.Watershed Management Programme

The programme aims for treating the micro watersheds on an integrated approach. The activities include treatment of arable land, non- arable land and drainage lines. Due to fund constraint, the activities have been confined mainly to afforestation, cash/ horticultural crop developmental works.

### B) Centrally Sponsored Schemes

### 1. Integrated Wasteland Development Programme (IWDP)

The scheme is funded by the Department of Land Resources, Ministry of Rural Development, Government of India with 91.66% as Central Share and 8.34% as State Share. With an intention of involving village communities in the implementation of Watershed Development Projects (WDP) under IWDP, the Ministry of Rural Development (MoRD), Government of India, adopted the WDP Guidelines (1995) which was subsequently revised in 2001 (WDP Revised Guidelines, 2001) and later evolved the New Guidelines for Hariyali (2003) which are under implementation w.e.f. April 1, 2003.

There are 112 projects sanctioned for treatment in 439 micro-watersheds covering a total area of 2,21,225.00 hectare with a total cost of Rs.13,053.25 lakh.

### 3. Integrated Watershed Management Programme (IWMP)

During 2009-10, the Government of India, Ministry of Rural Development, Department of Land Resources, has approved for treatment of 30,000 hectares in 18 watershed projects of the State. Subsequently, the Department of Land Resources, Ministry of Rural Development, Government of India approved 52,000, 37,500 and 38,870 hectares of area for treatment during 2010-11, 2011-12 and 2012-13 respectively.

The Central and State share for the IWMP projects is in the ratio of 90:10.

The main objectives of this programme are as follows:

- To dissipate soil and water erosion and surface run-off
- To harvest/ recycle surface runoff and rainwater
- To enhance soil moisture regime/ water holding capacity
- To promote sub-surface flow, base flow and ground water recharge
- To improve soil health and tilth
- To improve production and productivity
- To promote generation and gainful employment opportunities
- http://megsoil.gov.in/major_prog.html

**Major Programmes of the Department**

**C) Additional Central Assistance**

**1. Watershed Development Project in Shifting Cultivation Areas (WDPSCA)**

The scheme was implemented from the year 1995-96 onwards. It isa 100% Central assistance through the Ministry of Agriculture & Co- operation, Government of India.

The main thrust of the project is as follows:

- Protect hill slopes of Jhum areas through soil and water conservation measures on a watershed basis.
- Encourage and assist Jhummia families to develop Jhum land for productive uses with improved cultivation and suitable package of practices leading to settled cultivation.
- Improved socio-economic status of Jhummia families through household/land-based activities.
- Mitigate ill effects of shifting cultivation by introducing appropriate land use as per land capacity and improved technologies.

During 2012-13, Government of India did not release any fund for the scheme.

**3. Accelerated Irrigation Benefits Programme (AIBP)**

This is a Central assistance scheme sponsored by the Ministry of Water Resources. It is in the form of central grant (90 % of the project cost) and the balance cost of the project (10%) as the State's share whichis to be arranged by the state government from its own resources. The main thrust of the programme is to increase the area under irrigation thereby increasing the productivity of the area and improving the socio-economic condition of the people.

During 2011-12, a total of 32 projects sanctioned during 2009-10 have been completed and no new projects were sanctioned by the Government of India during the year 2012-13.

**D) NABARD Loan- Soil & Water Conservation Scheme under RIDF**

The Department started implementing Scheme under Rural Infrastructure Development Fund (RIDF) - NABARD Loan from the year 2000-2001 onwards. The basic objective of the scheme is to enhance the productivity of agriculture and its allied activities and in small river valleys, thereby improving the socio-economic set up of the people in the rural areas. Besides these, the scheme also envisages to promote sustainable development through conservation and management of soil and water.

A total of 49 projects had been implemented under the RIDF NABARD Loan. Out of these, 12 projects are under RIDF-V (2000-01 to 2002-03), 11 projects under RIDF-IX (2004-05 to 2006-07), 7 projects under RIDF· XIII (2007-08 to 2009-10), 10 projects under RIDF XIV (2009-10 onwards) and 9 projects under RIDF-XV. 40 Projects under RIDF-V, RIDF-IX and RIDF· XIII and RIDF XIV have been completed, while 9 projects under RIDF-XV are ongoing.

**E) Other Government of India Schemes**

**1. Soil and Water Conservation in the Catchment of River Kopili**

The Department is implementing a scheme known as River Valley Project & Flood Prone River (RVP & FPR) of River Kopili under the Macro-management mode. The State Agriculture Department is the Nodal

Department of this centrally sponsored programme of the Ministry Of Agriculture, Department of Agriculture & Co-operation (Natural Resource Management Division).

**Objectives:-**

Prevention of land degradation by adoption of appropriate based soiland water conservation measures on watershed approach.

Improvement of land capability and moisture regime in the water sheds.

Promotion of land-use to match land capability.

Prevention of soil erosion and run off from the watershed to prevent premature siltation of reservoirs.

The selection of the watersheds was based as per the priority list of the watersheds. The Soil and Land Use Survey of India (SLUSI) was engaged in the task of priority delineation and detailed Soil survey of the Kopili Catchment. The watersheds have been prioritized based on the magnitude and criticality of degradation into five categories; viz, Very High, High, Medium, Low and Very Low.

| **Priority Category** | **No. of Watersheds** | **Area in Ha** |
|---|---|---|
| Very High | 259 | 1,11,516 |
| High | 84 | 37,121 |
| Medium | 40 | 19,320 |
| Low | 4 | 2,032 |
| **Grand Total** | **387** | **1,69,989** |

A total of 12 watersheds falling under very high priority have been covered under this scheme. The total area of 12 watersheds is 5218 hectares with 4863 hectares as the treatable area, covering 21 villages with 1145 families.

**3. Rashtriya Krishi Vigyan Yojana (RKVY)**

The area of focus of this programme is for the development of Rainfed Farming Systems in and outside watershed areas as also integrated development of watershed areas, wastelands, river valleys and for activities relating to enhancement of crop production and popularization of micro-irrigation systems. The thrust area is to protect the loss of topsoil, improving soil fertility, enhancing crop production, land and water productivity of watershed areas comprising of wastelands, river

valleys and the eco-system as a whole. The programme is implemented with the Department of Agriculture as the Nodal Agency.

**Objectives**

- To incentivize the States so as to increase public investment in Agriculture & Allied Sectors.
- To provide flexibility & autonomy to States in the process of planning and executing Agriculture & Allied Sector Schemes
- To ensure the preparation of agriculture plans for the Districts and the States based on agro-c1imatic conditions, availability of Technology and natural resources.
- To ensure that the local needs/ crops/ priorities are reflected in the agricultural plans of the states.
- To achieve the goal of reducing the yield gaps in important crops, through focused interventions.
- To maximize returns to the farmers in Agriculture & Allied Sectors.
- To bring about quantifiable changes in the production & productivity of various components of Agriculture & Allied Sectors by addressing them in a holistic manner.

The proposed schemes under RKVY mainly comprise of the following:

a) Soil & Water Conservation for enhancing crop production & productivity in river valley/ valley bottom lands.

b) Soil & Water Conservation for improving crop production & productivity of cultivated Jhum & Bun lands including abandoned Jhum & Bun lands.

c) Soil & Water Conservation for restoring & reclaiming cultivable wastelands affected by mining & quarrying

d) Soil & Water Conservation for improvement of traditional water conservation & distribution system for enhanced crop production.

**F) Cherrapunjee Ecological Project-**

**Restoration of Degraded Lands under Sohra Plateau**

This project under Special Plan Assistance (SPA) was sanctioned by the Govt. of India during 2010-11. The objective of the Scheme is to enhance Soil moisture/water regime by the following ways.

- Ameliorate the ecology and environment of Sohra Plateau.
- Restore degraded lands
- Strengthen village level institutions or NRM
- Minimize human activities detrimental to the environment
- Create avenues for sustainable livelihood

The main objectives of the project are as follows:-

- Check soil loss and reduce silt load in streams and rivers
- Improve soil moisture regime
- Promote in-situ water harvesting
- Improve recharge of springs and aquifers
- Afforestation/ reforestation of denuded hills/areas
- Promote development of pasture lands and horticulture plantations
- Imparting training and capacity building for the villagers/ farmers on sustainable farming practices
- Provide support for livelihood activities-piggery, poultry, fisheries
- Create awareness amongst the people on natural resource management

## 3.11 SPECIFIC PROJECTS FOR WATER CONSERVATION

Water conservation: Cross country community efforts In drought hitareas, communities have contributed towards creating solutions to save, manage and restore water. A few examples are given below:

**I.** In drought hit Bundlekhand, Parmarth, a civil society organisation is supporting resilience amongst the drought affected families through development of more than 100 drought risk reduction plans, rainwater conservation and establishing community and institutional linkages. JalSahelis (friends of water) are managing in-village water supply and water conservation efforts.

**II.** Under Andhra Pradesh Farmer Managed Groundwater Systems (APFAMGS) project implemented in 7 drought prone districts of AP, farmers are managing their groundwater systems and have adopted suitable agricultural options.

**III.** In 2002, drought hit Raj Samadhiyala village in Gujarat, managed to take up three crops a year using the rainwater harvested through the construction of farm ponds, percolation tanks, check dams and sub-surface structures.

**IV.** Hiware Bazaar village, Ahmednagar district of Maharashtra, adopted an integrated model of water management wherein, the villagers contributed by providing labour. Annual water budgeting exercise was introduced in 2004.

**V.** Drought prone Laporiya village in Rajasthan has a unique dyke system called the 'chauka' to capture rainwater, improving water availability for drinking and harvest.

## 3.12 SUMMARY

Water is vital natural resource, we depend on it for irrigation, industry, domestic needs, shipping sanitation and for disposal of wastes. Water bodies like ponds, lakes, streams, rivers, sea, oceans have become polluted due to industrial growth, urbanization and other problems created by mankind. Water an essential nutrient plays a key role in the human body. We can survive for several weeks without food, but not without water. Every system in human body needs water for its functioning from cells and tissues to all the vital organs of the body. Water a unique natural resource available on earth is essential for all the important activities like food production, industries like energy, production and manufacturing. It plays an important role in economic development and the general well-being of the country. Water is not merely an economic commodity but also a social and cultural good as per united nations. Water scarcity in India has been created by the people of the country due to excess population growth and mismanagement of water resources. If we do **not** wisely use and conserve our water resources a situation will come where there will be water everywhere but not a single drop to drink.

# 4

# SOLID WASTE MANAGEMENT

**Unit Structure**



## 4.1 OBJECTIVES

a) To study the concept of Solid Waste

b) To study the problems and consequences arising from Solid Waste

c) To study effective management of Solid Waste

## 4.2 INTRODUCTION

The wide range of waste, useless and unwanted material produced due to commercial, industrial and agricultural and any other sources is called as Solid Waste. It may consist of radioactive, medical of environmental product which can be hazardous or non hazardous in nature. Solid waste refers to any type of garbage, trash, refuse or leftover which is discarded abandoned material. In our day to day activity, we often use the material and throw as a trash which is termed as Municipal Solid Waste. The wastes that generated from domestic or household activities, hotel restaurants and on road eatable stalls, shops or educational institutions and other public places are termed as Municipal wastes. They may be solid or liquid in the form of sewage, liquid and solid from homes

(waste water, used oil, stale food or papers/ documents, pins or broken or damaged part of TV, Radio or Mobiles) etc.

US Resource Conservation and Recovery Act (RCRA), defines "solid waste" as any garbage or refuse material resulting from common community activities of households, commercial establishments, industrial facilities, agricultural operations, and so on.

North America, which has two industrialized nations, has the greatest average daily trash production at 4.6 pounds. In reality, the continent produced almost 289 million tones in 2016. However, 99.7 percent of all waste is collected in North America. This indicates that there is some form of solid waste management programme in place in every state, city, and country.

In North America, recyclable items like plastic, metal, glass, cardboard, and paper make up about 55 percent of the waste. The remainder is dumped in clean landfills. Even yet, recycling still accounts for 30% of landfill garbage.

## 4.3 SOLID WASTE

Solid waste is a broad category of garbage that includes frequently used, unnecessary, and undesirable products. Residential, commercial, industrial, agricultural, medical, and radioactive sources all frequently produce this kind of trash.

Solid waste is any material that is subject to the Resource Conservation and Recovery Act (RCRA) of the US federal Environmental Protection Agency (EPA). Keep in mind that only waste products that strictly adhere to RCRA's standards of solid waste are classified as such. The EPA also creates regulations that specify which solid wastes fall into the non-hazardous and hazardous categories.

Understanding these definitions is crucial for governmental organisations and private companies that have been tasked with or wish to explore solid waste management. The same is true for those who produce these garbage. This understanding is an essential first step in waste management programmes because it enables all organizations to correctly identify whether the wastes they produce or treat are unregulated hazardous materials or not.

**The following can be considered solid waste:**

Recyclable materials include things like plastic bottles, glass, paper, cardboard, aluminium cans, tyres, and aluminium foil. Biodegradable waste includes things like food and kitchen waste as well as dried leaves and grass clippings. Electrical and electronic waste includes things like broken electronics like phones, watches, alarm clocks, and fuses. Tetra food packages, toys, and outdoor furniture comprise composite waste. Concrete slabs, bricks, stones, and gravel from construction and demolition projects; hazardous household waste from cleaning agents, light bulbs, aerosol spray cans, and paint products; Fungicides, herbicides, and pesticides are examples of toxic waste. Biomedical waste includes old medications and bandages.

Solid waste types differ from one nation to another as well. For instance, US solid wastes are frequently less in weight and volume than equivalent materials from Europe or Japan. Paper and cardboard products make up around 40% of the solid trash produced in America, while food wastes make up about 10%. The remainder is made up of various trims, wood, glass, plastic, metal, and other materials.

We can also classify Solid Waste as given below:

**Biodegradable Waste** – leftover food items and kitchen waste, fruit covers, dried plants, leaves and leafy vegetables etc.

**Biomedical Waste** – human or animal body parts, expired medicines, used syringes or bandages.

**Construction and Demolition Waste** - concrete slabs, cement blocks, bricks, stones, grinded powder, tiles etc.

**Electrical and Electronic Wastes (E-wastes)** - non-functioning electrical

Appliances / gadgets, TV, Radio parts, broken mobile phones, watches, copper wires, fuse etc.

**Hazardous Waste** - cleaning fluids, light bulbs, aerosol spray cans, painting liquids.

**Household Toxic Wastes** - fungicides, sprays, herbicides, pesticides, common fluids.

**Recyclable Materials** – paper plates, newspapers, plastic bottles, cardboard, aluminum cans, tiers, pins, paper boxes, clothing etc.

There is variety of solid wastes as per the nature of the area or surroundings. In industrial areas, one can find industrial solid wastes whereas in slum areas it can be food leftovers or household wastes. In the regions like Institutional areas it may be paper, pens, books or related material whereas in villages one can find cow dung, dried leaves or grass as solid wastes. On the construction or demolition sites, it is full of solid wastes like concrete slabs, cement blocks or bricks or stones etc. The solid wastes is also vary from the nature and culture of the country. Like US, solid wastes mainly based on paper products and a food waste is minimal whereas in European countries it is largely wooden products, plastic or metal wastes. It is only because of style of culture they follow and availability of sources for livelihood.

**Sources of Solid Waste**

There are many sources of solid waste that can be classified as below:
1.Residential (domestic or household)

2. Industrial / Commercial

3. Medicine field or Institutional

4. Construction or Demolition Sites

5. Agricultural Waste

The process of waste handling and disposal varies in different countries. In India, the processes differ according to the source of solid waste. They can be classified as:

1. **Hazardous Solid Waste- Hazardous wastes:** These are substances that have characteristic ignitability or reactivity or toxicity. Radioactive substances, chemicals, flammable wastes and explosives are common hazardous wastes.

**2. Municipal Solid Waste** - Municipal wastes are produced by residential tasks, eating establishments, educational facilities, and public spaces. Municipal wastes can be either solid (municipal solid trash) or liquid (domestic liquid waste), including garbage from businesses, workplaces, hospitals, and other locations.

## 4.4 BIO-WASTE

All human endeavors result in garbage. We are all aware that this garbage might be toxic and has to be disposed of properly. Water, soil, and air are polluted by industrial waste, sewage, and agricultural waste. Both humans and the environment may be at risk from it. Similar to this, hospitals and other healthcare institutions produce large amounts of garbage that might expose individuals to illnesses, notably HIV, Hepatitis B & C, and Tetanus. India produces over three million tones of medical waste yearly, and that volume is anticipated to increase by 8% every year.

We can classify biomedical waste as given below:

Any solid or liquid waste, including its container and any intermediate products, produced during the diagnosis, treatment, or immunization of humans or animals, or during related research activities, as well as during the production or testing of biological or in health facilities, is referred to as bio-medical waste.

The biomedical waste can produce infection and it can be toxic in nature, so one be very careful while handling it.

Human anatomical waste, such as tissues, organs, and body parts, is included in biomedical waste.

- animal waste produced by veterinary clinics during research
- Biotechnology and microbiology waste,
- Toxic substances and abandoned medications.
- Waste including blades, syringes, hypodermic needles, used gloves etc.
- contaminated waste, including dressings, bandages, plaster casts, bloody
- materials, tubes, and catheters
- liquid waste produced in any of the diseased regions
- Chemical wastes and incinerator ash.

The biohazard emblem should be on the cans and bags to let patients and the general public know what kind of waste is being disposed of.

## 4.5 E-WASTE

Electronic garbage, sometimes known as e-waste, is another category of solid waste that is possibly expanding at the quickest rate in many industrialised nations. This category includes old computers, televisions, phones, and other electronic gadgets. There is growing concern about this form of waste. Among the elements of concern found in electronic gadgets are lead, mercury, and cadmium. Government rules may be needed to control their recycle and disposal.

**Solid Waste Management**

Solid waste management refers to the administrative framework that coordinates the operations of collection, source separation, storage, transportation, transfer, processing, treatment, and disposal of solid waste.


Image courtesy: http://cdn.britannica.com

**Classification of Municipal Solid Waste Management**

Based on their properties, solid waste may be divided into two types.

1. Solid Organic Waste

2. Solid Inorganic Waste

**Solid Organic Waste**

When left unattended, biodegradable trash that is in the process of decomposing releases an unpleasant and obnoxious odour. Food, sewage sludge, green waste, etc. are a few examples.

**Organic Material**

Solid waste that doesn't break down in any way. Depending on the kind and nature of the substance they are made of, this category of waste material may be flammable.

Solid waste should be properly /managed. If not, it would harm the environment and endanger public health. Environmental planning for a region ought to take solid waste management into account.

The system of administration that manages the activities of collection, source separation, storage, transportation, transfer, processing, treatment, and disposal of solid waste.

There are various types of waste management, a few of them are listed below:
(a) Solid Waste Management

(b) Liquid Waste Management

(c) Biological Waste Management

**Management of solid waste**

Solid-waste management system is a collection, handling, and disposal of solid waste that is disposed after being used up or becoming unusable. Unsanitary circumstances brought on by improper municipal solid waste disposal can result in environmental contamination and epidemics of vector-borne diseases, which are illnesses carried by rodents and insects.

The handling of solid waste involves intricate technological issues. They also provide a wide range of management and solution challenges in the administrative, economic, and social spheres.

Earlier, wastes were thrown into unpaved streets and highways in ancient towns, where they were allowed to collect. The earliest recorded rule outlawing this practise was not enacted until 320 BCE in Athens. At that time, Greece and the eastern Mediterranean cities with a Greek majority started to develop a system for disposing of trash. The disposal techniques were quite primitive and used open trenches that were close to the city walls. An attempt was made to move garbage further from the cities as the population grew. Scavengers were given the job of transporting trash to landfills outside the limits around. But in smaller towns, the majority of residents continued to throw trash into the streets. However, rubbish collection system became the part of government roles for public safety. The countries like Boston, New York City, and Philadelphia started municipal rubbish collection towards the tail end of the eighteenth century. The techniques for getting rid of waste were still relatively primitive as it was thrown in river or the sea.

## 4.6 B. PROBLEMS WITH SOLID WASTE AND CONSEQUENCES

### Garbage Collection

Planning a collection route and scheduling it is another difficult challenge for the administration. The route needs to be planned for the most effective utilisation of labour, machinery, people, and fuel. Just a few of the factors that must be considered while formulating a route and schedule are the service type, distance, population density, and even the climate. To achieve this, sophisticated computers and algorithms are used.

### Solid-waste disposal

For the preservation of the environment's quality, safety, and public health, proper solid-waste collection is crucial. As it makes up around three-quarters of the overall cost of solid-waste management, it is a labor-intensive operation. The work was handed over to local municipal corporation with the help of labours and small as well as big vehicles like trucks and lorries under the contract system. The taxes were imposed and the system was regularized where the commercial workers were hired and paid on reasonable rates. For each collecting truck, a driver and one or two loaders are needed. It is possible to load from the front, back, or side. The amount of waste and process of collection and dropping was decided. Choosing the best collecting route is a difficult issue, particularly in big and heavily populated cities. An optimal route is one that yields the most economical use of labour and equipment. Collection frequency, hauling distance, service type, and climate are among the variables. Due to low population densities and high unit costs, garbage collection can be particularly challenging in rural locations.

Due to the requirement for specialized machinery and controls, highly qualified technical staff, and auxiliary fuel systems, waste-to-energy systems are more expensive to construct and run than standard incinerators. The recovery of thermal energy from trash is a feasible solid-waste management alternative from an engineering and economic point of view, on the other hand, since the sale of produced steam or electricity offsets most of the additional cost. The technique of composting provides a way to simultaneously treat and recycle waste and sewage sludge. Composting is projected to become increasingly prevalent as landfill and solid-waste incinerator choices are constrained by environmental regulations and proper restrictions. Sorting and separating, size reduction, and digestion of the waste are the phases that make up the process.


Image courtesy: http://thehansindia.com

**Locations for dumping the trash**

The location for dumping grounds is an essential part. Such locations are situated outside the city areas. It increases the travelling cost of trash to such locations followed by treatment on it. One or more transfer stations are required if the end location of the trash is far from the neighborhood where it is generated. A transfer station is a hub where waste from several

collection trucks is consolidated into a bigger truck, such a tractor-trailer unit. Non hazardous garbage can be transported in open-top trailers to a local processing or disposal facility. There are also closed compactor-type trailers available for dangerous kind of waste material such as bio medical trash, however these need to include ejector systems. Several collecting trucks empty straight onto the transfer vehicle at a station with direct discharge. In a station that uses storage discharge technology, trash is first dumped into a pit or platform for storage before being hoisted or pushed onto a delivery truck using gear. More than 2000 ton of waste is handled daily in the cities like Mumbai.

**Processing on trash digestion**

Either in covered mechanical facility or via the open windrow approach, pulverized trash is ready for composting. Windrows are lengthwise, slender piles of trash. Every few days, they are rotated or mixed to provide the bacteria that are digesting the organics access to air. It might take five to eight weeks for the waste to be completely digested, depending on the moisture levels. The metabolic activity was manually conducted for bacteria generation, eliminating any harmful organisms that may be present in the trash. Composting on open windrows takes a sizable amount of land.

**Need of mechanical composting facilities**

The amount of area needed for mechanical composting facilities is an important condition to treat the trash. One or more closed tanks or digesters with revolving vanes that mix and aerate the shred waste are used in mechanical composting systems. It takes roughly a week for the trash to completely digest.

Compost that has been dug up has to be treated before it can be used as mulch or a soil enhancer. Drying, screening, and granulating or pelletizing are all included in processing. Such processes are expensive to transport digested compost and there is rivalry among organic chemical fertilizers, demand for it in agriculture is often minimal. The waste and dirt are dispersed and compacted using a variety of heavy equipment, such as rubber-tired dozers or crawler tractors. To accomplish high-density compaction of the garbage, heavy steel-wheeled compactors may also be used which is expensive.

**Serious environmental pollution**

Leachate is another by-product of decomposition in unclean landfills, and it is a highly polluted liquid. The majority of leachate is produced when runoff comes into contact with decaying waste in the refuse cells. Serious environmental pollution issues, including the potential contamination of drinking water sources, can arise if leachate seeps out onto the ground surface or into the groundwater.

Methane gas is one of the byproducts of this breakdown. Methane is a powerful greenhouse gas that is explosive and toxic when diluted in the

air. It may also move through permeable soil layers over great distances, and if it is allowed to build up in basements or other small spaces, deadly situations may develop. Methane migration is regulated in contemporary landfills by gas-venting systems and impermeable barriers. Methane gas is sometimes recovered from landfills and used as fuel, either directly or as a component of biogas.

## 4.7 C. SOLID WASTE MANAGEMENT

Solid waste is any garbage or refuse material coming from routine community activities such as those performed by households, businesses, factories, farms, and other similar enterprises. Waste materials that are semi-solid, liquid, or gaseous are also included in this.

Tons of solid trash are produced every day. These trashes need to be disposed of. However, without efficient waste management, the build-up of improperly dumped or processed trash would damage our environment and provide a threat to the public's health. As a result, each local government needs a reliable solid waste management strategy. The goal is to decrease or perhaps completely remove the harmful effects that generated waste material has on the environment and public health. Such initiatives should promote a higher standard of living for all members of society and assist economic growth.

The best possible conceptualization, planning, design, and implementation must also go into solid waste management. This will keep the cost of disposing of trash and processing wastes low and avoid the problems raised out of it.

During the first half of the 20th century, technological developments persisted, leading to the creation of trash grinders, compaction trucks, and pneumatic collecting systems. By the middle of the 20th century, however, it was clear that issues with pollution and threats to public health were being caused by open dumping and inefficient combustion of solid waste. In order to replace the practise of open dumping and lessen the dependency on trash incineration, sanitary landfills were developed as a result. Due to the quick degradation of food waste, refuse collection often happens at least once every week. Garbage grinders or garbage disposals can minimise the quantity of trash in a single home's trash. The additional strain that ground waste places on sewage systems can often be handled.

**Features of Solid Waste**

a) Household, industrial, educational, and industrial activities are among the sources of solid waste. Refuse or municipal waste is any nonhazardous garbage from a community that has to be collected and transported to a processing or disposal location. Garbage and waste are included in refuse. Decomposing food waste makes up the majority of garbage, which also includes dry materials like glass, paper, linen, and wood. Bulky waste such as old refrigerators, sofas, and enormous tree stumps are considered trash. Trash needs specific management and pickup.

b) The construction and demolition (C&D) waste (or debris) makes up a sizeable portion of total solid waste. C&D trash, however, is often disposed of in municipal sanitary landfills since it is inert and nonhazardous.

c) The properties of solid waste vary greatly between towns and countries. Nearly 40% of waste is made up of paper and paperboard products, whereas less than 10% is made up of food waste. Yard waste, wood, glass, metal, plastic, leather, fabric, and other random materials make up the remainder. Geographical location, economic conditions, the time of year, and many other variables all affect these numbers. Before designing and constructing any treatment or disposal facility, it is important to carefully examine the waste characteristics of each community.

d) Prior to developing a waste management system, it is important to carefully examine the characteristics of the prevalent solid wastes in each location. Before designing or constructing any transfer station, dump, incineration plant, treatment facility, or recycling facility, they must be carefully analyzed.

e) Discarded Military Munitions - unused or damaged ammunition items and components that are manufactured or used by the armed forces or the Department of Defense are classified as solid waste. Such munitions may be discarded, destroyed, or otherwise rendered useless. Ammunition that has been used, fired, or detonated is regarded as solid waste if it is gathered for storage, recycling, treatment, or disposal.

Image courtesy: Hindustan imes

**Collection of Solid Waste**

The collection of solid waste at its source is a crucial component of solid waste management. Following that, wastes must be transferred safely to a transfer station, processing plant, incineration plant, or landfill. For the sake of preserving environmental quality, public safety, and public health, proper collection is crucial. The labor-intensive task costs about 3/4 of the overall amount incurred for solid waste management in a particular area. The local government entity often assigns public employees to complete the assignment. Solid trash collection trucks are entirely covered and include an integrated compactor. Although there are larger trucks as well, each truck has a capacity of 30 to 40 cubic metres of compacted rubbish.

There are typically specified collection places across the city where they are subsequently gathered. Instead of chutes, some have designated locations on the curb side. A schedule is also used to collect solid trash. In big cities, collection is typically done every day. Collection occurs once or twice a week in suburban or poorly populated areas. Additionally, there are scheduled collections for specific trash kinds. For instance, one monthly collection of burned-out fluorescent bulbs and regulated hazardous trash may be planned. Some locations provide drop-off points where individuals can deliver their recyclables.

**Collection of biological wastes**

Utilizing various sorts of containers to collect biological waste from places like operating rooms, labs, wards, kitchens, and hallways is part of the process. The containers or bins should be positioned such that complete collection is made possible. Sharps must always be housed in puncture-proof containers to protect the workers handling them from harm and infection.

Biomedical waste is kept properly after collection has taken place. Wastes from various types must be collected separately in recognizable containers. In large hospitals (with more than 250 beds), storage should not last more than 8 to 10 hours. It is possible to properly identify each container with the ward or room it is kept in. The labelling is done because it could be required to track the garbage back to where it came from. In addition, a warning notice has to be placed in the storage space.

Transporting the garbage for treatment should either be done in covered wheelbarrows or trolleys. Avoid manually loading whenever possible.

**Segregation**

Segregation is the fundamental separation of various waste types created at the source, lowering the hazards and expenses associated with management and disposal. The most important stage in the management of biomedical waste is segregation. Good biomedical waste management is only possible with effective segregation.

- The amount of garbage that requires specific handling and treatment is reduced through segregation.
- Sharps and other medical trash cannot be mixed with regular municipal rubbish because to effective segregation processes.
- It prevents the illicit reuse of some medical waste components, such as old syringes, needles, and plastics.
- It offers the chance to recycle some parts of medical waste, such as plastics,

following rigorous and appropriate cleaning.

The benefits of segregation of wastes.

- Recycled plastic can be utilized in applications that are not intended for food.
- The biodegradable garbage from the general rubbish can be composted on the hospital grounds and utilized for gardening.
- Recycling is a responsible environmental practice that may also provide income.
- It reduces the expense of treatment and disposal (80% of hospital trash is general garbage, which doesn't need special treatment if it isn't contaminated with other contagious waste).

**Storage**

Storage of unwanted bio wastes is another problem. If it is infectious, it may create problems to others. To disinfect it another issue but it cannot be ignored. Such bio waste material should be disposed off immediately or if necessary it should be kept in special storage which is made for it.

**Transportation**

Before shipping, the bags or containers carrying Bio Medical Wastes should be fastened or lidded. To restrict access to and direct contact with the garbage by transportation operators, scavengers, and the general public, special trucks must be utilized. The shipping containers need to be completely covered. The driver must get training on the protocols he must follow in the event of an accidental spillage, and the design should take into account the impacts of traffic accidents. The inside of the containers should also be able to be completely cleaned.

All employees handling trash should be required to wear safety equipment.

Gloves: The garbage retrievers should handle waste with heavy-duty bright yellow color rubber gloves. The gloves should be rinsed twice after handling the trash. After each usage, the gloves should be cleaned with carbolic soap and a disinfectant. The operator should be able to wear it.

**Reduce Infection possibility**

To reduce rodent or insect infestation and disagreeable odours, most towns require household waste to be kept in sturdy, readily cleaned containers with tight-fitting lids. Although some towns utilize bigger containers that may be physically lifted and dumped into collection vehicles, most communities use galvanized plastic and metal containers. For curbside pickup, plastic bags are typically utilized as disposable containers or liners. Dumpsters can be used as temporary holding until the waste is dumped in areas where huge amounts of trash are produced, such as in retail malls, hotels, or residential complexes. On-site compactors are used in some business and office buildings to cut down on garbage volume.

**Solid Garbage Management:** The process of collecting waste and processing or discarding it is referred to as solid waste management. It is crucial for children to understand where solid waste originates.

Solid home trash, solid agricultural waste, solid construction waste, sewage sludge, solid waste material from various industries and more are the sources of solid waste. Municipal solid waste management, solid waste management regulations, and other topics should be taught to the students in the beginning.

**Recycling: Solid Waste Management**

The collection, transportation, recovery, and disposal of trash, as well as the oversight and control of the waste management process, can all be summed up as waste management.

The more recent approach to waste management, however, emphasizes the seven R's: Rethink, Refuse, Reduce, Reuse, Recycle, Regulate, and Research.


However, the non-biodegradable wastes can be recycled or used again.

1. Recycling is the process of turning outdated products into new ones in order to conserve resources. For instance, used newspapers may be recycled to generate cardboard and tissue paper. Cans made of aluminum may be recycled to make new ones. Recycling is the process of identifying parts of solid waste that may still be useful economically and recovering them for reuse. Recovering and using thermal energy is one sort of recycling; this process is covered separately under incineration. Since composting recovers the organic components of solid waste for reuse as mulch or soil conditioner, it may also be thought of as a recycling process. Other waste products could be put to good use again. This article discusses the recovery of these materials, which include paper, metal, glass, plastic, and rubber.

2. By utilizing used objects repeatedly, reuse means preserving the resources in those items. Glass bottles, for instance, may be gathered, cleaned, and filled once again.

**Common Methods of Disposing of Solid Waste**

The following are typical and beneficial intermediate solid waste treatment, reuse, and disposal procedures used in rural communities:

1) Composting: Both urban and rural regions utilize composting as a method of waste reduction to cut trash. Its organic components disintegrate into smaller forms and become organic fertilizer for the plants.

2) Solid trash that cannot be recycled or repurposed should be disposed of through controlled tipping or burial. It is a technique for isolating garbage of any kind without sorting or separating it first.

Here are a few techniques for isolating the garbage:

a) To start, the disposal site should be located, and garbage that is close to water sources, highways, and walkways, among other places, should be collected from the location.

b) Dispose of the daily rubbish or solid waste collection in the pit.

c) Every day, cover the soil over the rubbish that has been dumped in the pit and let it settle.

d) Keep the dirt covered over the garbage that has been dumped in the pit each day and let it decay. After the trenches have been filled, the plants may be planted.

3. Plowing in the Fields: Plowing in the fields aids in the separation of organic, biodegradable waste, which aids in the recovery and reuse of waste for soil conditioning.

4. Incineration: An incinerator converts organic and combustible garbage into inorganic, incombustible stuff through a high-temperature dry oxidation process, significantly reducing waste volume and weight.

**Other Methods of Disposal**

Sanitary Landfill Waste: A way to dispose of trash on land without endangering the health or safety of the people. The qualities of a sanitary landfill that set it apart from an open dump include:

a. The trash is disposed of in a properly specified way at a landfill site that has been carefully chosen and prepared.

b. Using the required heavy machinery, the waste materials are dispersed and compacted.

c. A layer of compacted earth is placed on top of the garbage every day.

**Treatment and Disposal of Solid Waste**

Treatment of solid waste frequently starts at the source of the trash. Many local government agencies have laws requiring generators to separate their trash first. Additionally, producers are urged to cut back on waste output by recycling, reusing, or composting.

**Composting** - You may compost organic waste, including grass clippings and food scraps, right at the source. Compost uses worms, enzymes, loam soil, and the natural process of decomposition. Compost is the end product, and it may be applied to the soil or used as fertilizer.

**Segregation** - In the final facility, waste materials may be further divided into categories. The segregation may be carried out swiftly and efficiently using specialized equipment.

Any item that is to be recycled must first be processed and separated from the raw garbage. Separation may be carried out at the waste's origin or at a centralized processing plant.

Curbside separation, also known as source separation, is carried out by private persons who separate newspapers, bottles, cans, and rubbish before setting them out for collection. Many towns permit the "commingling" of recyclables other than paper (glass, metal, and plastic). Municipal collection of source-separated trash is more expensive than regular trash collection in both scenarios.

Recycling materials and trash can be separated at centralised mechanical processing facilities in place of source separation. Experience has shown that contamination with wet waste and broken glass lowers the quality of recyclables recovered from these facilities. The optimum method, as it is presently understood, is to have people divide their trash into a small number of categories, such as rubbish and other non recyclables, magazines and other wastepaper, mixed metals, glass, and plastics, and newspapers. An electromagnetic separator removes steel cans ("tin" cans are actually steel with only a thin covering of tin), and the remaining material is then sent over a vibrating screen to remove shattered glass. Aluminum, plastic, and lighter glass containers are separated from each other on the conveyor using an air classifier. Aluminum cans are separated from plastics using an eddy-current separator, which repels the aluminium from the conveyor belt, and glass is manually sorted by colour.

Hazardous and nonhazardous garbage were separated into two categories in several nations, and different procedures were created for their disposal. Risks to human health and the environment were reduced via landfill design and operation. In order to meet strict air quality regulations, new rubbish incinerators were built with significant air pollution control equipment and were designed to recover thermal energy from the waste.

Image courtesy: Encyclopedia Britannica

**Chemical or mechanical treatments**-Some solid wastes may need to go through chemical or mechanical treatments in order to be sterilized before they can be disposed of properly. In a vacuumed drum, for instance, discarded fluorescent bulbs must be pulverized. The hazardous mercury, which may be recycled, is removed from the bulbs using a vacuum. The shattered glass is then either packaged for disposal or repurposed as aggregate.

**Incineration**- Waste may be burnt at an incineration facility through the process of incineration. These incinerators are built with numerous incineration chambers, allowing for the oxidation of even the gases released during the burning process. A considerably cleaner gas is then discharged into the environment as a result.

In a furnace, there are two phases of combustion: primary and secondary. Primary combustion causes the trash to ignite and volatilize while removing moisture from the air. The leftover unburned gases and particles are oxidized during secondary combustion, which removes odours and reduces the quantity of fly ash in the exhaust. Sometimes, supplemental gas or fuel oil is utilised to initiate primary combustion when the waste is extremely wet.

Air must be extensively mixed with the burning waste in order to supply enough oxygen for both primary and secondary combustion. Air is injected into the space above or supplied through apertures beneath the grates. To ensure optimum combustion efficiency, the plant operator must establish the proportions of this under fire air and over fire air. A natural draught in a tall chimney or mechanical forced-draft fans may both maintain a constant flow of air.

**Operation of an Incinerator**

Burning solid trash is a very efficient way to reduce its volume and weight, but it does produce greenhouse gas emissions. In contemporary incinerators, garbage is burnt inside a professionally constructed furnace under strict control. The waste's combustible material reacts with oxygen to produce primarily carbon dioxide, water vapour, and heat. An inert residue of ash, glass, metal, and other solid materials termed bottom ash is left behind after incinerating garbage, which can reduce the volume of uncompacted waste by more than 90%.


The incinerator airstream carries the gaseous byproducts of incomplete combustion as well as the finely separated particulate debris known as fly ash. There are cinders, dust, and soot in fly ash. Modern incinerators must be fitted with elaborate emission control mechanisms in order to capture fly ash and gaseous by-products before they are released into the atmosphere. If harmful metals are discovered to be present in the ash, it must be handled as a hazardous waste.

**Energy Restoration** is a technique that uses the heat and steam produced by burning solid waste to power turbines within an incineration plant. The electricity generated by these turbines is subsequently sent into the neighboring grid or used to run the factory. The final disposal of these procedures' remaining materials takes place at a landfill.

Depending on the amount of paper present, the energy value of waste can be as high as one-third that of coal. The heat released during incineration can be captured using a refractory-lined furnace connected to a boiler.

Boilers allow the energy content of the waste to be recycled by converting the heat of combustion into steam or hot water. Waste-to-energy facilities are incinerators that utilise this method of thermal energy recycling.

A water-tube wall furnace can also be utilised for energy recovery in place of a separate furnace and boiler. Vertical steel tubes placed near enough together to form continuous wall sections line the interior of such a furnace. To prevent heat loss, the outside of the walls are insulated. In addition to helping to regulate combustion temperatures without the need for too much air, the water that is circulated through the tubes absorbs heat to generate steam, which lowers the cost of air pollution management.

Waste-to-energy facilities run using either mass burning or fuel obtained from waste. A mass burning system burns all the waste without any prior preparation or treatment. Prior to burning, a refuse-derived fuel system

separates combustible material from non-combustibles like glass and metal. Cogeneration is a method that may create both steam and electricity if a turbine is put at the facility.

**Reuse**

Broken glass that has been recovered can be crushed and utilised in asphalt paving. Crushed color-sorted glass is sold to glass producers as cullet, a crucial component in the production of glass. Aluminum is baled or compacted for use by smelters, and steel cans are baled and transported to steel mills as scrap. Although it makes up a modest portion of municipal solid trash, aluminium is the most valuable recyclable commodity. Due to the numerous distinct polymeric components used in its creation, recycling plastic is difficult. Mixed thermoplastics can only be used to create inferior goods like "plastic timber."

Old newspapers are manually sorted on a conveyor belt in the paper stream to eliminate corrugated debris and mixed papers. They are then put loosely or in bales into trucks for transport to paper factories, where they are recycled to create new newspapers. For sale to tissue manufacturers, mixed paper is separated from corrugated paper. Despite the fact that pulping, de-inking, and screening wastepaper normally costs more than producing paper from raw wood fibres, the market for recycled paper has expanded as more processing facilities have been built.

Re-vulcanization is a technique for recovering rubber from solid waste; however, the recycled rubber is typically not as durable as the original.

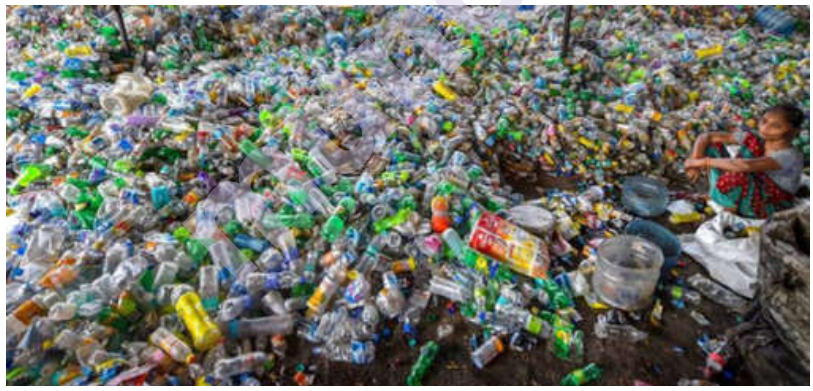


Image courtesy: Indian Express

**Importance in the management of garbage**

Sanitary landfills often offer the most cost-effective solution for non recyclable waste disposal in places where suitable sites are readily accessible. Finding locations, nevertheless, that provide sufficient capacity, accessibility, and environmental conditions is become more and more challenging. However, landfills will always be important to the management of solid waste. Not all parts of solid waste can be recycled, and there will always be leftovers after incineration and other treatment

procedures that will ultimately need to be buried. Furthermore, landfills may really make bad land better. In some towns, legally finished landfills are transformed into parks, playgrounds, or golf courses for recreation.

In the second half of the 19th century, a technical approach to solid-waste management started to emerge. In the United States, the first watertight trash cans appeared, and heavier trucks were utilised to collect and carry rubbish. The first rubbish incinerator was built in England in 1874, which represented a significant advancement in solid-waste treatment and disposal techniques. 15% of the main American cities around the turn of the 20th century were burning solid trash. But even then, the majority of the biggest cities continued to use archaic disposal techniques like open dumping on land or in water.

Nowadays, a lot of cities have source-separation and recycling systems whereby residents and businesses sort recyclables from trash and put them in different containers for collection. Additionally, some towns provide recycling drop-off locations where locals may bring their recyclables.

**Shredding and sorting**

Through sorting and separating processes, the decomposable components of waste are separated from glass, metal, and other inorganic elements. Utilizing variations in the physical qualities of the waste, such as size, density, and magnetic properties, these are carried out mechanically. By reducing the size of the waste materials, shredding or pulverizing creates a homogenous mass of material. Rotary shredders and hammer mills are used to achieve this.

**Clean landfill**

The most popular management technique for municipal solid trash is land disposal. A sanitary landfill, a disposal location that has been carefully chosen, developed, built, and maintained to preserve the environment and public health, is where refuse may be securely dumped. The fact that the buried garbage is never in touch with groundwater or surface water is one of the most crucial aspects of land filling. There must be a minimum distance between the landfill's bottom and the groundwater table, which is seasonally high, according to engineering design specifications. Most brand-new landfills must feature a system of groundwater monitoring wells and an impermeable liner or barrier at the bottom. To prevent precipitation or surface drainage from the completed landfill sections, an impermeable cover must be placed on top of them.

To prevent precipitation or surface runoff from contaminating the buried garbage, finished landfill portions must be covered with an impermeable lid. Flexible plastic membranes, clay soil layers, or a mix of the two may be used as bottom and cap liners.

**Building the landfill**

The trash cell is the fundamental component of a sanitary landfill. Refuse is spread out and compacted in thin layers in this small, enclosed area of the site. A maximum of three metres' worth of layers can be compressed on top of one another (10 feet). The volume of the compacted waste is around one-fourth that of the loose waste. To get rid of odours, insects, and rodent issues, a layer of earth is placed over the trash at the end of each day's operations. Thus, the daily amount of compacted waste and soil cover is contained within one garbage cell. A lift is made up of many neighboring waste cells, and eventually a landfill may consist of two or more lifts piled one on top of the other.

A new landfill's dimensions are precisely marked, and the base is ready for the building of any necessary liners and leachate-collection systems. To protect it from garbage vehicles, at least 30 cm (12 inches) of sand must be properly put over any plastic liners utilised. The trench technique of building may be used at locations where excavations may be done below grade. When geography or groundwater issues make this impractical, the area approach may be used, resulting in a mound or hill growing over the original ground. The area approach doesn't need any ground excavation, thus dirt must often be transported from somewhere to the site.

**Regulating by-products**

Leachate control techniques include intercepting surface water to keep it out of the landfill and putting impermeable liners or barriers between the garbage and the groundwater. Leachate-collection and treatment systems as well as groundwater monitoring wells should be installed at new landfill sites.

## 4.8 PERSONAL SAFETY

**Boots**: When handling contaminated waste in big amounts or splashes, boots, or shoe covers offer more skin protection. Boots should have rubber soles and be non-slip. The leg should be covered.

**Safe clothes:** Wearing clothing helps to protect the skin and keep clothes clean. Examples include aprons, gowns, suits, and other clothing. It could be constructed of fabric or an impermeable substance like plastic. People working in incineration chambers should wear non-flammable gowns or suits.

**Masks**: A protective barrier is created by wearing a variety of masks, goggles, and face shields, either alone or in combination. Employees working in the incineration chamber are required to wear a mask that covers their mouth and nose, ideally a gas mask with filters.

## 4.9 CLEANING TOOLS:

**Brooms**: The broom must be at least 1.2 metres long so that the worker does not have to kneel to sweep. The broom should have a handle-friendly diameter. Depending on the kind of flooring, the broom's brush might be soft or firm.

**Vacuum cleaners**: Depending on the size of the rooms, either domestic or industrial vacuum cleaners may be utilized.

**Mops**: The floor must be swept with mops with long handles. Either rubber or fabric must be used for them. Depending on wear and tear, the mop needs to be updated.

**Dustbins:** Dust from sweeping activities should be collected using dustpans. They might be made of metal or plastic. Before each usage, they should be cleaned with disinfectants and dried.

It's crucial to assess how much rubbish is produced at each location. The capacity of dustbins should be sufficient that they do not overflow between garbage collection cycles. After each round of garbage removal, dustbins should be disinfectant-cleaned. Dustbins may be lined with chlorine-free plastic bags that are color-coded in accordance with the legislation.

**Trolleys**

Instead of creating a new trash category, the use of trolleys will make it easier to remove infectious garbage directly from the source.

**Handling equipment**

Wheelbarrows are used to move garbage from the point source to the recycling facilities. Wheelbarrows come in two varieties: covered and open. Steel wheelbarrows have two wheels, a handle, and are constructed from the material. Only packaged trash should be transported (in plastic bags). A further precaution is to avoid allowing fluids. The size of a wheelbarrow might vary depending on its purpose.

**Risk factors**

1. Open piles of solid trash serve as a breeding ground for pests that spread illness, such as pigs, flies, and mosquitoes. Gas and garbage piles produced by them provide a fire danger.

2. Unattended garbage frequently finds its way into drains, where it causes obstructions that lead to floods and unhygienic conditions. Solid waste burning contaminates the air.

3. The general degradation of the environment as a result of gaseous emissions, particulate matter, ash, leachate, mounds of waste materials, etc. contaminating the air, water, and soil environments.

**Solid waste management benefits**

1. Burning of trash destroys harmful organisms and lowers waste volume.

2. It aids in disposing of a lot of rubbish.

3. Heat energy is generated out of burning which can be utilized elsewhere.

4. There is a decrease in the amount of solid and rotten trash in the environment.

5. Availability of space increases.

**Problems of Solid waste management's (drawbacks)**

1) The solid waste management equipment is highly expensive.

2) The manpower is much needed and expenses of transportation are increased.

3) The management must oversee the garbage collection at each interval or it may have an impact on people's health.

4) It affects the health of labours working for it.

5) When certain solid waste is burned, very poisonous fumes are produced.

6) A challenge in sorting or segregating the trash.

7) As the population is increased in cities so as the garbage. So extra space is needed to accumulate and management.

8) Public awareness to tackle the issue is the challenge.

9) Local support of the people is necessary.

10) Transportation causes traffic issue in the cities.

## 4.10 SUMMARY

**Solid Waste**

Solid waste is a broad category of garbage that includes frequently used, unnecessary, and undesirable products. Residential, commercial, industrial, agricultural, medical, and radioactive sources all frequently produce this kind of trash.

Solid waste types differ from one nation to another as well. For instance, US solid wastes are frequently less in weight and volume than equivalent materials from Europe or Japan. Paper and cardboard products make up around 40% of the solid trash produced in America, while food wastes make up about 10%. The remainder is made up of various trims, wood, glass, plastic, metal, and other materials.

**Sources of Solid Waste**

There are many sources of solid waste that can be classified as below:
1.Residential (domestic or household)

2. Industrial / Commercial

3. Medicine field or Institutional

4. Construction or Demolition Sites

5. Agricultural Waste

**BIO-WASTE**

Any solid or liquid waste, including its container and any intermediate products, produced during the diagnosis, treatment, or immunization of humans or animals, or during related research activities, as well as during the production or testing of biological or in health facilities, is referred to as bio-medical waste.

The biomedical waste can produce infection and it can be toxic in nature, so one be very careful while handling it.

Human anatomical waste, such as tissues, organs, and body parts, is included in biomedical waste.

- animal waste produced by veterinary clinics during research
- Biotechnology and microbiology waste,
- Toxic substances and abandoned medications.
- Waste including blades, syringes, hypodermic needles, used gloves etc.
- contaminated waste, including dressings, bandages, plaster casts, bloody materials, tubes, and catheters
- liquid waste produced in any of the diseased regions
- Chemical wastes and incinerator ash.

**E-WASTE**

Electronic garbage, sometimes known as e-waste, is another category of solid waste that is possibly expanding at the quickest rate in many industrialised nations. This category includes old computers, televisions, phones, and other electronic gadgets. There is growing concern about this form of waste. Among the elements of concern found in electronic gadgets are lead, mercury, and cadmium. Government rules may be needed to control their recycle and disposal.

**Management of solid waste**

Solid-waste management system is a collection, handling, and disposal of solid waste that is disposed after being used up or becoming unusable. Unsanitary circumstances brought on by improper municipal solid waste disposal can result in environmental contamination and epidemics of vector-borne diseases, which are illnesses carried by rodents and insects. The handling of solid waste involves intricate technological issues. They also provide a wide range of management and solution challenges in the administrative, economic, and social spheres.

**B. Problems With Solid Waste And Consequences**

1. Garbage Collection
2. Solid-waste disposal
3. Locations for dumping the trash
4. Processing on trash digestion
5. Need of mechanical composting facilities
6. Serious environmental pollution

## 4.11 C. SOLID WASTE MANAGEMENT

During the first half of the 20th century, technological developments persisted, leading to the creation of trash grinders, compaction trucks, and pneumatic collecting systems. By the middle of the 20th century, however, it was clear that issues with pollution and threats to public health were being caused by open dumping and inefficient combustion of solid waste. In order to replace the practise of open dumping and lessen the dependency on trash incineration, sanitary landfills were developed as a result. Due to the quick degradation of food waste, refuse collection often happens at least once every week. Garbage grinders or garbage disposals can minimise the quantity of trash in a single home's trash. The additional strain that ground waste places on sewage systems can often be handled.

**Features of Solid Waste**

1. Collection of Solid Waste
2. Collection of biological wastes
3. Segregation
4. Storage
5. Transportation
6. Reduce Infection possibility

**Solid Garbage Management:** The process of collecting waste and processing or discarding it is referred to as solid waste management. It is crucial for children to understand where solid waste originates.

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**Solid Waste Management: Benefits and Drawbacks.**

## 4.12 SELF-STUDY

Q.1. Define and explain the concept of Waste management?
Q.2. What are the types of Waste Management?
Q.3. What are the benefits and drawbacks of Solid Waste management?
Q.4. What are the methods of disposing solid wastes? What precautions to be taken while discomposing?
Q5. What are the problems with Solid Waste Management?

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