NATURAL RESOURCE

Natural Resources and its Classification

Definition

- Natural resources are the raw materials supplied by the earth and its processes and include things in the physical environment used for housing, clothing, heating, cooling, transportation and to meet other human wants and needs. For example, trees are used for shelter, animals for food and clothing, plants for medicine, minerals and fossil fuels for power.

Classification of natural resources

A. Classification Based on the Availability of Resource

1. **Inexhaustible and immutable resource:** These include the ocean, water, solar energy, wind power, climate, gravitation, etc.
2. **Inexhaustible but misusable resources:** These include water, power, surface water bodies, area and space, etc.
3. **Maintainable and renewable resources:** These include timber, human numbers, land fertility, ground water, etc.
4. **Maintainable but non-renewable resource:** These include physical soil materials, human talents and genius fish, wild animals, trees, etc.
5. **Exhaustible but reusable resource:** They include gems, some non-metallic minerals, most metals, e.g. iron, tin, copper, gold and silver.
6. **Exhaustible, non-resusable resources:** These include coal, petroleum, natural gas, most non-metallic and certain metals.

B. Classification Based on Distribution and Frequency of Occurrence of Resource

1. **Ubiquities:** Occuring everywhere, for example, oxgen in the air.
2. **Commonalities:** Occuring in many places, such as tillable soil.
3. **Rarities:** Occuring in few places, for example, tin.
4. **Uniquities:** Occuring in one place, for example, commercial cryolite.

C. Classification According to Use of Resources

1. **Unused resources:** The resources lying unused fall in this category. For example, the forests and mineral resources of North America remained unused for thousands of years until the continent was colonized by the Europeans.
2. **Unusable resources:** Resources which cannot be used further even with the present day technique, become unusable. For example, deep mines which cannot be worked out at further depth, become unusable.
3. **Potential resources:** Those resources which can be developed or used in near future are called potential resources. For example, the water available in rivers of India is at present not being fully utilized for power-generation.
4. **Latent resources:** There are many resources which have been unknown to man. Such as petroleum was lying unused until the eighteenth century when combustion engine was invented and distillation process was developed. Later; the development of the science of geology helped in prospecting, exploration and source.

D. Classification of Natural Resources on the basis of rennovability

1. **Non-renewable resources:** These resources are not generated or reformed at rates equivalent to

the rate at which we use them. When these resources are gone. There is no hope of their replacement, e.g. wild life.

2. **Recyclable resources:** These are a special type of non-renewable resources which are not lost or worn out by the way we use them and can be reprocessed and used again and again, e.g. metals.

3. **Renewable resources:** All living things that have the capacity or reproduction and growth, are called renewable resources.

4. **Inexhaustible resources:** These resources such as sunlight, will continue to pour on to the earth as long as humanity will be around, whether we use it in certain way or not. Water and wind are other examples of inexhaustible natural resources.

Land Resources

The utilization of land depends upon physical factors like topography, soil and climate as well as upon human factors such as the density of population duration of occupation of the area, land tenure and technical levels of the people.

Land Use in India

The major land uses in India are:

Net sown Area

- Agriculture land means cultivated area, it includes net cropped area and fallow lands. Cropped area in the year under consideration in called net sown area.
- India stands seventh in the world in terms of total geographical area but second in terms of cultivated land.
- Net shown Area is about 46%.
- Percentage wise Punjab and Haryana are highest and Arunachal Pradesh is Lowest (3.2%)
- The net sown area and the area sown more than once together are called gross cultivated area.

Forest Area

- This includes all land classified either as forest under any legal enactment, or administered as forest, whether State-owned or private, and whether wooded or maintained as potential forest land.
- The area of crops raised in the forest and grazing lands or areas open for grazing within the forests remain included under the "forest area".

Area under Non-agricultural Uses

- This includes all land occupied by buildings, roads and railways or under water, e.g. rivers and canals, and other land put to uses other than agriculture.

Barren and Un-culturable Land

- This includes all land covered by mountains, deserts, etc.
- Land which cannot be brought under cultivation except at an exorbitant cost is classified as unculturable whether such land is in isolated blocks or within cultivated holdings.

Permanent Pasture and other Grazing Land

- This includes all grazing land whether it is permanent pasture/meadows or not.
- Village common grazing land is included under this category.

Land under Miscellaneous Tree Crops, etc.

- This includes all cultivable land which is not included in 'Net area sown' but is put to some agricultural use.
- Land under trees, thatching grasses, bamboo bushes and other groves for fuel, etc. which are not included under 'Orchards' are classified under this category.

Culturable Waste Land

- This includes land available for cultivation, whether taken up or not taken up for cultivation once, but not cultivated during the last five years or more in succession including the current year for some reason or the other .
- Such land may be either fallow or covered with shrubs and jungles which are not put to any use.

Fallow Lands other than Current Fallows

- This includes all land which was taken up for cultivation but is temporarily out of cultivation for a period of not less than one year and not more than five years.

Current Fallows

- This represents cropped area which is kept fallow during the current year.

Land Capability Concept

- Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded.
- The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management.
- The classification is as follows:

Class 1 soils have slight limitations that restrict their use.

Class 2 soils have moderate limitations that restrict the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that restrict the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that restrict the choice of plants or that require very careful management, or both.

Class 5 soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 7 soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forestland, or wildlife habitat.

Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

Land Degradation

As defined by the FAO "Land degradation is a *process which lowers the current and/or potential capability of soil to produce goods and services*".

There are two types of land degradation:

- ***Physical Degradation:*** Water logging, soil crusting, compaction, desertification, etc.
- ***Chemical Degradation:*** Salinization, solidification, acidification, nutrient removal, decrease of organic matter.

Causes of Land degradation

- The natural causes includes earthquakes, tsunamis, droughts, avalanche, landslides and mud flow, volcanic eruptions, flood, tornado, wild fire.
- Human induced causes include deforestation, overgrazing by livestock, wrong irrigation practices, urban sprawl and commercial development, pollution from industries, quarrying and mining activities.

Some specific causes are:

a) Soil erosion:

- **It is** wearing away of the land surface by physical forces such as rainfall, flowing water, wind, ice, temperature change, gravity or other natural or anthropogenic agents.

b) Soil contamination:

- It includes contamination by heavy metals, acidification, nutrient surplus (eutrophication), etc.

c) Soil salinisation:

- The salts which accumulate include chlorides, sulphates, carbonates and bicarbonates of sodium, potassium, magnesium and calcium.

d) Soil sealing:

- The covering of the soil surface with impervious materials as a result of urban development and infrastructure construction.

e) Overgrazing:

- Overgrazing occurs when plants are exposed to intensive grazing for extended periods of time, or without sufficient recovery periods.

f) Acidification of Soil:

- Acid soils are toxic to plants because they can release toxic levels of aluminium and other mineral elements.

g) Mining and quarrying activities:

- Due to this excavation process alter the structure of the land, stacking of top soil, loss of soil due to dumping of the mine wastes.

h) Improper crop rotations:

- It decreases fertility of soil.

Impact of land degradation

a) Loss of soil organic matter and nutrients.

b) Loss of soil structure.

c) Loss of soil biodiversity.

d) Loss of water holding capacity and water infiltration.

e) Soil pollution.

f) Reduced yields of crops.

g) Reduced land value and resilience to future events.

h) Impact on food security.

i) Reduces ability to adapt to climate change.

Methods for achieving sustainable land use

- Plan and manage land resources in an integrated manner for maximization of environmental, social and economic factors apart from ensuring livelihood and equity.
- Prepare comprehensive land inventories.
- Prepare a perspective plan for treating degraded land.
- Develop infrastructural facilities and strengthen the technology support system.
- Develop proper computerized, updated, on-line information system on land records.
- Develop and use advanced methodologies for land use planning.
- Invest in capacity building, education and awareness on the importance of conservation and optimum use of all natural resources.
- Continuously monitor and assess the impact of climate change on land use and take/suggest appropriate remedial measures.

Soil Resources

Soil can be defined as the solid material on the Earth's surface that results from the interaction of weathering and biological activity on the parent material or underlying hard rock.

Soil Characteristics

Soil Texture

- Textures range from clay, sand, and silt at the extremes, to a loam which has all three sized fractions present. The main influence of texture is on permeability which generally decreases with decreasing particle size.

  A clayey soil may thus be described as fine, a sandy soil as course, while a silty soil is intermediate.

Soil Air

- A certain amount of air is contained between the individual particles except for the waterlogged soils. The air in the soil helps in the process of oxidation which converts part of the organic material into nitrogen in a form readily available to the plants.

Soil water

- Depending on the texture of the soil, water moves downward by percolation.
- In damp climates, especially in high latitudes where the evaporation rate is low, water tends to move predominantly downward, particularly in coarse-grained sandy soils. This dissolves the soluble minerals in the soil, together with soluble humus material and carries both downward, a process called leaching or eluviations.
- In a hot, arid climate, evaporation exceeds precipitation for greater part of the year, so the water tends to move upward and the soil dries out. Consequently, in some areas, a thin salty layer is formed on the surface. This process of Stalinization can produce an extremely saline soil known as reh or kallar.

Soil Colour

- Generally soil colour is determined by the amount of organic matter and the state of the iron. Soil colour is also related to soil drainage, with free draining, well AERATED soils (with pore space dominated by oxygen) having rich brown colours.
- In contrast, poorly draining soils, often referred to as gleys, develop under ANAEROBIC conditions (the pore space dominated by water) and have grey or blue-grey colours.

Factors Responsible for Soil Formation

Soil formation is the combined effect of physical, chemical, biological, and anthropogenic processes on soil parent material.

a) Parent material

- This is the material from which the soil has developed and can vary from solid rock to

deposits like alluvium and boulder clay. It has been defined as 'the initial state of the soil system'.

- The parent material can influence the soil in a number of ways: colour; texture; structure; mineral composition and permeability/drainage.

b) Climate

- Temperature varies with lattitude and altitude, and the extent of absorption and reflection of solar radiation by the atmosphere. The absorption of the solar radiation at the soil surface is affected by many variables such as soil color, vegetation cover, and aspect. In general, the darker the soil color, the more radiation is absorbed and the lower the albedo. The absorption differs in areas with decidious trees (soil surface is shaded by trees most of the year) and arable land (soil surface is not shaded throughout the year).
- Temperature also influences the degree of thawing and freezing (physical weathering) in cold regions.
- Biological processes are intensified by rising temperatures. Reaction rates are roughly doubled for each 10°C rise in temperature, although enzyme-catalysed reactions are sensitive to high temperatures and usually attain a maximum between 30 and 35°C.

c) Biological Factors

- The soil and the organisms living on and in it comprise an ecosystem. The active components of the soil ecosystem are the vegetation, fauna, including microorganisms, and man.

1. Vegetation:

- The primary succession of plants that colonize a weathering rock culminates in the development of a climax community, the species composition of which depends on the climate and parent material, but which, in turn, has a profound influence on the soil that is formed.

2. Meso-/Macrofauna:

- Earthworms are the most important of the soil forming fauna in temperate regions, being supported to a variable extent by the small arthropods and the larger burrowing animals (rabbits, moles).
- Earthworms build up a stone-free layer at the soil surface, as well as intimately mixing the litter with fine mineral particles they have ingested.

3. Microorganisms:

- The organic matter of the soil is colonized by a variety of soil organisms, most importantly the microorganisms, which derive energy for growth from the oxidative decomposition of complex organic molecules.
- Types of micro-organisms comprise bacteria, actinomycetes, fungi, algae, protozoa, and soil enzymes.

4. Man:

- Man is perhaps now the most influential of all organisms. He affects the soil by such activities as: plowing, irrigating, mining, clearing, disposing and leveling.

d) Time

- Time is a factor in the interactions of all the above factors as they develop soil. Over time, soils evolve features dependent on the other forming factors, and soil formation is a time-responsive process dependent on how the other factors interplay with each other.

e) Relief

- Relief is not static; it is a dynamic system (its study is called geomorphology). Relief influences soil formation in several ways:

I. It influences soil profile thickness i.e. as angle of slope increases so does the erosion hazard.

II. It has an effect on climate which is also a soil forming factor.

III. Gradient affects run-off, percolation and mass movement.

IV. It influences aspect which creates microclimatic conditions.

Soil Forming Processes

The four major processes that change parent material into soil are additions, losses, translocations, and transformations.

- ***Additions***

- The most obvious addition is organic matter. As soon as plant life begins to grow in fresh parent material, organic matter begins to accumulate. Organic matter gives a black or dark brown color to surface layer. Most organic matter additions to the surface increase the cation exchange capacity and nutrients, which also increase plant nutrient availability.

- Other additions may come with rainfall or deposition by wind, such as the wind blown or eolian material. On the average, rainfall adds about 5 pounds of nitrogen per acre per year. By causing rivers to flood, rainfall is indirectly responsible for the addition of new sediment to the soil on a flood plain.

• ***Losses***

- Most losses occur by leaching. Water moving through the soil dissolves certain minerals and transports them into deeper layers. Some materials, especially sodium salts, gypsum, and calcium carbonate, are relatively soluble. They are removed early in the soil's formation. As a result, soil in humid regions generally does not have carbonates in the upper horizons. Quartz, aluminum, iron oxide, and kaolinitic clay weather slowly. They remain in the soil and become the main components of highly weathered soil.

- Fertilizers are relatively soluble, and many, such as nitrogen and potassium, are readily lost by leaching, either by natural rainfall or by irrigation water. Long- term use of fertilizers based on ammonium may cause acidity in the soil and contribute to the loss of carbonates in some areas.

- Oxygen, a gas, is released into the atmosphere by growing plants. Carbon dioxide is consumed by growing plants, but lost to the soil as fresh organic matter decays. When soil is wet, nitrogen can be changed to a gas and lost to the atmosphere.

- Solid mineral and organic particles are lost by erosion. Such losses can be serious because the material lost is usually the most productive part of the soil profile. On the other hand, the sediment relocated to lower slope positions or deposited on bottom lands has the potential to increase or decrease productive use of soils in those areas.

• ***Translocations***

- Translocation means movement from one place to another. In low rainfall areas, leaching often is incomplete. Water starts moving down through the soil, dissolving soluble minerals as it goes. There isn't enough water, however, to move all the way through the soil. When the water stops moving, then evaporates, salts are left behind. Soil layers with calcium carbonate or other salt accumulations form this way. If this cycle occurs enough times, a calcareous hardpan can form.

- Translocation upward and lateral movement is also possible. Even in dry areas, low-lying soils can have a high water table. Evaporation at the surface causes water to move upward. Salts that are dissolved in solution will move upward with the water and deposit on the surface as the water evaporates.

• **Transformations**

- Transformations are changes that take place in the soil. Microorganisms that live in the soil feed on fresh organic matter and change it into humus. Chemical weathering changes parent material. Some minerals are destroyed completely. Others are changed into new minerals. Many of the clay-sized particles in soil are actually new minerals that form during soil development.

- Other transformations can change the form of certain materials. Iron oxides (ferric form) usually give soils a yellowish or reddish color. In waterlogged soils, however, iron oxides loose some of their oxygen and are referred to as being reduced. The reduced form of iron (ferrous) is quite easily removed from the soil by leaching. After the iron is gone, generally the leached area has a grayish or whitish color.

- Repeated cycles of saturation and drying create a mottled soil (splotches of colored soil in a matrix of different color). Part of the soil is gray because of the loss of iron, and part is a browner color where the iron oxide is not removed. During long periods of saturation, gray lined root channels develop. This may indicate a possible loss of iron or an addition of humus from decayed roots.

Soil Profiles and Horizons

- Soil formation begins with the breakdown of rock into regolith. Continued weathering and soil horizon development process leads to the development of a *soil profile*, the vertical display of soil horizons.

- The top layer of the profile is the ***O horizon*** which is composed of organic matter. Decomposition of organic matter enriches the soil with nutrients (nitrogen, potassium, etc.), aids soil structure (acts to bind particles), and enhances soil moisture retention.

- Next layer is the ***A horizon*** in which organic material mixes with inorganic products of weathering. The A horizon typically is dark coloured horizon due to the presence organic matter.