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BGGET- 142

Economic Geography

BLOCK 1 INTRODUCTION TO ECONOMIC GEOGRAPHY

- Unit 1 Scope and Approaches
 - Unit 2 Concepts in Economic Geography
 - Unit 3 Economic Activities
 - Unit 4 Economic Development and Disparities
-

BLOCK 2 RESOURCES

- Unit 5 Concept and Classification
 - Unit 6 Natural Resources
 - Unit 7 Minerals and Energy
 - Unit 8 Human Resources
-

Block 3 PRIMARY SECTOR

- Unit 9 Agriculture
 - Unit 10 Animal Husbandry and Fishing
 - Unit 11 Forestry
 - Unit 12 Minerals and Mining Activities
-

Block 4 SECONDARY SECTOR

- Unit 13 Industry and Manufacturing
 - Unit 14 Agro-Based Industries
 - Unit 15 Mineral and Energy Based Industries
 - Unit 16 Factors of Industrial Location
-

Block 5 SERVICE SECTOR

- Unit 17 Commercial Activities and Services
 - Unit 18 Transport and Flow Networks
-

BLOCK 2: RESOURCES

Resources evoke a sense of reserve of valuable asset for human societies and economy. Broadly, resources are of two kinds viz., natural and human resources. First one is something which is made available by the forces of nature in its countless forms and varieties. All of the natural places or geographical regions are not endowed with equal proportion of resources. On the other side, human resources are something that is being cultivated, nurtured and sustained through various measures such like through provision of proper education, health and other developmental parameters.

Resources are made to be a valuable asset through the use of knowledge, as how best to utilise these in a best possible manner so as to augment the nature of economic and commercial activities meant for the betterment and advancement of human societies. Besides, the role of many more factors such as institutional, infrastructural, financial, labour and technological also helps to define the direction of utilisation, under-utilisation, over-utilisation and optimum utilisation of resources. It is not a very difficult task for you to visualise any two such different human societies or we can say nations, which may either correspond to each other or may show a striking contrast in terms of use with comparable set of both natural and human resources. The task of a geographer or spatial scientist fits here as they help us to see the trends, patterns, inter-relationships and areal variations as well as responsible set of factors for the same.

Second Block is divided into four Units that deal with the various kinds of resources.

Unit 5: Concept and Classification

Fifth Unit is devoted to the study of concept of resources. We will describe the classification of resources so as to make you learn, appreciate and relate these with the ground reality.

Unit 6: Natural Resources

Sixth Unit is devoted to the study of natural resources. It will make you learn various primary sets of natural resources. These are land, water, soil and forest etc., which provides the base for the play of spatial economic activities and also sets the limits as how much of these should be utilised in a sustained manner, so as not to jeopardize the aspirations of future generations.

Unit 7: Minerals and Energy Resources

Seventh Unit is devoted to the study of minerals and energy resources. These two are considered as the backbone on which range of industries are based and created in any geographical or administrative region. You will learn about the distribution, utilisation and conservation etc.

Unit 8: Human Resources

Eighth Unit is devoted to the study of Human resources. You will learn about many aspects including size of population, workforce, work participation, employment and unemployment etc., in nutshell.

Our best wishes are always with you to complete this final semester course of your Bachelor's programme successfully.

UNIT 5

CONCEPT AND CLASSIFICATION

Structure

5.1	Introduction		Based on the Renewability of Resources
	Expected Learning Outcomes		
5.2	Concept of Resources	5.4	Conservation and Sustainable Use of Resources
	Nature, Human and Culture Interaction		Need for Conservation and Sustainable Use of Resources
	Functional Theory of Resources		Resource Management
5.3	Classification of Resources	5.5	Summary
	Based on the Availability of Resources	5.6	Terminal Questions
	Based on the Distribution and Frequency of Occurrence of Resources	5.7	Answers
	Based on the Quality, Changeability and Reuse of Resources	5.8	References and Further Suggested Reading

5.1 INTRODUCTION

Can you think of a day in your life without food to eat, clothes to wear, and home where you reside and so on many such day to day essentials? These are the basic needs of any human being. Apart from these basic needs, we use a variety of things for making our lives more comfortable or to increase our standard of living. These materials which satisfy our wants are known as resources. We cannot think about the human survival and progress without resources. Therefore, availability of resources is the basic requirement for human survival, progress and development. But, you might have observed that the area having plenty of resources are also least developed like many parts of Africa, South America and Asia. On the contrary, there are certain countries in the world namely Japan and Singapore where availability of physical resources like mineral and energy are limited but these countries are one of the leading economy in the world. Why is it so? This is because; there are many other factors that are responsible for this. This is due to factors like levels of knowledge, technology and skilled human resources, etc. On the

contrary, today many parts of the world are facing severe crisis due to over exploitation of natural resources like soil, water, air, mineral and energy resources. Over exploitation of these resources leads to scarcity of resources in many parts of the world and has affected quality of life. Hence, there has been dire need for conservation and sustainable use of resources. Otherwise, time is not very far that the survival of life on the Earth would be in danger.

Therefore, we begin our discussion by describing the concept of resources in Section 5.2. In Section 5.3, an attempt has been made to classify resources on various bases. After discussing these, an attempt has been made to explain the need and significance of resource conservation by making sustainable use of resources in Section 5.4.

Expected Learning Outcomes

After studying this unit, you should be able to:

- describe the concept of resources;
- classify resources on various bases; and
- explain the significance of conservation and sustainable use of natural resources.

5.2 CONCEPT OF RESOURCES

As mentioned in the introduction, we must have a clear understanding about the concept of resources. It would help us further classifying resources on various bases. It would also further help us in realising the significance of conservation and sustainable use of natural resources.

After reading the introduction, you might have some idea about the concept of resource. Can you describe what is resource? In simpler terms, the word resource is a combination of two words i.e., 're' and 'source'. This means anything or substance that may occur unhindered many more times. If you look at different English dictionaries like Oxford, Cambridge and Webster for the meaning of word 'resource' the following are the meanings of word resources depicted on the above-mentioned dictionaries.

- a useful or valuable possession or quality of a country, organisation, or person (**Cambridge Dictionary**).
- a supply of something that a country, an organisation or a person has and can use, especially to increase their wealth (**Oxford Learner's Dictionary**).
- something that you can use to help you to achieve something, especially in your work or study (**Macmillan Dictionary**).

Resource can be divided as subjective as well as objective. Subjective resource denotes internal resource, objective resource is external resource. Examples of subjective resources are namely knowledge, skill and scientific temperament etc. Whereas water, forest and minerals etc., are examples of objective resources.

But, if we look at the proper conceptualisation of the term 'resource' then it goes back to the year 1933, when the eminent German economist E. W. Zimmermann published his famous "Concept of Resource" in his book titled **"World Resources and Industries"**. "Resource, popularly, signifies a source or possibility of assistance; an expedient; means of support; means to attain a given end; capacity to take advantage of opportunities and above all that upon which one relies for aid, support or supply (Zimmerman, 1933). The above definitions vary markedly and fail miserably to produce any comprehensive universally accepted meaning of resource. However, after critical examinations and analyses, all these meanings can be grouped into two, i.e., resources may help us if we are: (a) Taking advantage of opportunity and (b) Overcoming obstacles or resistances.

The most popular definition of Zimmermann states that ***"The word resource does not refer to a thing or a substance but to a function which a thing or a substance may perform or to an operation in which it may take part, namely, the function or operation of attaining a given end such as satisfying a want. In other words, the word resource is an abstraction reflecting human appraisal and relating to a function or operation"***.

In other words, a thing or substance is not considered as resource when it fails to give satisfaction to human beings. You might be knowing there are many areas in the world where proven reserves of mineral and energy resources namely coal, petroleum and natural gas has already been identified. However, these proven reserves are not considered as resources because these reserves located in the inaccessible terrain and cannot satisfy human wants. Similarly, geo-thermal energy in this contemporary world is considered to be the most useful resource, but, till recently, this was not considered as resource. This is because human beings were absolutely ignorant about its uses and we did not have knowledge and technology to use it as energy resource in the past. Till now you might have understood that resource must possess two important properties. These two properties are:

- (a) Functional ability and
- (b) Utility.

Therefore, to define anything or substance as resource, it has to be ensured that the above mentioned two properties are being fulfilled. Hence, fulfilling of both the properties namely utility and functional ability is mandatory for resource creation. The functional ability of resources depends on space and time. "Any material which is valuable and useful for humans is called a resource". In fact, "every material has some utility for human beings but its utilisation is possible on the availability of appropriate technology (culturally driven)". We will discuss it in detail while discussing about Functional Theory of Resources in this Section. But before that you should know that as how the interaction between human, nature and culture convert a neutral stuff into resource.

5.2.1 Interaction between Nature, Human, and Culture

Till now, you might have understood that resources are those substances which have some functional ability and utilitarian value. But, have you ever

thought how these resources came into existence. To have a clear understanding about the process of resource creation, we have to understand the interaction among nature, human and culture. These interaction leads to creation of resources. Another two concepts associated with resources are resistances and neutral stuffs. Let us understand these three concepts and their relationships with the help of a diagram.

Resources, Resistances and Neutral Stuffs: Fig 5.1 depicts the trinity of nature, human and culture interactions. If you observe the figure critically, you will find that this figure provides a trilogy of land, labour and capital in the resource formation process. There is a total antagonistic relationship between resource and resistance - like light and shade. This inverse relationship is the key issue in the overall scheme of resource creation. Anything or any process that restricts substance becoming resource is called **neutral stuff**. Fertility of soil is resource but barrenness is resistance. Rain may be considered resource but flood is resistance. In the same manner, knowledge is a key resource while ignorance is the worst type of resistance. In this connection, the concept of neutral stuff has been introduced by Zimmermann. Anything or substance, be it tangible or intangible, should be either resource or neutral stuff. If anything or substance does not contain functional ability or utility value, it is termed as neutral stuff.

A neutral stuff should not necessarily remain neutral forever. What is considered neutral stuff today may transform into resource tomorrow. Man's knowledge, wisdom and technological innovation may transform neutral stuff into precious resource, e.g. petroleum was not considered resource until 1859, because man was quite ignorant about its uses while, with the development of science and technology, it is now considered as a mainstay for harnessing energy.

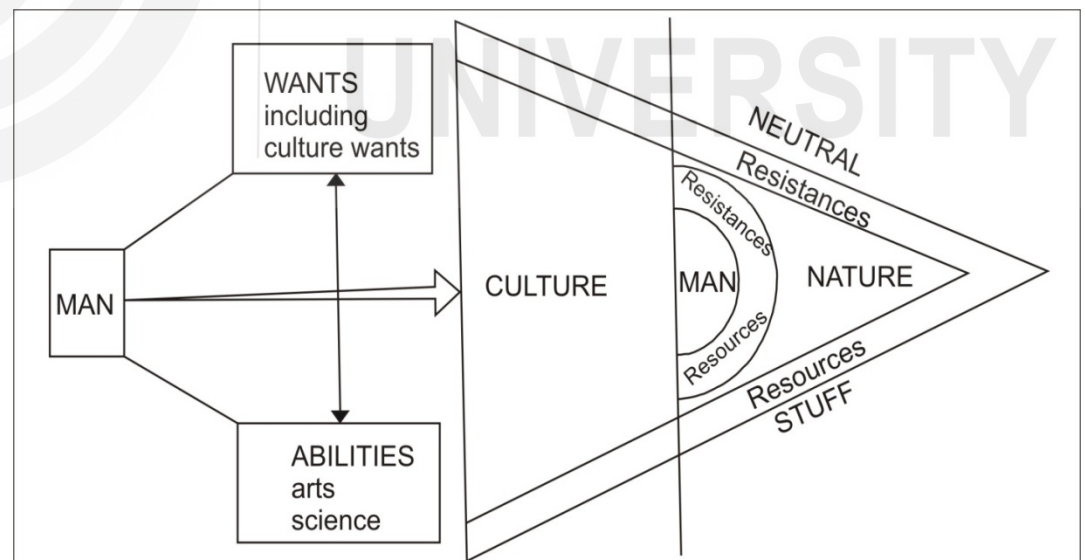


Fig. 5.1: Human, Nature and Culture Interaction.

In this context, let us now explain some more terminologies related to resources which have a very thin line of differences.

- (i) **Stock:** The sum total of mass and energy, both physical and biotic is called the stock.

- (ii) **Reserves:** Reserves are that sub-division of resources which are not available at present for use but technological changes in future will turn them into resources.
- (iii) **Potential Resources:** Potential resources are those resources which can be developed in future. For example, solar energy has vast potential to be developed extensively as power resources in future.

Till now, you might have fair amount of idea about the concept of resource and processes through which a neutral stuff converts into resource. Apart from this, attempt has been made to formulate theory on resources. One of the most popular theory is Functional Theory. Let us discuss briefly about the Functional Theory of resources.

5.2.2 Functional Theory of Resources

This theory of resources postulates three aspects related to resources. These three aspects are:

- (i) Resources are functional and operational;
- (ii) They are human creation; and
- (iii) They are dynamic.

Let us explain these three aspects with examples.

- (i) **Resources are Functional and Operational:** It has been repeatedly mentioned above that resources satisfy human wants and that they are beneficial for human. Thus, the sunlight which is essential for physical growth of human being, the air that human being needs to breathe, the land on which human lives are derived from nature and have been operational ever since the origin of the Earth. On the other hand, many natural elements like rivers, waterfalls, soils and minerals etc., were not operational for human being in their original form. Let us discuss one example. Coal remained as a neutral stuff until human being discovered its utility and began utilizing it. It, then, turned into a resource. Similarly, all the minerals which we are using extensively today were mostly existed as a neutral stuff before industrial revolution. Prior to industrial revolution, human being had very limited knowledge about these minerals, particularly since the beginning of chalcolithic period when human being discovered and developed copper as a resource for making tools and implements. Later on, human being started using iron extensively. Similarly, many non-physical (cultural) elements like technical skills, education, economic policies and planning etc., which are operational, become resources.
- (ii) **Resources are of Human Creation:** Till now, you might have understood the statement 'resources are not they become'. In simpler words, this means natural elements become resources only when they attain capacity to satisfy human wants. For example, the rivers possess the potential for generating hydro electricity ever since the beginning, but they became resources only when human being developed their potential by using technical knowhow. Similarly, coal, petroleum, natural gas and atomic minerals etc., have existed since time immemorial, but they were

lying unused as neutral stuff in the Earth's interior. They became a resource when human being discovered, developed and utilised them as fuel. As discussed in the previous paragraph, the vast deposits of iron ore, copper, tin, lead and zinc, etc., were lying unknown to humans for centuries. Fertile land, forests and animals existed on the Earth for millions of years. But they became resources only when human being started using them for their benefits by using their knowledge and skills. That is why we say resources are human creation.

(iii) Resources are Dynamic: You might have understood from this that resources are not static. We have already explained that these resources have been existing on the Earth surface as neutral stuff. These neutral stuffs have changed into resources by human knowledge, efforts and skills. Thus, human being has been able to expand the stock of resources. For example, human being developed coal as a resource for fuel, coke, tar and nylon etc. Rivers were used for navigation, irrigation, hydro-electricity, etc. What were the driving forces behind converting neutral stuff into resources? Human wants and skills are the driving forces for converting neutral stuffs into dynamic resources. Expansion of arable land down the ages is an example of human being's ingenuity, efforts and skills in utilizing a so-called fixed asset (resource).

If we critically analyse all the resources over time and space, it has been observed that many resources have contracted either due to over-use or misuse. For example, mineral deposits have exhausted and wastelands have been growing on account of their misuse. Indiscriminate felling of trees has resulted in large scale deforestation. A contraction in resources results in expansion of resistances. Wastelands, unproductive soils, destructing floods and epidemics, etc. are the various resistances that are on increase. Thus, resources are dynamic either expanding or contracting.

SAQ I

Fill in the blanks with suitable words.

- (i) Two important properties of resources are _____ and _____.
 - (ii) _____ are that sub-division of resources which are not available at present for use but technological changes in future will turn them into resources.
 - (iii) If anything or substance does not contain functional ability or utility value, it is termed as _____.
 - (iv) _____ are those resources which can be developed in future.
-

5.3 CLASSIFICATION OF RESOURCES

In the previous Section, we discussed about the concept of resource. This will help us in classifying resources into various types. Therefore, in this Section we shall discuss various classifications of resources based on different criteria. We have discussed four major bases for classification of resources. These bases are:

- Availability of resources;
- Distribution and frequency of occurrence of Resources;
- Quality, changeability and reuse of resources; and
- Renewability.

Let us discuss these classifications one by one.

5.3.1 Classification based on the Availability of Resources

This classification was propounded by G.T. Renner in the year 1950. Renner attempted a classification of natural resources to formulate a conservation programme. According to him, natural resources fall into two major categories: (i) inexhaustible and (ii) exhaustible. He further classified these two broad categories, which are discussed below:

1. **Inexhaustible:**
 - (i) Immutable
 - (ii) Misusable
2. **Exhaustible:**
 - (i) Maintainable
 - (a) Renewable
 - (b) Non-renewable
 - (ii) Non-maintainable
 - (a) Reusable
 - (b) Non-reusable

Thus, if we make combination of the above mentioned sub-categories with broad categories of six distinct classes of resources are obtained. Let us discuss these categories briefly.

1. **Inexhaustible and immutable resources:** The oceans, water, solar energy, wind power, climate and gravitation are some of the examples in this category.
2. **Inexhaustible but misusable resources:** This category includes resources namely water, power, surface water bodies, area and space etc.
3. **Maintainable and renewable resources:** Under this category of resources, namely timber, human numbers, land fertility and groundwater etc., are included.
4. **Maintainable but non-renewable resources:** These include physical soil materials, human talents and genius, fish, wild animals and trees etc.
5. **Exhaustible but reusable resources:** They include gems, some non-metallic minerals, and most metals, e.g. iron, tin, copper, gold and silver.
6. **Exhaustible, non-reusable resources:** These include coal, petroleum, natural gas, most non metallic and certain metals.

5.3.2 Classification Based on Distribution and Frequency of Occurrence of Resources

This classification was given by **Zimmermann**. He classified resources into four major categories namely ubiquities, commonalities, rarities and univities. Let us discuss these categories in brief.

1. **Ubiquities:** It refers to the resources which are found everywhere. Examples of this category of resources are oxygen in the air.
2. **Commonalities:** There is a thin line of difference between ubiquities and commonalities. The later one i.e., commonalities occur in many places. Example of this category is tillable soil.
3. **Rarities:** This category of resources is those resources which occur in few places. An example of this category is diamond.
4. **Univities:** This category refers to those which occur in one place. Example of this category is commercial cryolite.

5.3.3 Classification of Resources on the Basis of Quality, Changeability and Reuse of Resources

Owen (1971) classified resources according to renewability of resources into two main categories: (1) inexhaustible, and (2) exhaustible. His classification of resources is based on the quality, changeability and reuse of resources. He has also suggested measures of their maintenance and conservation. The classification is as follows:

1. Inexhaustible resource: solar energy, air and water.
 - (i) Immutable water
 - (ii) Misusable water
2. Exhaustible resources: Fossil, fuels and minerals.

(i) Maintainable	-	Forests, wildlife and fertile soils;
(ii) Renewable	-	Plants, animals and fertile soils;
(iii) Non-Renewable	-	Wild life;
(iv) Non-Maintainable	-	Most of the minerals;
(v) Reusable	-	Precious gems and stones etc; and
(vi) Non-Reusable	-	Coal, petroleum and natural gas etc.

5.3.4 Classification of Natural Resources on the Basis of their Renewability

R.F. Dasmann (1976) has classified natural resources into four types on the basis of their renewability. These are as follows.

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 for reproduction and growth are called renewable resources. As long as the rate of use is less than their rate of regeneration and as long as their environments are kept suitable, they will go on replacing themselves. However, living communities are not necessarily renewable if the way in which we use them is destructive. No living species can survive if we cut it at a rate more rapid than it can reproduce or if we destroy the habitat in which it depends. For example, several animals (live Indian lions) and birds have become endangered species and are facing their extinction because of the destruction of their habitats through deforestation and environmental degradation.
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.

SAQ 2

Match the following:

Types of Resources

- (a) Renewable
- (b) Recyclable
- (c) Inexhaustible
- (d) Non-Renewable

Examples

- (i) Wild Life
 - (ii) Forest
 - (iii) Metal
 - (iv) Sun Light
-

5.4 CONSERVATION AND SUSTAINABLE USE OF RESOURCES

Till now, we have discussed about the concept of resources and classification of resources in the Sections 5.2 and 5.3, respectively. The obvious question that might be bothering you is that “why should we conserve and preserve resources?” As mentioned in the beginning of this unit is that resources are essential for survival and progress of the human civilisation. In the following sub-section, let us discuss briefly about the need for conservation and sustainable use of resources.

5.4.1 Need for Conservation and Sustainable Use of Resources

During the last four hundred years after industrial revolution in general and last hundred years in particular, we have got lots of evidences that the present development activities of this modern era has improved standard of living and quality of life in a significant way. However, these achievements have been lopsided and have produced a lot of global environmental

problems that threatens sustainability of the Earth. Therefore, it has been urgently felt by the people that this needs to be reoriented.

In the context of resources, it has been felt that the consumption and production of resources should be made judiciously both in quantitative and qualitative ways. When we talk about quantitative aspects of resources, we emphasize judicious use of non-renewable resources so that future generation can use it for their sustenance and development. On the other hand, qualitative aspect deals about maintaining standards of those resources which would not affect humans adversely whenever these resources are used. For example, water is a renewable resource. But due to industrialisation, we are dumping and discharging solid and liquid wastes to rivers, lakes, and other available water bodies. As a result of which, fresh water of these water bodies get severely polluted and not fit for any use like the river Yamuna water in Delhi. Although, water is available in Yamuna, but of no use due to its high pollution level. Similar situation is applicable for air, land and soil, etc. Therefore, we have to keep in mind both qualitative and quantitative aspects while planning for conservation and sustainable use of resources. Can you name some of the strategies for rationale use of resources? Some of the strategies are listed below:

- (i) Natural resources in general and of a particular place in specific should be utilised according to the environmental conditions.
- (ii) Care should be taken so that use of natural resources should not have major effect on other essential elements of nature like air, water, soil and forest, etc.
- (iii) Renewable resources should be used keeping in consideration of their replenishment or reproduction rate so that the process of regeneration is continuous.
- (iv) Non-renewable resources should be used judiciously so that these resources can last for a longer period.

5.4.2 Resource Management

Till now, it must be very much clear to you that for a sustainable future Earth, we need a robust mechanism for resource management. Any effective resource management plan has three components. These are:

- (i) Resource Appraisal
- (ii) Resource Evaluation
- (iii) Resource Conservation and Management

Let us discuss each point briefly:

- (i) **Resource Appraisal:** This is the first step in resource management. In simpler terms, it means usefulness of the resources to human being. It seeks to determine whether an aspect of the resource provides or supports or serve as a source of supply of desirable goods and services. Appraisal, therefore, is at the heart of the resource process. The study of appraisal of resources inevitably becomes the study of synthesis of knowledge. According to Zimmermann, understanding and appraisal of

resources are joint responsibilities. The appraisal of resource proceeds from:

- (a) Knowledge of the facts of nature and culture;
- (b) Determination of technical feasibility;
- (c) Determination of profitability; and
- (d) Formulation of a strategy along socio-economic lines.

Resources are dynamic not only in response to increased knowledge, prevailing culture, expanding science, but also in response to changing individual wants and social objectives. Thus, two sets of independent criteria may be distinguished in the appraisal of resources.

1. **The State of Wants:** It includes the expression of human needs, individual wants, social objectives and higher aspirations.
2. **The State of Arts:** The summation of human capacities along lines of both technology and social organisation.

The constant flux in which these two sets of criteria exist, communicates itself to the resources for whose appraisal these criteria apply. Resource appraisal that is, the appraisal of the usefulness of it to human-must be studied from two view points: (1) from the stand point of individual human wants and (2) from that of social objectives. The wants of individual are the foundation of all resource appraisals, but humans seldom live alone. Group life promotes efficiency and security. The resources appraisal of the environment, therefore, must be modified to take these social wants or objectives into accounts.

- (ii) **Resource Evaluation:** After resource appraisal, the next step is resource evaluation. The geographer's contribution to resource evaluation may include providing assistance in mapping the distribution of resources, coordinating the findings of resource specialists; and integrating the natural resource potentials and correlating them with the human resources and the existing economic development. The soil scientist determines the quality, quantify and distribution of agricultural soils, whereas the forester evaluates timber stands and the geologist makes estimates of mineral reserves.
- (iii) To be effective, comprehensive studies of the individual resource evaluation must be correlated, analysed and integrated in a form of presentation that can be utilised by economists, planners and devolvment agencies. The geographer who specialises in resource evaluation plays a key role in resource evaluation by using their tools of spatial analysis through the use of GIS and geoinformatics. The geographers provide the basic maps on real-time basis using remote sensing data which becomes helpful in resource evaluation and analysis.
- (iv) **Resource Conservation and Management:** In the present day world, the expanding technological revolution is building excessive pressure on the utilisation of resources. The allocational and managerial implications of such demands need to be specified. Conservation emerges from an environmentalistic, preservationistic, moralistic and ethical

consideration. Economic growth, population growth and posterity are the most fundamental issues involved with the resource conservation and management.

There is a growing apprehension that the manner in which our resources are being consumed, our very existence will be at risk in the near future. Also, there is a deep and widespread concern that the way in which we are exploiting, using, and indeed wasting resources, despite the substantial conservation steps, is significantly damaging our environment.

Economic growth, the primary objective of all our development plans, has no upper limit. In developing countries like India, where living standards remain low, it is still necessary to ask whether the resources involved have been economically and efficiently employed. Many of the natural resources of our country being finite, they may well be insufficient, even with a static population, to provide the raw material for the kind of economic growth which is specified by our development policy. In the wake of a fast growing population in our country, it seems inevitable that the continuation of our population growth will engulf our abiotic resources and induce a crisis which will eventually destroy us. As trustees of our natural resources, if we fail to manage them judiciously, we will deprive future generations of the economic and social options that we ourselves enjoy and bequeath to them dangers of increased poverty, conflict and pestilence.

We have before us a task of management of resources, concerned with choices. The choice in the interests of posterity should be to use non-renewable resources with a most meticulous care for conservation.

Resource conservation has long been a body of ideas and actions, circumscribed only by what conservationists thought and did. But now, it is one of the themes on which many share a concern involving relationship between man, the materials he uses, and the environment he inhabits (Vasantha Kumaran, 1984). It is because of the fact that conservation results from an attitude towards man's "environment", where environment is taken to mean not only the physical phenomena that comprise his habitat but also resources. Because of the spatial ubiquity, numerical strength and technological outreach of man, the concern of conservation is that of the relationship between population, resources and environment. Since, technology plays a vital role in the development of resources and it should also play an equally important role in the conservation of resources.

SAQ 3

- i) Name the three components of resource management
 - ii) Differentiate between state of wants and state of arts.
-

5.5 SUMMARY

In this unit, you have learnt the following:

- The most popular definition of resource of Zimmermann states that "the word resource does not refer to a thing or a substance but to a function

which a thing or a substance may perform or to an operation in which it may take part, namely, the function or operation of attaining a given end such as satisfying a want. In other words, the word resource is an abstraction reflecting human appraisal and relating to a function or operation”.

- Resources can be broadly divided on the basis of traditional use and on the basis of availability. On the basis of traditional use energy resources can be grouped as conventional and non-conventional whereas on the basis of availability it can be grouped as renewable and non-renewable energy resources.
- Renewable resources are virtually inexhaustible. They are generated with minimal pollution. Renewable energy sources have no fuel costs and are freely available. Switching to clean, renewable energy will bring us cleaner air and water while improving human health and increasing energy security.
- Conservation of resources is urgently required as its excessive consumption is not only costly but also leads to multiple problems. Some of the conservation measures are improving efficiency of resources, wastage prevention, and optimum utilisation of resources, use of clean technologies and more use of renewable resources.
- Some of the strategies for conservation of natural resources are that: natural resources in general and of a particular place in specific should be utilised according to the environmental conditions; care should be taken that use of natural resources should not have major effect on other essential elements of nature like air, water, soil, forest etc; renewable resources should be used keeping in consideration of their replenishment or reproduction rate so that the process of regeneration is continuous; and non-renewable resources should be used judiciously so that these resources can last for a longer period.

5.6 TERMINAL QUESTIONS

1. Define resource. Explain in detail functional theory of resources.
2. Discuss classification of resources given by Renner and Zimmerman.
3. Describe any four strategies for conservation and sustainable use of natural resources.
4. Explain in brief the three components related to resource management.

5.7 ANSWERS

Self-Assessment Questions (SAQ)

1. (i) Functional ability and Utility; (ii) Reserves; (iii) neutral stuff; (iv) Potential Resources
2. a - (ii); b -(iii); c -(iv); d -(i).

3. (i) Resource appraisal, resource evaluation, and resource conservation and management.
(ii) It includes the expression of human needs, individual wants, social objectives and higher aspirations whereas the state of arts refers to the summation of human capacities along lines of both technology and social organisation.

Terminal Questions

1. Your answer should include the definition of resources and detailed explanation on functional theory of resources. Refer to Section 5.2.
2. Your answer should include the discussion on classification of resources as propounded by Renner and Zimmerman. Refer to Section 5.3.
3. Your answer should include the description on any four strategies adopted for conservation and sustainable use of natural resources. Refer to Section 5.4.
4. Your answer should include the brief explanation of the three components dealing with resource management namely resource appraisal, resource evaluation and resource conservation and management. For details refer to Section 5.4.

5.8 REFERENCES AND FURTHER SUGGESTED READING

1. Bharucha, E. (2005). *Textbook of Environmental Studies for Undergraduate Courses*, Hyderabad: Universities Press (India) Private Limited.
2. Gautam, A. (2013). *Geography of Resources: Exploitation, Conservation and Management*. Allahabad: Sharda Pustak Bhawan.
3. Zimmerman, E. W. (1933). *World Resources and Industries*. New York: Harper and Brothers.

NATURAL RESOURCES |

Structure

6.1	Introduction Expected Learning Outcomes	6.5	Management Policies and Strategies for Sustainable Development of Land, Soil, Forest and Water Resources
6.2	Land, Soil, Forest and Water as Resources	6.6	Utilisation and Conservation
6.3	Land Use and Land Cover Classification	6.7	Summary
6.4	Land, Soil, Forest and Water: Degradation and Conservation	6.8	Terminal Questions
		6.9	Answers
		6.10	References and Further Suggested Reading

6.1 INTRODUCTION

In previous Unit of Block 2, you have studied about the concept and classification of resources. In this Unit, you will learn the nature and distribution of land, soil, forest and water resources. In nature, they are all interlinked in many different ways as known to us. You will also learn about land use, land use classification and criteria adopted by international and national agencies. As for soil, you will study the functions as an essential component for the biosphere which includes its role in nutrient cycling, water storage, above ground diversity and biotic regulation. You will learn forest and its role in keeping the health of our environment through regulating water cycles, maintaining soil quality and reducing natural disasters. Our society depends on water and you will learn how fundamental water resources are important to national and local, social, ecological and economic well-being, and in sustaining life on Earth.

In this Unit, therefore, you will learn the basics of land, soil, forest and water as resources and how improper land use and water utilization could lead to land degradation and water contamination/pollution in Section 6.2. You will also learn about the judicious use of land and water resources by understanding the concept of conservation. This will help you to interpret the need for land and water policies and how at international, national and state levels these policies help in the development and conservation plans. In

Sections 6.3 and 6.4, you will study and learn about land use classification, land, soil, forest and water quality degradation and conservation. Management policies and strategies for sustainable development of land, soil, forest, and water resources are explained in Section 6.5. Last Section 6.6 discusses the utilisation and conservation of these resources.

Expected Learning Outcomes

After studying this unit, you should be able to:

- describe the nature of distribution of land, soil, forest and water resources;
- explain the importance of land, soil, forest and water as resources;
- explain why classification of land use is necessary and the criteria used in land use classification;
- discuss how overuse of these resources could lead to environmental degradation and pollution; and
- analyse the significance of resource conservation and its approaches towards sustainable development of resources.

6.2 LAND, SOIL, FOREST AND WATER AS RESOURCES

Land is part of the Earth's crust and is the surface of the continental plates. Soil and forest thrive on this surface and makes human life possible. Soils are like sponge, absorbing, retaining and releasing, and also modify and purify most of the water in the land. One of the major functions of the soil is to process recycled nutrients, including carbon, allowing living things to use it for their sustenance. Food and Agriculture Organization (FAO) of the United Nations (UN) estimates that forests shelter three to one hundred million plants and animals on land. Planet Earth, which is probably the only habitable planet in the entire Universe, is made up mostly of water (70.8 percent) and land (29.2 percent) as shown in Fig. 6.1.

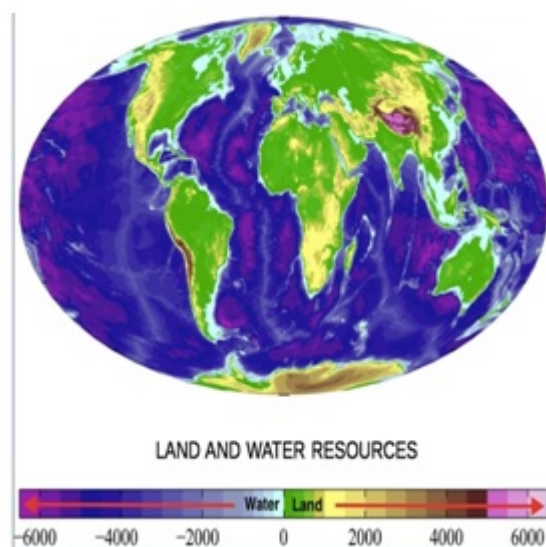


Fig. 6.1: Distribution of Land and Water Resources on the Globe.

(Source: http://commons.wikipedia.org/wiki/File%3AYool_topography_15min.png)

The 29.2 percent landmass consists of habitable land, waste land, desert, wet land, forest land, badland and frozen land. According to FAO, forests are the “Land with a tree canopy cover of more than 10 percent and area of more than 0.5 hectares” (see Fig. 6.2).

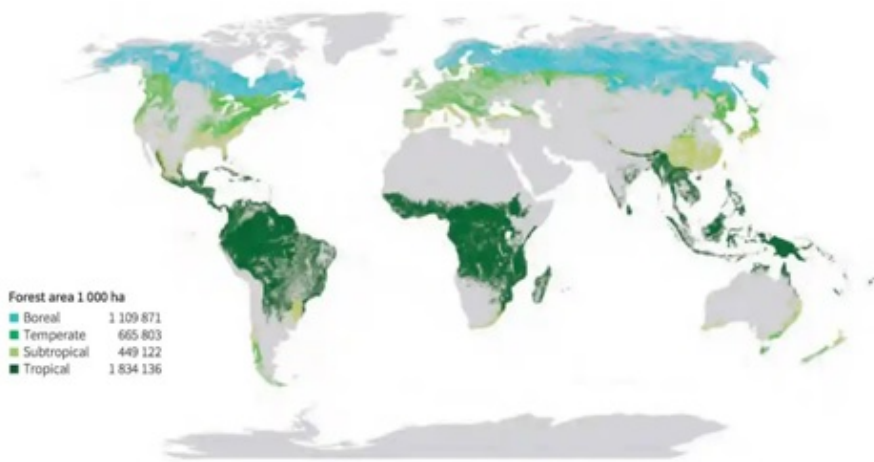


Fig. 6.2: World Distribution of Forests.

(Source: Adapted from United Nations World map, 2020)

Although, three-fourth of the Earth is covered with water, there is only 2.5 percent of freshwater available that help the entire humanity of 7 billion people and the requirements of all other living species of plants and animals (see Fig. 6.3). We all know that these natural resources i.e., land, water, soil and forest are finite resources.

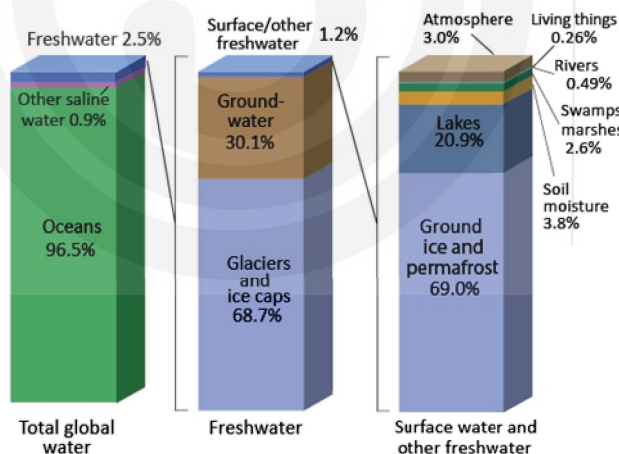


Fig. 6.3: Availability of Water Resources.

(Source: <https://water.usgs.gov/edu/gallery/watercyclekids/earth-water-distribution.html>
Downloaded from Wikimedia Commons, the free media repository)

As we know that portion of the Earth which is not permanently submerged in water is land. Land is a major and yet, a finite natural resource and land is open to competing demand from increasing urbanisation, industrialisation, tourism and recreation, and host of other processes and economic activities. However, the lands that are under tremendous pressure are those habitable parts of it. A larger share of land is uninhabitable stretches of barren, wet, frozen, arid or badlands. To a large extent, geographical attributes of habitability could be influenced by the types of land. Mathew and Herbert (2004) cite the example of how, in the 19th century, “the name ‘Great

American Desert' which spread over much of the central USA west of Mississippi, was populated by railway companies and land speculators attracting settlers, with a more attractive sounding 'Great Plains', although physical conditions remained unfavourable".

Major determinants of habitability of the planet Earth are climate, topography, soil, vegetation and water availability. Increasing natural resource scarcity stemming from unchecked growth of population was a major concern for the early classical economists namely Adam Smith, Robert Malthus, David Ricardo and John Stuart Mill. Neoclassical economies viewed and claimed physical assets that are abundant in land such as mineral deposits, oil, forests, prime properties, bio-productive lands and potable water are all resources of the land that are developed for the benefit of human well-being and not based on equitable distribution (read Alfred Marshall and J. M. Keynes). According to White (2007), "Overlooking scale (economic scale in relation to the ecosystem) has allowed the neo-classical paradigm to avoid the potential conflict between economic efficiency and just distribution by advocating that economic growth will lead to a rising standard of living for all, and therefore should be pursued without regard to distribution". The basic assumption of neo-classical paradigm focuses on how market forces determine the quantity, quality and price of goods and services that are sold in a market. Neo-classical economics failed to address the issues of sustainability as they did not take into account the factors of environmental irreversibility such as rapid urban growth nor did they take notice of cultural, institutional and religious factors, thereby, failing to address reality. For a proper understanding of land, soil, forest and water as resources, you need to take into account various disciplines apart from Geography. These include Urban, Town and Country Planning, Regional Planning, Sociology, Biogeography, Ecology, Pedology, Environmental Law and almost every discipline in the organization of knowledge.

You learned in the earlier Section that land, soil, forest and water as resources are under competing demand and therefore, under tremendous pressure. Foremost among them is the pressure exerted by the growing population. World population continue with its upward trend, adding roughly a billion people a decade, adding more pressure on the finite land resource. It is estimated that there will be 9 billion people inhabiting the planet by year 2050. This would mean increasing demand and thereby production of food. Current estimates of arable land are only 1.5 billion hectares (see Fig. 6.4).

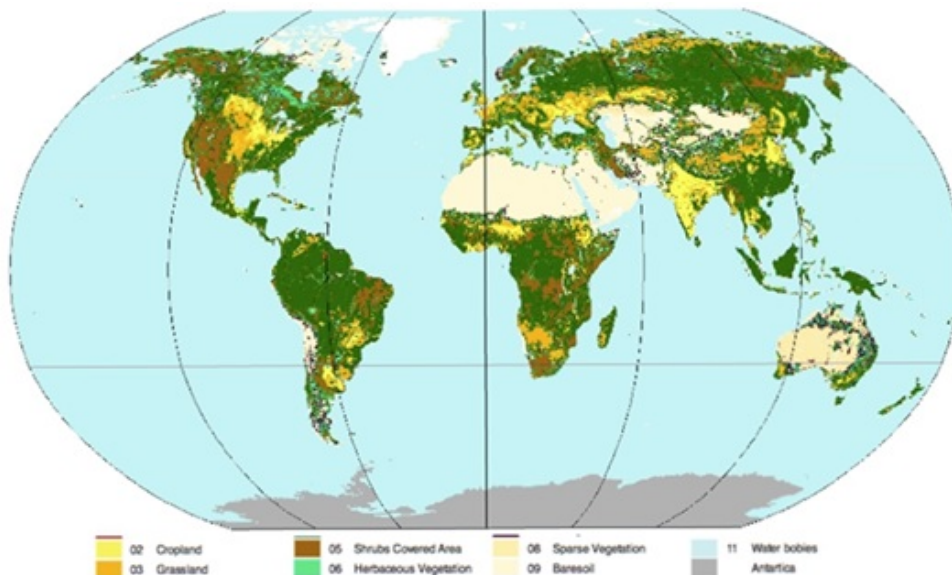


Fig. 6.4: Distribution of different Land Cover Types of the World.

(Source: John Latham, Renato Cumani, Ilaria Rosati and Mario Bloise, 2014; Global Land Cover (GLC-SHARE) Beta Release 1.0 Database, Land and Water Division, FAO, Rome)

The major challenge for nations was to identify, measure and record efficiently a good global overview of land cover. Recognising this challenge, United Nation's Food and Agriculture Organization (FAO) developed a reliable global database, so as to assess and monitor the Earth's land and water resources to support food security and early warning system. This includes eleven global land cover layers each representing the major land cover classes defined by the FAO and System of Environmental-Economic Accounting (SEEA) legend. While demand for increased food production exerted pressure on limited land, soil, forest and water resources, industrialisation added pressure for mineral extraction and power supply and development of infrastructure.

Intensification of food production, mining and industrialisation had a spatial spread horizontally while increasing urban population demanded more habitations and restrictions on encroaching into agricultural land led many urban centres to start vertical expansion. Present day metropolis and megalopolis are testimony to this expansion.

SAQ I

Why land, water, soil, and forest are important as resources?

6.3 LAND USE AND LAND COVER CLASSIFICATION

The link between human interaction and land resource is expressed in different types of land uses. Study of diverse types of land use land cover will enable you to understand the real world problems. For the purpose of classification, you need to understand different types of land resources that exist within the given area. Land resources include agricultural land, fallow land, forest land, residential, recreational, commercial land, industrial land,

barren land, waste land and landfill sites, wetland and water bodies. The list is exhaustive and it indicates the human activities that are taking place over these types of land – agriculture, mining, fishing, urbanisation, industrialisation, tourism and so on.

Early land use classifications were simple exercises of demarcating transition lines between 'classes of lands suitable for various kinds and intensities of farming' (Van Kooten, 2011), also applying inductive techniques to land classification. Later, mining sector had a major impact on land which is determined by the area acquired and land use characteristics. Before we proceed to defining and understanding land use classification system, it is important for you to distinguish between land use and land cover. Land use is defined in economic terms and land cover in terms of visible features which may often are natural features. It is, however, important to distinguish between these two for the purpose of policy analysis and decision making. Since land use statistics hold the key to reflect the intensity of human activities directly related to land.

Classification at International Level: At International level, it is hard to have a classification that could serve as a reference system applicable ubiquitously. However, universally applicable land cover classification system that is currently operational regardless of data source, economic sector or country is the Land Cover Classification System (LCCS) developed by FAO. The purpose of developing the LCCS is to “meet the need for improved access to reliable and standardized information on land cover and land cover change” (FAO, 2005). Keeping in mind of the future generations, developing a sustainable land use system is imperative. LCCS defines land cover as “the observed bio-physical cover on the Earth’s surface, and, in addition, it is considered as a geographically explicit feature that other disciplines may use as a reference (e.g., for land use, climatic and ecological studies)”. In LCCS, there are two standard terms which is used 1) Variable Minimum Mappable Area and, 2) Mixed Mapping Units.

Minimum Mappable Area is a scale dependent smallest area that can be visualised in a map. The representation of different sizes for different features can be depicted with varying importance by Variable Minimum Mappable Area. Mixed Mapping Units helps you “to develop a particular legend that reflects both parameters of scale and inherent characteristics of the area”. Classification of natural and semi-natural vegetation is determined by two parameters – Life Form and Dominance. Life Form is based on its physiognomic aspects (Trees, Herbs and Shrubs, Lichens and Mosses) and Dominance is defined by the uppermost canopy layer. In case of cultivated areas, LCCS uses physiognomic-structural classification – based on the structure of vegetation which ensures compatibility with existing agricultural classification systems (see Table 6.1).

Table 6.1: Land Cover Classification System (LCCS)

Label No	Label	Description
1	Tree Cover, Broadleaved Evergreen, Closed to Open (>15 percent)	Broadleaved Evergreen Closed to Open Trees

2	Tree Cover, Broadleaved Deciduous, Closed (>40 percent)	Broadleaved Deciduous closed to Open (100-40 percent) Trees
3	Tree Cover, Broadleaved Deciduous, Open (15-40 percent)	Broadleaved Deciduous (20-10 percent) Woodland
4	Tree Cover, Needle-Leaved Evergreen, Closed to Open (>15 percent)	Needle-leaved Evergreen Closed to Open Trees
5	Tree Cover, Needle-Leaved Deciduous, Closed to Open (>15 percent)	Needle-leaved Deciduous Closed to Open Trees
6	Tree Cover, Mixed Leaf Type, Closed to Open (>15 percent)	Broadleaved Closed to Open Trees/ Needle-leaved Closed to Open Trees
7	Tree Cover, Closed to Open (>15 percent), regularly Flooded, Fresh or Brackish Water: Swamp Forests	Closed to Open Broadleaved Evergreen Trees on Permanently Flooded Land Water Quality: Fresh Water/Closed to Open Broadleaved Evergreen Trees on Permanently Flooded Land Water Quality: Brackish Water/Closed to Open Broadleaved Evergreen Woodland on Temporarily Flooded Land. Water Quality: Fresh Water/ Closed to Open Broadleaved Evergreen Woodland on Temporarily Flooded Land/Water Quality: Brackish Water
8	Tree Cover, Closed to Open (>15 percent), regularly Flooded, Saline Water: Mangrove Forests	Broadleaved Evergreen Trees on Permanently Flooded Land (With Daily Variations) Water Quality: Saline Water
9	Mosaic of Tree Cover and other Natural Vegetation (Crop Component Possible)	Closed Trees/ Natural and Semi-Natural Primarily Terrestrial Vegetation/ Cultivated and Managed Terrestrial Area(s)
10	Shrub Cover, Closed to Open (>15 percent), Evergreen (Broadleaved or Needle-Leaved)	Broadleaved Evergreen Closed to Open Thicket/Needle-leaved Evergreen Closed to Open Thicket
11	Shrub Cover, Closed to Open (>15 percent), Deciduous (Broadleaved)	Broadleaved Deciduous Closed to Open Thicket
12	Herbaceous Cover, Closed to Open (>15 percent)	Herbaceous Closed to Open Vegetation
13	Regularly Flooded (> 2 Month) Shrub Or Herbaceous Cover, Closed to Open	Closed to Open Shrubs on Permanently Flooded Land/Water Quality: Fresh Water/ Closed to Open Shrubs on Permanently Flooded Land Water Quality: Brackish Water/ Closed to Open Shrubs on Temporarily Flooded Land. Water Quality: Fresh Water/

		Closed to Open Shrubs on Temporarily Flooded Land. Water Quality: Brackish Water/ Closed to Open Herbaceous Vegetation on Permanently Flooded Land Water Quality: Fresh Water/ Closed to Open Herbaceous Vegetation on Permanently Flooded Land
		Water Quality: Brackish Water/ Closed to Open Herbaceous Vegetation on Temporarily Flooded Land Water Quality: Fresh Water/ Closed to Open Herbaceous Vegetation on Temporarily Flooded Land/Water Quality: Brackish Water
14	Cropland (Upland Crops or Inundated/Flooded Crops e.g., Rice)	Cultivated and Managed Terrestrial Area(s)/Cultivated Aquatic or Regularly Flooded Area (s)
15	Mosaic of Cropland/Tree cover/Other Natural Vegetation	Cultivated and Managed Terrestrial Area(s)/Closed to Open Trees/ Natural and Semi-Natural Primarily Terrestrial Vegetation
16	Bare Areas	Bare Area (s)
17	Water Bodies (Natural or Artificial)	Artificial Water bodies/Natural Water bodies
18	Snow or Ice (Natural or Artificial)	Artificial Snow/Artificial Ice/Snow/Ice
19	Urban Areas	Built-up Area (s)
20	Tree Cover, Burnt (mainly Boreal Forests)	Closed to Open Trees
21	Sparse Herbaceous or sparse Shrub Cover	Herbaceous Sparse Vegetation/Sparse Shrubs
22	Mosaic of Cropland/Shrub or Herbaceous Cover	Cultivated and Managed Terrestrial Area (s)/Closed to Open Shrub land (Thicket)/Herbaceous Closed to Open Vegetation

(Source: Compiled from "Land Cover Classification System. LCCS: Classification Concepts and User Manual". Food and Agriculture Organization of the United Nations, 2005)

Classification at National Level: India has a total land area of 3,287 million square kilometre. Managing India's land poses many challenges. Population densities in the country have been on the rise – from 140 in 1961 to 382 in 2011 persons per square kilometre. With increasing rate of population, urbanization is on rapid rise. With three-fourth of the rural population dependent on agriculture, land is an essential requirement. National Forest Policy of 1952 stipulates State governments to ensure 33 percent of land area to be afforested or brought under forest cover. Development strategies that the country adopted demand land, particularly for the infrastructure that is promoted to expand rapidly. Consequently, industrialisation, particularly manufacturing and mining tends to become intense and extensive. For all these, land is an essential requirement. When land for development encroach into social, cultural and environmental space, there would be conflicts such as infrastructure development over natural heritage area, mining in reserved natural vegetation zones, tourism in coastal regulated zone and many more

such development that demand land. In terms of legal status, **Seventh Schedule** of the Constitution of India (Entry No.18 of the State List), “land including assessment and collection of revenue, maintenance of land records, land management and alienation of revenue, etc. fall under the purview of the State Governments”. It is the State Government's responsibility to ensure that proper land utilisation plans are made and implemented. State Governments, in turn, as per **Article 243ZD (1)** of the Constitution, constitutes district level District Planning Committee (DPC) to consolidate plans prepared by Panchayats and Municipalities at lower administrative levels. Constitutional amendments to article 73 and 74 of the Indian Constitution empowered local governments to plan proper land use based on sound scientific and technical procedures with correct land utilisation strategies supported by people's participation. Planning land use implies a procedure so as to assess the physical, socio-economic, cultural, institutional and legal constraints and evaluation of the development potential of the land that may help in decision – making process.

Land Use and Land Cover Classification (LULC) in India: Although, LULC classifications are tailor-made as per objectives of the end user, some standard criteria are used broadly in the classification systems (Anderson et al., 1976). This includes:

- Minimum level of interpretation accuracy (at least 85 percent), if remote sensing data is used.
- Accuracy of interpretation should be equal if several categories are used.
- Repetitive results should be available.
- Ensure that LULC classification can be applied to extensive areas.
- Categorisation should be broad enough to allow different types of land cover to be shown as activity.
- Classification should be suitable for repetitive data over different time periods.
- High resolution remote sensing data and ground surveys provide details for sub-categorisation.
- It should be possible to aggregate different categories.
- Possibility to compare land use changes that happen in the future.
- Possibility to recognise multiple uses of land.

Based on the above criteria, broad classes are proposed by prestigious National Remote Sensing Centre (NRSC) situated at Hyderabad (refer to Table 6.2).

Table 6.2: Land Use and Land Cover Classification (LULC)

S. No.	Level 1	Level 2	Description
1	Built-up	Urban	Residential, Mixed built-up, Public / Semi-Public, Communication, Public Utilities/Facility, Commercial, Transportation, Reclaimed Land, Vegetated Area, Recreational, Industrial, Industrial/Mine Dump, Ash/Cooling Pond
		Rural	Rural

		Mining	Mine/Quarry, Abandoned Mine Pit, Landfill area
2	Agriculture	Crop land	Kharif, Rabi, Zaid, Double cropped, More than Double cropped
		Plantation	Plantation – Agricultural, Horticultural, Agro-Horticultural
		Fallow	Current and Long Fallow
		Current Shifting Cultivation	Current Shifting Cultivation
3	Forest	Evergreen/Semi-Evergreen	Dense/Closed and Open category of Evergreen/Semi-Evergreen
		Deciduous	Dense/Closed and Open category of Deciduous and Tree-Clad Area
		Forest Plantation	Forest Plantation
		Scrub Forest	Scrub Forest, Forest Blank, Current and Abandoned Shifting Cultivation
		Swamp/Mangroves	Dense/Closed and Open Mangroves
4	Grass/Grazing	Grass/Grazing	Grassland: Alpine/Sub-Alpine, Temperate/Sub-Tropical, Tropical/Desertic
5	Barren/Uncultivable/Wastelands	Salt Affected Land	Slight, Moderate and Strong Salt Affected Land
		Gullied/Ravineous Land	Gullied, Shallow Ravine and Deep ravine area
		Scrub land	Dense/Closed and Open category of Scrub Land
		Sandy Area	Desertic, Coastal, and Riverine Sandy Area
		Barren Rocky	Barren Rocky
		Rann	Rann
6	Wetlands/Water bodies	Inland Wetland	Inland Natural and Inland Man-made Wetland
		Coastal Wetland	Coastal Natural and Coastal Man-made Wetland
		River/Stream/Canals	Perennial and Dry River/Stream and Line and Unlined Canal/Drain
		Water Bodies	Perennial, Dry, Kharif, Rabi and Zaid extent of Lake/Pond and Reservoir and Tanks
7	Snow and Glacier		Seasonal and Permanent Snow

(Source: NRSC (2006), Land Use/Land Cover Database on 1:50,000 scale, National Remote Sensing Centre, ISRO, Hyderabad, India)

SAQ 2

What is land use classification?

6.4 LAND, SOIL, FOREST AND WATER QUALITY DEGRADATION AND CONSERVATION

In the previous Section 6.3, you have learnt about the land use and land cover classification. In this Section, you will study about degradation and conservation of these resources.

Degradation of Natural Resources

Land, soil, forest and water are shrinking and depleting resources. Agricultural and industrial activities and also, everyday life of human beings have had serious impact on land, soil, vegetation and water. All over the world, a good percentage of agriculture or natural land disappears every year as a result of conversion into built-up areas. Intensification of agriculture with increased use of chemical fertilisers and additional use of pesticides and herbicides degrade land and pollute the water resources. Soil, when degraded does not provide the goods and services to the ecosystem and losses all of its nutrients. However, subsistence farming and small holding cultivations had a minimum impact. With mechanisation and increased pressure for maximising production, large scale, extensive as well as intensive farming started taking place. Wealth distribution became skewed. Capitalisation of agriculture leads to land alienation of the majority. Those who owned large holdings often lived far away in cities with hardly any attachment to land. These lands, over a period of time, are affected by degradation resulting into the loss of ecosystem services.

Millions of species of plants and animals that populate the Earth survive from Sun's energy directly or indirectly (plants directly and animals feeding on plants, predation and parasitism or decomposition indirectly), along with water and nutrients. Linkages between animals and plants and their environment are often through competition, predation, parasitic and facilitative ways such as pollination, dispersal and provision of habitat. This forms the **ecosystem**, where humans are one of the components and like all other species; humans too depend on ecosystem properties and on above said network of interactions among organisms. The benefits that humans derive from ecosystems are called ecosystem services. According to Daily (1997), "Ecosystem services are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life. They maintain biodiversity and the production of ecosystem goods, such as seafood, forage timber, biomass fuels, natural fibre and many pharmaceuticals and industrial products". Another equally important definition of ecosystem services is given by Constanza et al. (2008), "Ecosystem goods (such as food) and services (such as waste assimilation) represent the benefits humans derive, directly or indirectly, from eco-system functions".

Forty two percent of India's geographical area is already under different agricultural land use and further expansion for agriculture use could degrade already fragmented forests of the remaining areas. Forest Survey of India (FSI) estimates that 23.48 percent of the country's geographical area is under forest cover. And, fragmented nature of forests is under threat of further degradation due to other modern technology driven developmental activities. Both unsustainable land use practices and over-exploitation of land poses a threat to India's precious land and its associated resources.

Water is considered as elixir of life to both flora and fauna along with human beings. It is a renewable natural resource, which is unique and irreplaceable. Three-fourth of the planet is covered with water – in oceans, rivers, lakes and ponds – and also in solid form (ice and snow) in the higher latitudes and

altitudes. Most of the planet's available water is found in the ocean whereas fresh water is stored in the glaciers or in underground water channels. It's only a tiny fraction that is found in streams, lakes, wetlands and the atmosphere. In fact, water keeps on continually cycling between land, ocean and atmosphere. It is made possible through the processes of transpiration, evaporation, condensation and precipitation.

If removal of forest cover for cultivation had a minimal impact on land, deforestation for timber, building materials and as raw material for paper, pulp and other forest-based industries had a larger impact on land degradation. This is all the more severe when the forests are cleared from mountain slopes and steep gradients, exposing top soil to erosion from natural processes of weathering and erosion. Heavy rainfall on a vegetation-cleared slope would trigger diverse types of erosion, including splash, rills, gullies and sheet erosion. Sometimes entire land may slide down in the form of slope failure, which has started occurring in case of some mountainous areas of the world, in recent times.

In the recent past, it is known that land is put to intense misuse than proper and optimum use for various anthropogenic purposes. Examples of this could be found in poorly managed land-fills, garbage dumps, mining locations and untreated discharge of urban and industrial waste. Mining and industrial development activities can increase pollutant loadings in land and water, particularly, pathogens, household chemicals, metals, fertilizers, pesticides, oil and grease. This in turn, increases the concentrations of pollutants that may negatively impact surface and ground waters over longer periods of time, if left untreated.

Apart from human induced degradations of land, soil, forest and water resources, natural forces is also known to accentuate the process of land degradation. Climate change due to global warming and resultant rain induced landslides in part of the Western Ghats and Himalayas in the recent past stand testimony to such event. With the changing weather patterns due to climate change, intense rainfall or drought have intensified flooding, particularly near the coasts as sea-level shows fluctuating trends. Scientists predict that many areas will experience more frequent, intense storms and subsequent coastal flooding and submergence. This would impact much larger share of population, who may suffer owing to lack of access to water sources.

In the 1950s and 1960s, the rapid pace of industrialisation and economic growth in the western world led to an increase in human activities and a corresponding rise in environmental pollution. Warnings of Rachel Carson through her pioneering work, *Silent Spring*, published in 1962 had created a worldwide impact. *Silent Spring* brought out shocking reality of the impacts of pollution which were till then not obvious enough to people and politicians. That was the period when "development and growth through maximising economic productivity" to make up for the ravages of the Second World War was considered the priority. "To many politicians and voters, pollution and environmental degradation were regarded as a necessary price for economic growth and this was a price worth paying" (Carson, 1962).

Management Strategies to Conserve Land, Soil, Forest, and Water Resources

The United Nations defines Sustainable Land Management (SLM) as “the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions” (FAO, 2022). How is this done in practice? First and foremost step is to recognise the productivity and sustainability of a land-use system. This can be determined by understanding the interaction between land resources, climate and human activities. FAO outlined and gave broad guidelines to develop management strategies in order to conserve land resources on the basis of following principles:

- targeted policy and institutional support, including the development of incentive mechanisms for SLM adoption and income generation at the local level;
- land-user-driven and participatory approaches;
- the integrated use of natural resources on farms and at the ecosystem scale; and
- multi-level, multi-stakeholder involvement and partnerships at all levels – land users, technical experts and policy-makers.

Based on these guiding principles, the Department of Land Resources, in the Ministry of Rural Development, Government of India ensures optimum utilisation and sustainable productivity of rain fed/degraded lands. Moreover, The Constitution of India allows the Centre and the States to legislate laws to preserve and conserve natural resources. “The eleventh schedule (Article 243-G) of the constitution lists matters pertaining to land improvement, implementation of land reforms, land consolidation, soil conservation and watershed development and management under the authority and responsibility of Panchayats” (Babu and Nautiyal, 2013). Making use of this provision, various departments under the Centre and the State ministries developed Land Information Systems (LIS) and Land Resource Management System (LRMS). This helps develop appropriate management strategies to enhance the productivity, arrest land degradation and enhance livelihood opportunities. It would also help to put in place effective agrarian reforms such as efficient land use policies and upkeep land records.

6.5 MANAGEMENT POLICIES AND STRATEGIES FOR SUSTAINABLE DEVELOPMENT OF LAND, SOIL, FOREST AND WATER RESOURCES

United Nations (UN) defines sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Seventeen goals were adopted by all UN Member States in 2015, as part of the 2030 Agenda for Sustainable Development. These are:

- 1: No Poverty
- 2: Zero Hunger
- 3: Good Health and Well-being
- 4: Quality Education
- 5: Gender Equality
- 6: Clean Water and Sanitation
- 7: Affordable and Clean Energy
- 8: Decent Work and Economic Growth
- 9: Industry, Innovation and Infrastructure
- 10: Reduced Inequality
- 11: Sustainable Cities and Communities
- 12: Responsible Consumption and Production
- 13: Climate Action
- 14: Life Below Water
- 15: Life on Land
- 16: Peace and Justice Strong Institutions
- 17: Partnerships to Achieve the Goals.

Ministry of Water Resources, Government of India has declared water week during 12th to 17th January, with the slogan “hamara jal, hamara jeevan” encouraging entire nation to celebrate and bring awareness to the needs of conserving water.

To achieve these goals, member nations agreed to develop national sustainable development strategies. World Water Council (WWC) is a network of international multi-stakeholder platform that work towards to create new synergies and propose innovative solutions. Its mission is to promote awareness, build Nation States political commitment and prompt action at highest decision-making levels to conserve, protect, develop, plan, manage and utilise natural resources in the most sustainable ways. With the council's sustained efforts, Water is being acknowledged as a worldwide priority. During the Rio Summit, a sustainable development dialogue was solely dedicated to Water.

Agriculture is the largest consumer of land, soil, forests and water in the world, accounting for removal of natural forest cover and 70 percent of total water withdrawals. Second largest consumption happens in urban areas. Increasing urbanization takes a toll on natural vegetation, degrade the soil and contaminate surface and sub-surface water. Many cities of the developing world are already facing acute water shortage. Lack of proper urban planning further accentuates this problem. Urban water management require careful planning – from planning an early development of compact settlement to conservation of water sources with use of multiple water sources that include rainwater harvesting, storm water management, and wastewater treatment and reuse.

Quantity, quality and availability of adequate quantities of water depend on healthy forest cover and soil ecosystems and are considered as an ecosystem service. Unfortunately, ecosystem services are being altered to a large extent and compromised worldwide. Submerging extensive forest tracts and thereby soil, impounding large quantities of water for hydropower generation and irrigation purposes through building large and medium dams across rivers is a critical issue due to concerns of growing conflicts between various interest groups.

While forest over land maintains and conserve soil, water that is received from rain and moisture interception keeps a steady flow in the form of rivers,

lakes, estuaries, and other water bodies, soils and aquifers through the environment. In order to sustain the continued human consumption, soil and forests need to be managed and is known as natural resources management. Management also involves protecting forest, conserving soil and capturing the waste water for treatment and safe discharge or reuse. Most countries have developed regulation and legislation in natural resource use and conservation. In India, management of land, soil, forest and water is a state subject. Since 1970's, one of the key planning strategies as reflected in the fourth five-year plan has been sustainable development. For sustaining production, land, soil, forest and water need to be protected from degradation and pollution with long-term conservation objectives. Inter-state water sharing disputes are resolved at National level by Central Water Commission (CWC), which is a technical organisation that functions under the Ministry of Water Resources, Government of India. The Commission's responsibilities include initiating, coordinating and furthering schemes for control, conservation and utilization of natural resources, in consultation with the State Governments concerned. It is required for the purpose of land management against landslides, forest and soil conservation, flood control, irrigation, navigation, drinking water supply and hydro-power development.

Integrated Natural Resources Management (INRM): Ecological and hydrological cycles are highly dynamic in nature and are interlinked with how people use them. Since it has ecological, environmental, social, political and economic implications, an INRM involves planning and management of land, soil, forest and water with all of its environmental parameters. It inevitably aims to create equitable, efficient and sustainable use. INRM objectives derive its strength from UN Council for Environment and Development (UNCED) principles which are four-fold: 1) that water and land must have integrated management strategies; 2) that water to be managed at the lowest appropriate governance level; 3) that allocation of water should take into account all the stakeholders; and 4) water should be recognized as an economic good.

Majority of India's growing population depends on these natural resources. Unfortunately, natural resources have started depleting and degrading at an alarming rate primarily on account of unscientific anthropogenic practices. INRM is an attempt to reverse the process of degradation through the enactment of certain strategies such as watershed-based approach. This approach attempts to bring about a balance in environment between natural resources and its use by people.

SAQ 3

List the types of land use and land cover based on NRSC classification system.

6.6 UTILISATION AND CONSERVATION

Till now, you have studied about the land, soil, water and forest as a resource and their degradation and conservation. In this Section, you will study about the utilisation and conservation of these resources.

6.6.1 Trends in Utilization and Conservation of Water, Land, Soil and Forest Resources

Population has been growing rapidly on one hand while the water, land, soil and forest resources have been degrading at an alarming rate on the other hand. FAO on its synthesis report (2021) on the state of the world's resources provided extensive information on the status of land, soil and water resources. It has provided evidence of alarming trends in resource use. As the trend in population numbers continue to rise, demand for food kept increasing. It is projected that food production will increase to hundred percent in developing economies (FAO, 2011). Increased competition in the utilisation of water, land, soil and forest resources poses increased vulnerability to food insecurity. Therefore, it creates challenges for nations to cope up with it. United Nations Environment Program together with World Wildlife Fund commissioned World Conservation Strategy (WCS), which presents a statement of "agreed conservation requirements and priorities". WCS aims to explain the importance and contribution of living resource conservation that is essential for human survival and to sustain development. It identifies issues and requirements that help to deal with the conservation strategies. FAO urges member nations to adapt to environmentally responsible and climate smart production systems. This is needed with an aim to reverse the ongoing trends in the deterioration of water, land, soil and forest resources and also promote inclusive growth. Their strategic framework is: "better production, better nutrition, a better environment and a better life" (FAO, 2021). Institutional and technical guidelines to address the increasing need for arable land and water and soil health is built on integrated approaches. The examples of such approaches are sustainable land management (SLM), sustainable soil management (SSM) and integrated water resources management (IWRM).

Many nations including India has put in place, policies, practices and technologies, which is required to conserve natural resources and boost production systems and strengthen food security. Facilitating finances and prioritising institutional arrangements while ensuring sustainability is given a major thrust in the planning processes. Measures to increase agricultural output and thereby strengthening food security are carried out with pro-poor, market-friendly policies and management practices. In order to increase output, the strategy adopted in India includes proper soil management systems that would ensure healthy soils and ecosystem services and prevent resource degradation. Following on the global trends in conservation agriculture, India adopted sustainability principles of efficient use of water, reduced use of agro-chemicals, improved soil health, adapt to climate change and doubling the farmer's income. Given India's huge population numbers, it was inevitable that the pressure on water, land, soil and forest resources to produce more from less lands and through use of additional inputs were made. "For meeting food requirements, since 1950, nearly 22 million hectares have been added to the net sown area, which now stands at around 140 million hectares, with little possibility for further expansion" (Gupta et al., 2018). Another major challenge that India faces is the uncertainty imposed on 480 million people engaged in rain-fed agriculture. With the unpredictability in weather phenomena due to climate change, the government initiated the

National Innovations in Climate Resilient Agriculture in 2010-11. This program was intended to make village's climate resilient and 151 villages were chosen initially, that are vulnerable in terms of climatic parameters. In this program, several interventions are made to boost natural resource management, crop production, develop livestock and fisheries potential and above all, farmers' livelihood enhancement. Another significant method to address the challenges in rain-fed areas is the watershed management approach. The idea behind this approach is to help improve the recharge of local aquifers and down-stream water flows. Once surface and ground water situation improves, vegetative cover also increases, and in turn soil erosion is arrested and thereby may help to increase agricultural productivity.

SAQ 4

Highlight the main features of utilisation and conservation of natural resources.

6.7 SUMMARY

In this unit, you have learnt the following:

- The nature of distribution of land, soil, forest and water resources.
- Basic characteristics of land use, methods of land use classification, and criteria adopted by International and National agencies.
- How these natural resources sustain our life support system.
- Extent and intensity of their usage affects the environment in various ways and its availability determines whether these resources are renewable over time or non-renewable.
- Food habits and consumption patterns are changing rapidly and population growth is estimated to peak at 9 billion in 2050. This will create additional demand on precious and finite resources of land, soil, forest and water.
- To meet the food security, productive capacity of existing arable land need to be increased, more land need to be brought under cultivation and conservation of land and forest is required to prevent further degradation.
- Growing more food would mean additional demand on land, soil, and water. This calls for urgent need to protect and conserve all available natural resources.
- Need to reverse forest degradation which according to Global Land Assessment of Degradation by FAO is highest in Asia, followed by Africa, and Latin America.
- Arable land ownership in Asia, Africa and Latin America are highly skewed towards few wealthy owners holding major portions while poor and small holdings dominate in numbers.

- In totality, you would have understood the limitations of the land, soil, forest and water resources and therefore, the need for sustainability.

6.8 TERMINAL QUESTIONS

1. How is the link between human interaction with land, soil, forest, and water resources expressed in land use classification?
2. What are the major classes of land use standardised in LCCS system developed by FAO?
3. What are the standardized criteria used in the land use and land cover classification (LULC) systems in India?
4. What do the synonyms SLM, SSM and IWRM stand for? How will they help feed millions?

6.9 ANSWERS

Self-Assessment Questions (SAQ)

1. Land, water, soil and forest are primary resources and hold a special importance for both floral and faunal species including human beings and their multifarious needs and activities.
2. Land resources are classified into different categories to cater various human needs and economic activities. These may include agricultural land, fallow land, forest land, residential, recreational, commercial land, industrial land, barren land, waste land and landfill sites, wetland and water bodies, etc.
3. Built-up, agriculture, grass/grazing barren/uncultivable/wastelands, wetlands/water bodies and snow and glacier.
4. Utilization of natural resources should be done in such a manner so as to conserve these for future generations.

Terminal Questions

1. Your answer should include the link between human interaction with land, soil, forest and water resources as expressed in land use classification. Refer to Section 6.2.
2. Your answer should include the major classes of land use standardised in LCCS system as developed by FAO. Refer to Section 6.3.
3. Your answer should include the standardised criteria used in the land use and land cover classification (LULC) systems in India. Refer to Section 6.4.
4. Your answer should include the full forms of SLM, SSM, and IWRM and also highlight their importance in terms of feeding millions. Refer to Section 6.5.

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- National Remote Sensing Agency. For various remotely sensed data products and research reports based on remote sensing: <http://www.nrsc.gov.in>.
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UNIT 7

MINERALS AND ENERGY RESOURCES

Structure

7.1	Introduction Expected Learning Outcomes	7.10	Types of Energy Resources Alternative Sources of Energy
7.2	Defining Minerals and Mineral Resources	7.11	The Changing Energy Mix
7.3	Types of Resources	7.12	Changing Geography of Energy Production and Consumption
7.4	Types of Minerals	7.13	Energy Conservation Strategy Understanding and Changing Modern Life Styles
7.5	Distribution of Mineral Resources		Increasing Efficiency in Energy Use
7.6	Minerals Production		Reducing Transmission and Distribution Losses
7.7	Utilisation of Minerals Mineral Resources Consequences of Over- Exploitation of Mineral Resources	7.14	Summary
7.8	Conservation of Mineral Resources	7.15	Terminal Questions
7.9	Energy Resources Fossil Fuels Dominating the Energy Scene	7.16	Answers
		7.17	References and Further Suggested Reading

7.1 INTRODUCTION

In the previous Units of this Block, you have learnt about the concept and classification of resources along with natural resources. In this Unit, you will study about the minerals and energy resources. One of the reasons for disparities in development among nations of the world is the spatial variations in the types of resources available and their exploitation. Besides, the marked contrasts in physical environment such as climate, soil, vegetation and animal life, mineral and energy resources are also distributed unevenly. Minerals are very important for the growth of industry of any country. For industrial and economic prosperity, it is essential to find out all available mineral and power resources because these are imperative for the growth and advancement of

our present civilised and industrialised societies. Minerals provide the materials used to make most of the products of industrial society. The demand for the minerals is increasing across the world with increasing population on daily basis. You may know that minerals are formed after millions of years of geological processes.

First Section 7.2 defines minerals and mineral resources. Next Sections 7.3 to 7.6 have been devoted to the study of types of resources, types of minerals, distribution of mineral resources and mineral production. The utilisation and conservation of mineral resources are discussed in Sections 7.7 and 7.8. After that, Sections 7.9 to 7.13 focuses on the energy resources and its types, the changing dynamics of energy mix of the present time, changing geography of energy production and consumption along with energy conservation strategies, etc.

Expected Learning Outcomes

After studying this unit, you should be able to:

- describe the types of mineral and energy resources;
- explain the consumption and exploitation of minerals and changing energy mix; and
- explain the production, consumption, trade and conservation strategies of minerals and energy resources.

7.2 DEFINING MINERALS AND MINERAL RESOURCES

Minerals are pure inorganic substances that occur naturally in the Earth's crust. Some minerals consist of a single element such as gold, silver, diamond and sulphur whereas majority of them contain inorganic compounds formed by various combinations of different elements. The *Glossary of Geology* (Bates and Jackson, 1980, p.401) defines a mineral as "a naturally occurring inorganic element or compound having an orderly internal structure and characteristic chemical composition, crystal form and physical properties." Minerals differ from rocks, which are naturally occurring solids composed of one or more minerals. Rocks do not have a distinctive chemical composition or crystal structure like minerals.

A mineral is an element or chemical compound that is normally crystalline and that has been formed as a result of geological processes (*International Mineralogical Association*). Minerals are valuable natural resources being finite and non-renewable. These constitute the vital raw materials for many industries and are a major resource for development. Management of mineral resources has therefore, to be closely integrated with the overall strategy of development; and exploitation of minerals is to be guided by long-term national goals and perspectives in a sustainable manner.

SAQ I

What is mineral? Explain with examples.

7.3 TYPES OF RESOURCES

The resources are varied and manifold. In fact, resources are not there, these become so when these are used. Natural resources can be classified on the basis of their level of development and use, origin, stock and distribution (Fig. 7.1).

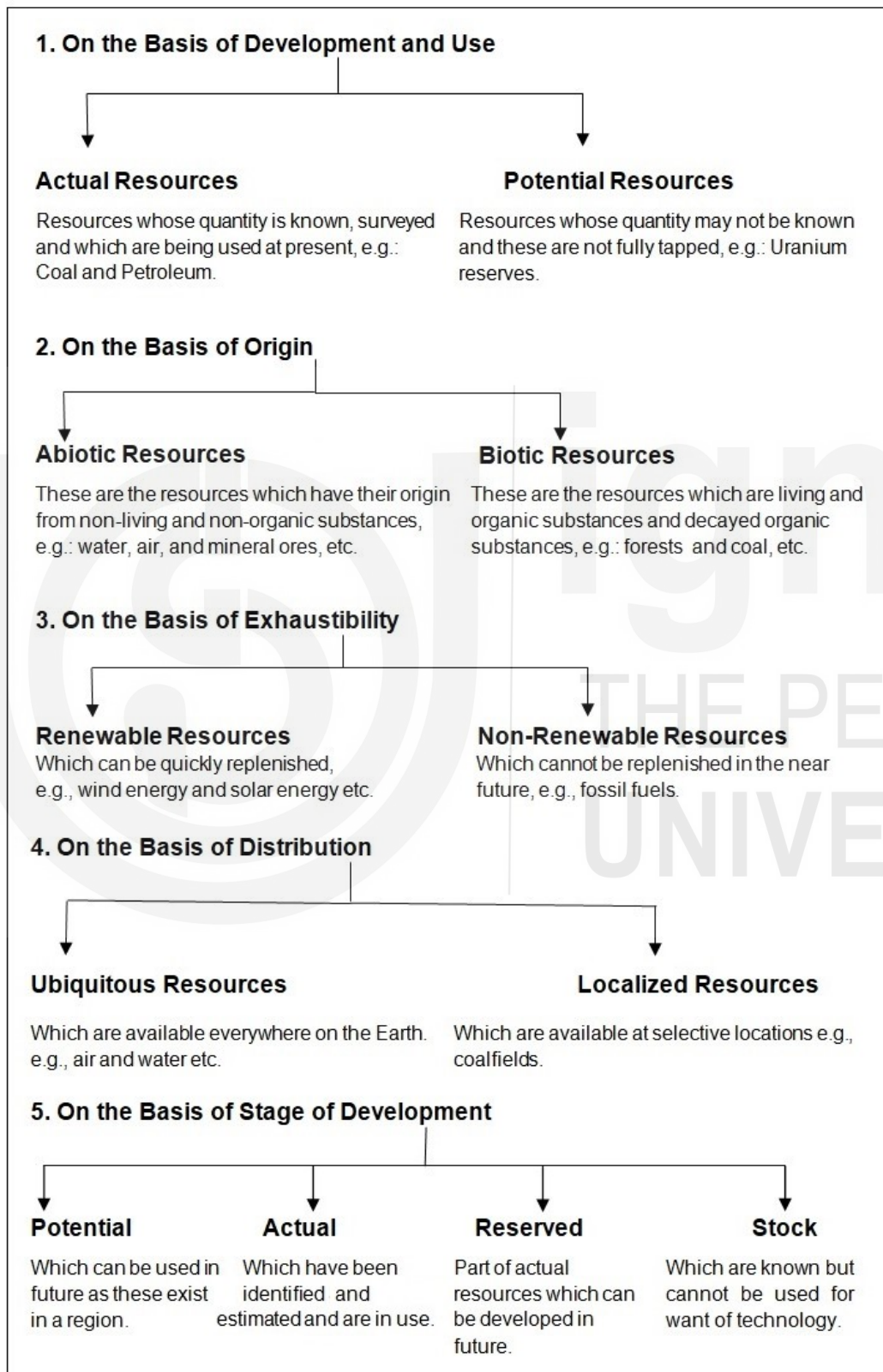


Fig. 7.1: Bases of classification of natural resources.

(Source: Adopted from Misra, H.N. 2014)

SAQ 2

Which are different ways of classifying natural resources?

7.4 TYPES OF MINERALS

Minerals can be classified as a) metallic minerals such as iron, copper, aluminium, lead, zinc and tin to name a few, b) Non-metallic minerals like limestone, gypsum, sandstone, sand, clay and other materials and c) Mineral fuels like coal, lignite, petroleum and natural gas (Fig. 7.2). Fuel or energy minerals like coal, oil and natural gas have been given prime importance as they account for nearly 87 percent of the value of mineral production whereas metallic and non-metallic minerals constitute 6 to 7 percent.

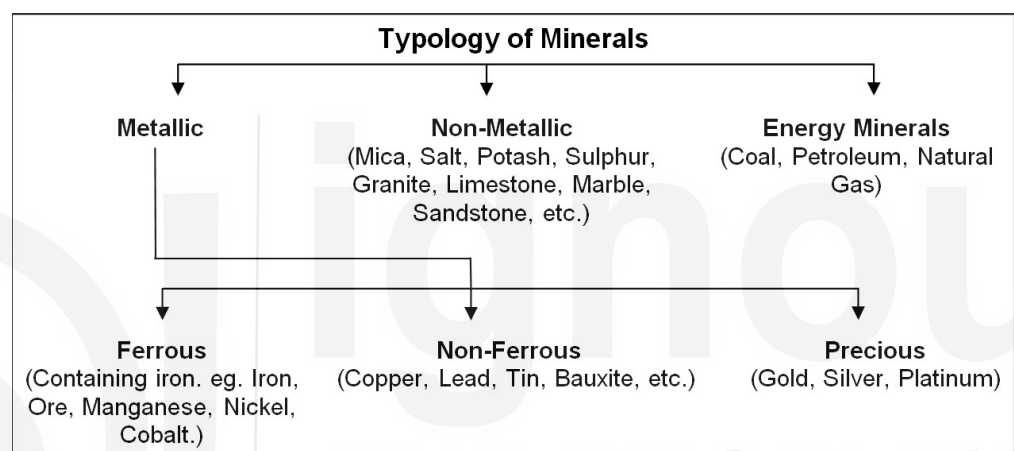


Fig. 7.2: Typology of Minerals.

Metallic Minerals: These minerals show physical properties similar to metals exhibiting a luster. Depending on the chemical composition, metallic minerals can be oxides, sulphides, carbonates and halites, etc. Metallic minerals can further be sub-categorized into three sub-types. These are:

- i) **Ferrous Minerals:** These are the metallic minerals which contain iron content in them. For example, iron ore, manganese, nickel and cobalt, etc.
- ii) **Non-Ferrous Minerals:** These are metallic minerals which do not contain iron content in them. For example, copper, lead, tin and bauxite, etc.
- iii) **Precious Minerals:** These are metallic minerals found in their pure form and are considered very valuable. For example, gold, silver and platinum.

Non-Metallic Minerals: These minerals do not contain any metals, so we cannot extract minerals from them. These minerals also do not contain metals in their chemical composition. These do not have a shiny appearance of their own. These are not ductile and brittle and non-malleable. Examples are mica, salt, potash, sulphur, granite, limestone, marble and sandstone etc.

SAQ 3

What is non-metallic mineral? Explain with examples.

7.5 DISTRIBUTION OF MINERAL RESOURCES

- Minerals are unevenly distributed in the world. Some areas are fairly minerals rich while others lack in a type of minerals. Mineral resources are present in the Earth's crust which comprise of just 0.4 percent of the Earth's mass.
- The continental crust is quite more homogeneous since magnetic, sedimentary and metamorphic processes have led to segregation and local concentration of elements. There are nine elements called major elements which make up over 99.5 percent of the continental crust. These are oxygen, silicon, aluminium, iron, calcium, magnesium, sodium, potassium and titanium; while the rest of the elements, called minor and trace elements accounts for less than 0.5 percent.
- The distribution of mineral resources in the Earth's crust and across the continents and the major reserves of metallic ores are geographically concentrated in a handful of countries.
- In general, the global distribution of mineral resources is very conservative and it has not changed over a long time. Fig. 7.3 shows the distribution of metallic minerals and Fig. 7.4 shows the distribution of non-metallic minerals. The spatial distribution of some prominent minerals is as under:

Iron Ore: Iron ore is unevenly distributed on the Earth. China, Brazil, Australia, India, Russia, Ukraine, USA, South Africa, Canada and Sweden are the prime producers of iron ore. In China, Manchuria, Sinkiang, Si-kiang, and Shandog peninsula are popular iron ore mining areas. Ruhr, South Wales, Krivoy Rog, Bilbao and Lorraine are significant regions of iron ore in Europe. In Africa, iron ore is distributed primarily in Transvaal and Liberia. Postmasburg and Transvaal in South Africa are remarkable regions of iron ore. Magnitogorsk, Novotrotsky, Zlatoust, Nizny Taghil and Seerow are famous regions in Ural Mountains in Russia and Kazakhstan. Mesabi Regions of Great lakes and Labrador in North America are also storehouse of iron ore. Itabira, Hills of Brazil in South America also have iron ore deposits. Pilbara Region, Koolyanobbing, and Iron Duke regions of Australia also have notable deposits of iron ore.

Manganese: The main producers of manganese in the world are Cape Province of South Africa, Leonara, Victoria, Queensland and Woodie Woodie regions of Australia, Kiangsi, Hunan, Kuangsi, Kwangtung, Kuangsi and Kwichou regions of China, Moanda Mine of Gabon, Amapa region of Brazil, Odisha, Madhya Pradesh, Chhattisgarh, Maharashtra and Jharkhand states of India.

Copper: Copper in nature often exists in compound. These compound deposits are found in Mt. Chuquicamata, El Teniente, El Salvador and La-Africana regions of Chile, Cerro de Pasco, Morococha, Caspalca and Toquepala regions of Peru, Arizona, Utah, Montana, Nevada and New Mexico states of USA, Ontario, Manitoba, Quebec regions of Canada, Katanga region of Zaire and Transvaal and Cape Province of South Africa.

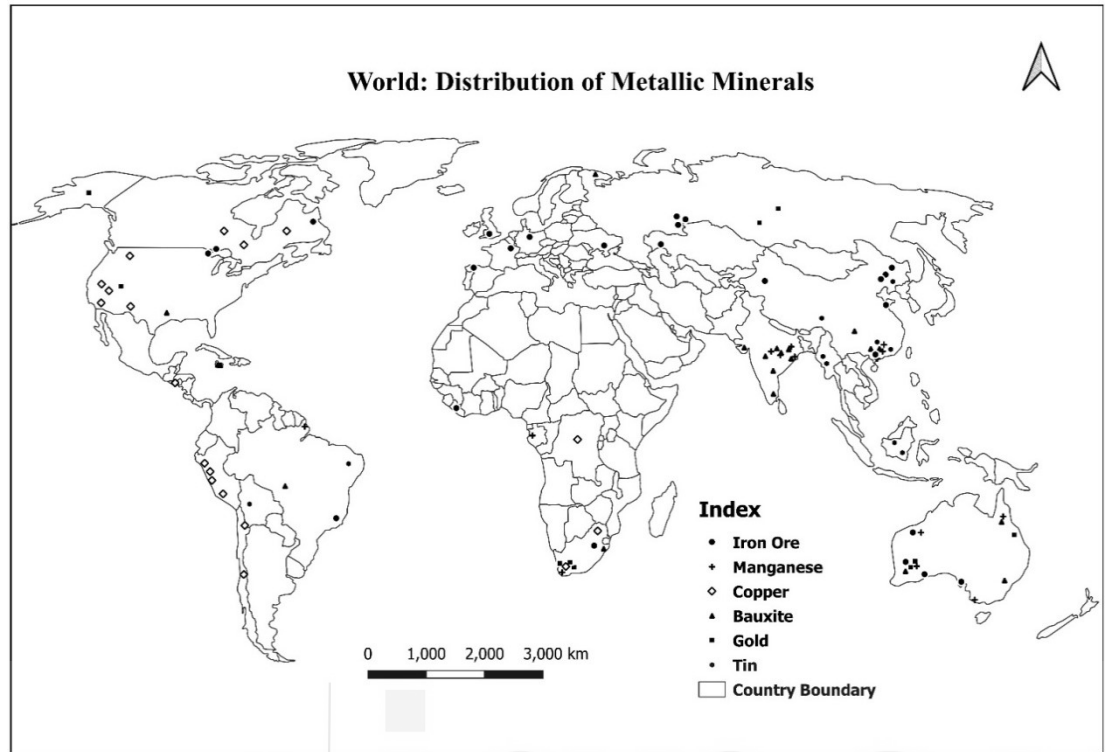


Fig. 7.3: World Distribution of Metallic Minerals.

Aluminium (Bauxite Ore): The remarkable deposits of Bauxite ore are found in Queensland, New South Wales and Western parts of Australia, Hunan, Guichou and Sichuan of China, the central region of Brazil, Madhya Pradesh, Chhattisgarh, Jharkhand, Odisha, Maharashtra, Andhra Pradesh, Tamil Nadu and Gujarat of India, St. Elizabeth and St. Mary region of Jamaica, Saline country region of Arkansas State of USA, Kola peninsula of erstwhile USSR, Boko and Baruka island of Guinea and North Natal Province of South Africa.

Gold: Significant deposits of Gold are found in Johannesburg, Boksburg and Orange free state and Kimberley regions of South Africa, Salt lake region and Alaska of USA, Mount Morgan, Kalgoorlie and Coolgardie regions of Australia, Polyus Gold's Olimpiada gold mine in the Krasnoyarsk region of Russia.

Silver: The main ore of Silver are argentite, stephanite, pyrargyrite and proustite. Silver ore mining is concentrated only in few countries. Deposits of Silver ore are found in Hidalgo regions of Mexico, Ontario, British Columbia, Quebec regions of Canada, Utah, Montana, Arizona and Colorado regions of USA, Mt. Isa, Queensland, Broken hill area of Australia, Potosi regions in Bolivia, Transvaal and Natal Province of South Africa.

Tin: Tin deposits are limited in certain pockets. It is highly unevenly distributed around the world. Significant deposits are found in Yunnan, Nanking mountains, Kiangsi and Hunan regions of China, Selangor, Penang Island, Kinta valley and Kelang valley regions of Malaysia. Few pockets of tin deposits are also found in San Antonio de Palo area of Peru, high plateau of Bolivia, Boreborema plateau in Brazil and Shan plateau and Kaynni plateau regions of Myanmar.

Lead (Galena): Lead deposits are found in China, Broken bill, Mt. Isa (Queensland) regions of Australia, Sudbury region of Canada and Cerro-de-Pasco area of Peru.

Diamond: The leading producers of natural diamonds are Russia, Botswana, Canada, Australia, South Africa, Russia and Zaire. South Africa has the most diverse range of diamond deposits in the world. Kimberley, Johannesburg, and Cape Town are significant regions in South Africa, where diamond deposits are found. Apart from these, Catanga plateau in Zaire, Parma and Golkonda mines in India and Catoca region in Angola also house deposits of diamonds.

Nickel: Important reservoirs of nickel are found in Kola Peninsula and Southern Urals of Russia and Sudbury regions of Canada.

Tungsten: This mineral is primarily found in Nanking, Hunan and Jiangxi regions of China.

Mica: Mica is mainly found in Andhra Pradesh and Rajasthan states of India and Atlantic coast and Sao Paulo regions of Brazil.

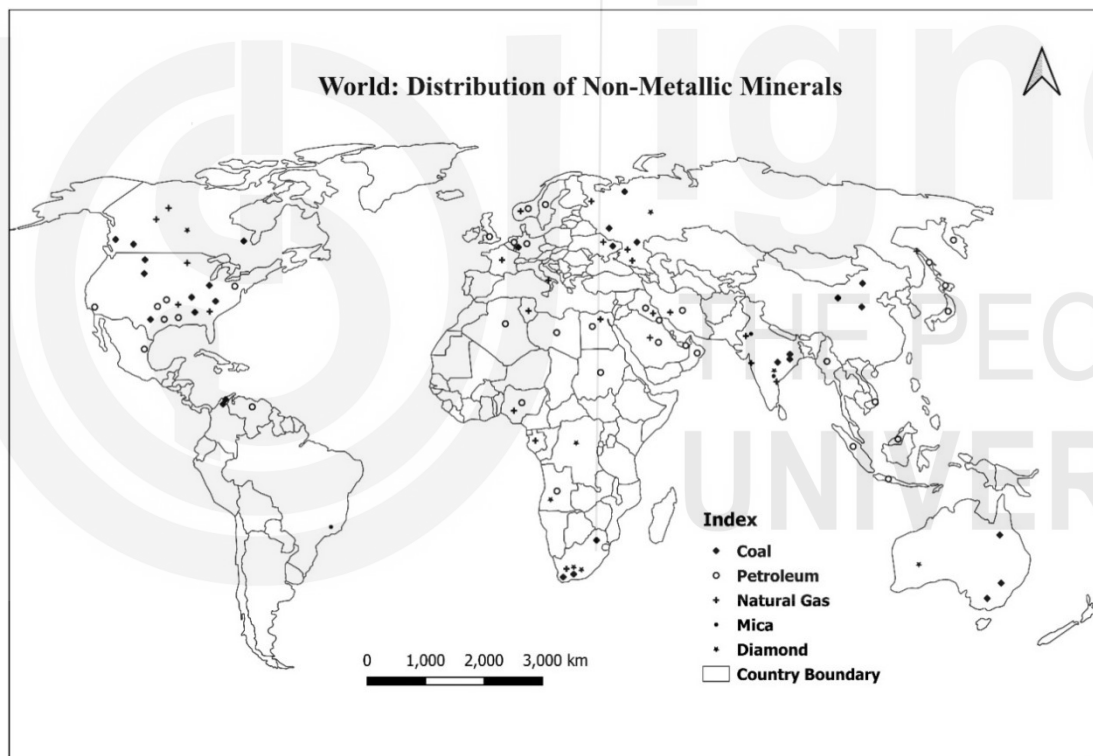


Fig. 7.4: World Distribution of Non-Metallic Minerals.

Coal: The coal deposits exist in nearly every part of the world, but commercially exploitable coal reserves are found mainly in Northern Shansi, Shensi and inner Mongolia in China, Appalachian, Montana, Wyoming, Illinois, Indiana, Western Kentucky, West Virginia, Alabama, Pennsylvania, Ohio, Missouri, Michigan and Texas regions of USA, Donetskii and Pechora basins in Western Russia, New South Wales, Queensland and Victoria regions of Australia, Nanaimo, Bowser, Skeena, Moose river, Maritime and Bowron Valley in Canada. Besides, Ruhr coal basin in Germany, Donetsk basin in eastern Ukraine, Jharkhand, Chhattisgarh and Chota Nagpur plateau regions in India, Transvaal, Cape of Good Hope and Natal in South Africa,

Guajira peninsula and Correjón coal mines of Colombia are famous coal rich areas in the world.

Petroleum: The countries in the Middle East region – Iran, Iraq, Saudi Arabia, Bahrain, Kuwait, UAE, Qatar, Oman and Syria constitute the richest oil region on the Earth. Venezuela in South America has the largest oil reserves followed by Saudi Arabia. In North America, the states of Texas, Oklahoma, Kansas, California, Louisiana, Wyoming and Pennsylvania are prominent regions of petroleum reserves. Tampico and Tuxpam in Mexico, Libya, Algeria, Egypt, Sudan, Nigeria, Angola in Africa, Caucasian region, Volga basin, Caspian Sea, Kamchatka peninsula and Sakhalin islands regions in Russia, United Kingdom, Norway, Denmark, Germany and Netherlands regions in Europe, and Indonesia has oilfields in central Sumatra, Java and Kalimantan, Myanmar, Vietnam, Philippines, South China sea region, Hokkaido and Honshu islands of Japan are other significant areas of petroleum reserves.

Natural Gas: Russia is the world's largest producer of natural gas. The significant regions of natural gas reservoirs are Saratov, Dashava Kiev, Stavropol, Setomia, Volga basin, Sakhalin Island and Pecora valley. The United States of America is the second largest producer of natural gas. The reserves are found in Appalachian basin, McAlester Basin, Gulf Embayment, Williston Basin and Pincher creek. Other regions of natural gas reserves include Alberta in British Columbia states in Canada, Saudi Arabia, Iran, UAE, Qatar and Iraq in west Asian region, Norway, United Kingdom, Italy, France and Netherlands in Europe and Algeria, Egypt, Nigeria, Gabon, South Africa and Tunisia region in Africa. India also possesses natural gas which is mostly concentrated in Bombay High, Godavari basin and Barmer area of Rajasthan.

Uranium: Remarkable deposits of Uranium are found in Olympic Dam and Ranger mine in southern Australia, Athabasca Basin, Cigar Lake, McArthur River Basin regions in Canada and Chu-Sarysu basin in central Kazakhstan.

Thorium: Monazite is the chief source of Thorium in the world. Viable deposits of monazite are found in the beach sands in the coastal tracts of United States, Australia and India.

7.6 MINERALS PRODUCTION

In Table 7.1 and Fig. 7.5, mineral production by development status of producer countries has been shown. World Mining Data 2021 report claims that development status of all countries that produce mineral raw materials were classified according to international standards considering in particular the 'United Nations Conference on Trade and Development' (UNCTAD) and 'International Institute for Applied Systems Analysis' (IIASA) classification. The designations "developed", "in-transition" and "developing" are taken for statistical convenience and do not necessarily express a judgement about the stage reached by a particular country or area in the development process. In this table, total production of minerals in developed countries reveals that production in 2001 was 34.54 percent of total world production which declined to 27.16 percent in 2010. After 2010, production remained almost stagnant and hovered around 27.33 percent in 2020. Production data for transitional

countries also show that production decreased from 16 percent in 2001 to 12.62 percent in 2020. Minerals production of developing countries reveals notable increase from 48.49 percent in 2001 to 59 percent in 2020. Production in least developed countries exhibits less than 2 percent production of total production from 2001 to 2020.

Table 7.1: Total Minerals Production, by Development Status of Producer Countries in Metric Tons (bauxite is not included)

Years	Developed Countries	Transition Countries	Developing Countries	Least Developed Countries	Total
2001	3974057290 (34.54)	1842263400 (16.01)	5579769164 (48.49)	110184164 (0.96)	11506274018 (100)
2002	3961464475 (33.82)	1905784632 (16.27)	5722864043 (48.86)	121773285 (1.04)	11711886435 (100)
2003	3918509146 (31.63)	1934423648 (15.61)	6410994407 (51.75)	124695706 (1.01)	12388622907 (100)
2004	4213768929 (31.93)	1802291299 (13.66)	7031738906 (53.29)	148027733 (1.12)	13195826867 (100)
2005	4188837565 (30.36)	1882778218 (13.65)	7553120675 (54.74)	172687968 (1.25)	13797424426 (100)
2006	4197906733 (29.23)	2015893137 (14.03)	7973032494 (55.51)	177052424 (1.23)	14363884788 (100)
2007	4291493796 (28.96)	2009720537 (13.56)	8324981639 (56.17)	194608103 (1.31)	14820804075 (100)
2008	4338677140 (28.51)	2033646932 (13.37)	8638203351 (56.77)	205409608 (1.35)	15215937031 (100)
2009	4176523532 (27.88)	1928779614 (12.88)	8672022982 (57.89)	201718884 (1.35)	14979045012 (100)
2010	4300076812 (27.16)	2054144080 (12.97)	9267658392 (58.54)	209894980 (1.33)	15831774264 (100)
2011	4345161391 (26.31)	2130582601 (12.90)	9839874652 (59.59)	196758699 (1.19)	16512377343 (100)
2012	4423480077 (26.28)	2150374827 (12.77)	10063677549 (59.78)	196928290 (1.17)	16834460743 (100)
2013	4532543460 (26.63)	2143294290 (12.59)	10127461731 (59.51)	214283383 (1.26)	17017582864 (100)
2014	4754868839 (27.70)	2109816106 (12.29)	10083281875 (58.74)	218848610 (1.27)	17166815430 (100)
2015	4797416834 (27.88)	2104646822 (12.23)	10093889432 (58.66)	211189348 (1.23)	17207142436 (100)
2016	4596070741 (27.41)	2100734071 (12.53)	9853982727 (58.77)	216258502 (1.29)	16767046041 (100)
2017	4769872992 (27.66)	2204877570 (12.78)	10054097802 (58.30)	217947378 (1.26)	17246795742 (100)
2018	4948857166 (27.77)	2291314559 (12.86)	10380195482 (58.25)	199153872 (1.12)	17819521079 (100)
2019	5000998885 (27.76)	2313549098 (12.84)	10506362897 (58.32)	195117769 (1.08)	18016028649 (100)
2020	4686866045 (27.23)	2171975954 (12.62)	10167141618 (59.09)	183994368 (1.07)	17209977985 (100)

(Source: World Mining Data 2021, Vol. 36)

(Note: Figures in parentheses show the percentage to total)

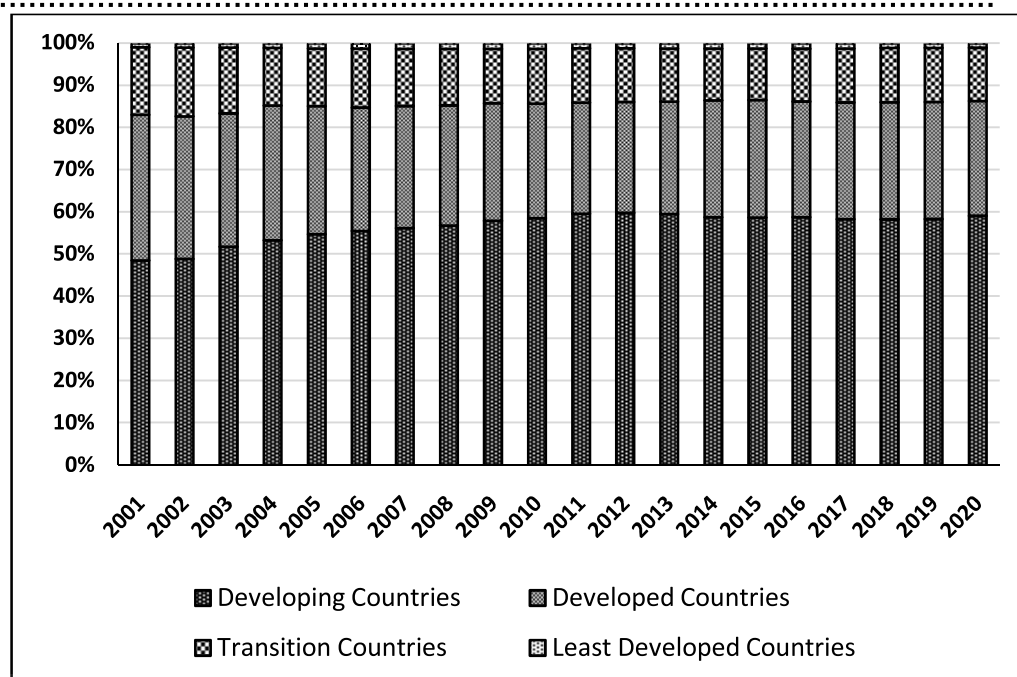


Fig. 7.5: Total Minerals Production by Development Status, 2001-2020.

Table 7.2: Total Minerals Production in Metric Tons

Years	Africa	Asia	Europe	Latin America	North America	Oceania	Total
2005	944557106 (6.86)	7060215805 (51.27)	1749570759 (12.71)	1060981049 (7.71)	231912141 3 (16.84)	62902792 5 (4.57)	137694740 57 (100.00)
2006	957844493 (6.47)	7544866813 (51.00)	1728435217 (11.68)	1104701083 (7.47)	235592295 2 (15.93)	64358759 3 (4.35)	147931912 67 (100.00)
2007	975719824 (6.60)	7946326405 (53.72)	1717358983 (11.61)	1130871364 (7.64)	234709709 8 (15.87)	67581759 3 (4.57)	147931912 67 (100.00)
2008	996725540 (6.56)	8280478013 (54.51)	1700017087 (11.19)	1121552522 (7.38)	238115478 1 (15.68)	71011616 9 (4.67)	151900441 12 (100.00)
2009	963712121 (6.44)	8315454457 (55.60)	1605815455 (10.74)	1067014561 (7.13)	227314781 5 (15.20)	73057968 6 (4.88)	149557240 95 (100.00)
2010	1009671549 (6.39)	8912444688 (56.38)	1621447085 (10.26)	1129489035 (7.14)	233369970 2 (14.76)	80184913 8 (5.07)	158086011 97 (100.00)
2011	929029245 (5.64)	9519403891 (57.74)	1638139459 (9.94)	1171345181 (7.11)	241022895 4 (14.62)	81795346 7 (4.96)	164861001 97 (100.00)
2012	995271428 (5.92)	9728539771 (57.87)	1617698857 (9.62)	1185412165 (7.05)	241816407 0 (14.38)	86616511 2 (5.15)	168112514 03 (100.00)
2013	965247288 (5.68)	9850220057 (57.97)	1573626198 (9.26)	117214973 (6.90)	247127684 2 (14.54)	96086169 7 (5.65)	169933818 21 (100.00)
2014	947121396 (5.53)	9793031358 (57.13)	1508338054 (8.80)	1203841307 (7.02)	262137312 3 (15.29)	10676255 35 (6.23)	171413307 73 (100.00)
2015	940157848 (5.47)	9811051285 (57.10)	1487131521 (8.66)	1196626694 (6.96)	260900832 8 (15.18)	11383607 45 (6.63)	171823364 21 (100.00)
2016	913585218 (5.46)	9634838023 (57.57)	1449220109 (8.66)	1158695515 (6.92)	241110422 6 (14.41)	11681457 20 (6.98)	167355888 11 (100.00)
2017	964574915 (5.60)	9907613569 (57.53)	1462447477 (8.49)	1151746597 (6.69)	253818255 2 (14.74)	11979302 20 (6.96)	172224953 30 (100.00)
2018	978736001 (5.52)	1029244830 0(58.04)	1417802540 (7.99)	1100126689 (6.20)	273192760 0 (15.40)	12134006 38 (6.84)	177344417 68 (100.00)
2019	983046049 (5.48)	1054930642 6(58.86)	1266683433 (7.07)	1028619331 (5.74)	283479083 7 (15.82)	12610224 20 (7.04)	179234684 96

Figures in parentheses shows percent to total production.

(Source: World Mining Data 2021, Vol. 36)

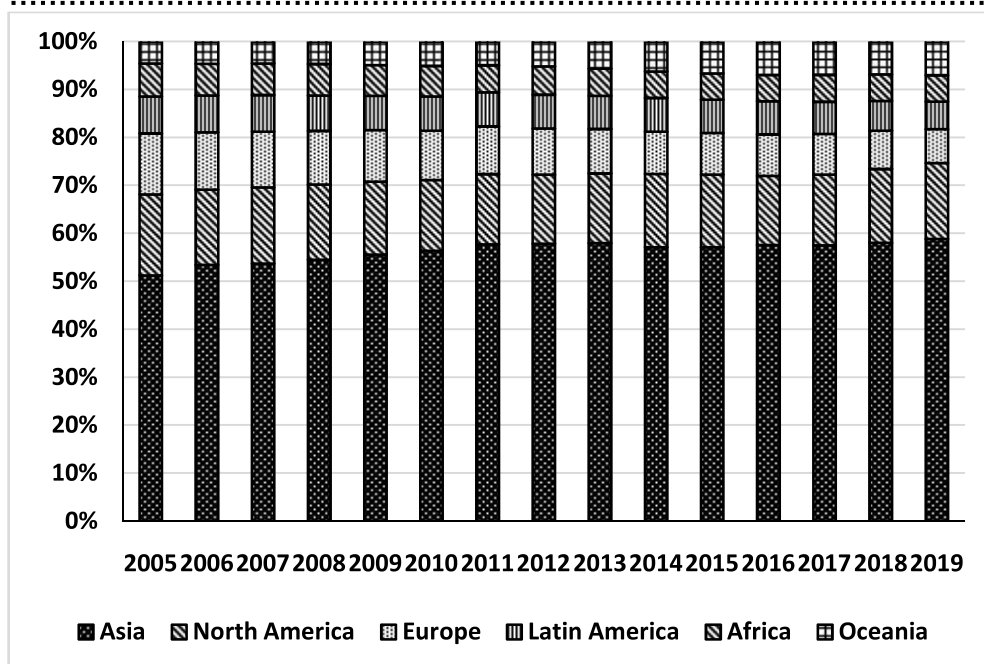


Fig. 7.6: Continent-Wise Mineral Production, 2005-2019.

Table 7.2 and Fig. 7.6 represent total mineral production. Data reveal that production in Africa continent shows 1.38 percent decline from 2005 to 2019 while in Asia production increased from 51.27 percent in 2005 to 58.86 percent in 2019. The mineral production in Europe continent also exhibits significant decline from 12.71 percent in 2005 to 7.07 percent in 2019 which is about 5.64 percent decline in 15 years. Production in Latin America has also declined from 7.71 percent in 2005 to 5.74 percent in 2019. A very little decline i.e., about 1 percent from 2005 to 2019 in production has also been observed in North America. Mineral production shows increasing trend in Oceania where production increased from 4.57 percent in 2005 to 7.04 percent in 2019.

Table 7.3: Production of Selected Minerals

Minerals	World Production (Kilo Tonnes)			Developed Countries		Transition Countries		Developing Countries		Least Developed Countries	
	2015	2019	Absolute Change (K. Tonnes) (2015-19)	2015	2019	2015	2019	2015	2019	2015	2019
Copper	19.35	20.67	1.32	3.97	3.62	1.39	1.74	11.88	12.64	2.11	2.67
Lead	4.98	4.97	-0.02	1.22	1.04	0.31	0.42	3.44	3.47	0.02	0.04
Zinc	13.35	13.17	-0.17	3.45	3.21	0.72	0.73	9.09	9.00	0.09	0.24
Tin	0.33	0.29	-0.03	0.01	0.01	0.0001	0.002	0.25	0.23	0.07	0.05
Iron	1454.45	1539.41	84.96	580.39	655.01	117.79	115.89	744.31	757.60	11.96	10.91
Manganese	16.01	21.42	5.42	3.28	3.27	0.94	1.01	11.73	16.70	0.05	0.45
Chromium	13.25	15.91	2.67	0.46	0.51	2.50	3.19	10.20	12.17	0.08	0.05
Nickel	2.06	2.71	0.65	0.53	0.41	0.28	0.24	1.19	2.01	0.07	0.05
Bauxite	294.38	363.42	69.04	83.31	107.16	11.18	12.58	177.57	170.38	22.31	73.30
Fluorspar	6.30	7.66	1.36	0.34	0.34	0.001	4000*	5.96	7.27	0.01	0.05
Phosphate	82.89	71.11	-11.78	9.66	8.03	5.04	5.92	67.13	56.00	1.06	1.15

(Source: World Mining Data, 2021, Vol. 36) * Figure is in metric tonne.

It can be deduced from the above tables that:

1. The total volume of workable mineral deposits is an insignificant fraction of 1 percent of the Earth's crust and once consumed, there will not be a second crop (*Lovering, 1969*).
2. The production of all minerals has increased which is in consonance with the increasing demand for raw materials. It has been observed that despite recycling, the primary production of most of the raw materials has increased.
3. The pace of production of minerals in developing countries has shown considerable increase in comparison to developed and least developed nations.
4. World level change in the mineral production between 2015 to 2019 is phenomenally high i.e., 84.96 kilo tonnes in iron, followed by bauxite and Manganese. Lead, Zinc, Tin and Phosphate have registered negative change (Table 7.3).

7.7 UTILISATION OF MINERALS

The utilisation of metals can be traced back to several millennia i.e., from the Bronze age when the techniques of metal smelting and alloying were discovered and metals were first used in the manufacturing of tools and implements. However, the large-scale exploitation of mineral resources didn't take place until the time of Industrial Revolution, which started some 250 years ago. The changes initiated at that time were based essentially on the use of iron as a raw material and coal as a source of power. Exploitation of mineral resources is essential. Iron and steel are needed for the manufacturing of machinery, locomotives, automobiles, ships and other equipments. Copper and aluminium are essential for transmission of electricity. Limestone is used for manufacturing of cement. There is no economic activity which can be performed without the use of mineral products. More Developed regions (MDRs) consume large quantities of fuels and other minerals. The quantity of steel consumed per capita is often taken as a measure of economic development of a nation.

- World population is growing at a fast rate and so the mineral consumption is also increasing more quickly than population as the standard of living is increasing day by day.
- According to Gloser et. al. (2015), the rapid economic development of countries in combination with an accelerating spread of new technology has led to an increasing demand for industrial metals and minerals for the production of specific high-tech application tools.
- Increased world demand is determined by three factors:
 - a) The use of technology in processing the minerals.
 - b) The level of population that consumes these raw materials.
 - c) The standard of living that will establish how much each person consumes (*Kesler, 2007*).

7.7.1 Consequences of Over-Exploitation of Mineral Resources

In the entire history of human civilisation, such an unusually high demand has never been placed on the natural resources of our planet as it is in the present time. The consequence of this over-exploitation of mineral wealth is likely to have an adverse impact in the near future (www.preservearticles.com).

Consequences of over-exploitation of Mineral Resources can be summed up as follows:

- **Rapid Depletion of High-Grade Mineral Deposits:**

Exploitation of mineral wealth at a rapid rate shall naturally deplete our good quality deposits. The ever-rising demands shall compel miners to carry on the extraction from increasingly lower and lower grade of deposits, which possess a poorer percentage of the constituent metals.

- **Wastage and Dissemination of Mineral Wealth:**

Most of our mineral deposits occur as a complex mixture of a number of mineral elements. After removal of top soil and rocks, we dig out the desired mineral leaving behind others, which are often left in the open in the form of waste materials as over burden.

- **Pollution of Environment from Mining and Processing Wastes:**

Mining is a dirty industry. It has created some of the largest 'Environmental Disaster' zones in the world polluting land, water, forest and air.

- **Pollution caused by Heavy Energy Requirement of Mining Industry:**

Moving huge amounts of ores, sand, silt and clay, etc., requires energy. Concentration of ore requires energy. Smelting, refining operations and electrolytic processes require energy. In order to provide energy to mining industry a huge quantity of the power resources are burned which causes a variety of pollution and consequently a variety of health hazards.

7.8 CONSERVATION OF MINERAL RESOURCES

In 21st century, the volume and value of mining production has risen to unprecedented levels and shows no signs of slackening. Indeed, the depletion of many non-renewable mineral resources is a matter of serious concern and the impending exhaustion of many known reserves means that new resources must be discovered, if ongoing economic development chiefly based directly or indirectly on mineral resources is to continue unimpaired. The conservation of mineral resources has become imperative due to the following reasons:

1. Mineral Resources and Sustainable Development

The best way to mitigate the problem of mineral resource depletion is to use them in a sustainable way.

Other potential solutions to sustainability of mineral resources include the following:

- a) Improvement in the technology for removal of the deposits.
- b) Finding new materials to replace the existing ones.
- c) Enhancing recycling processes.
- d) Decreasing consumption by more efficient use.
- e) Looking for new and alternative possibilities (Wellmer and Becker, 2007).

2. Recycling of Mineral Resources

Mineral waste management priorities are organised according to the named three R's – reduce, reuse and recycle. Recycling will never be 100 percent efficient and varies greatly among different mineral commodities due to the use and functionality in their respective applications.

3. Social License to Operate

The term “social license” was coined by mining executive Jim Coonvey in 1997 (Andrew and Kydd, 2020). Social licensing refers to the acceptance accorded by the local community to operate any mining projects in the area, where human community directly or indirectly is attached for their livelihood. In Social Licensing System, local people and community act as stakeholders and give approval to the mining company for execution of activities. Thus, social licensing restricts injudicious exploitation of resources. Social License Operation has become worldwide certified tool to check misappropriation of resources at community level (Thomson and Boutilier, 2011).

4. Universal Legislation for Conservation of Resources

The world organisations should take up the matter of conservation of resources seriously and provide the guidelines for implementation of such universal laws. Reckless exploitation can be controlled by such laws and lead to benefit of future generations. Many nations and international organisations have taken this matter seriously. Consequently, many nations have been intended to frame legislation for the conservation of resources. India has been doing commendable legislation framework and amendments in the act to meet the need of development and conservation of resources at same time. The Water (Preservation and Control of Pollution) Act 1974, the Air (Prevention and Control of Pollution) Act 1981, the Environment (Protection) Act 1986, the Forest (Conservation) Act 1980 and National Green Tribunal 2010 are some of significant legislations in India. India's mineral and mining sector functions under federal structure as per the **Seventh Schedule** of Indian Constitution (uk.practicallaw.thomsonreuters.com).

7.9 ENERGY RESOURCES

Fig. 7.7 provides a simple classification of the different types of energy resources. For most of human history, human beings have utilised non-renewable sources of energy which include flow resources such as wood that can be depleted, sustained or increased by human activity, continuous

resources, such as water to drive watermills or the wind to turn windmills, which are available irrespective of human activities. They have also used draught animals, horses and buffalo, etc. but these need to be properly fed and housed. The industrial revolution changed the way in use of energy resources of the world.

7.9.1 Fossil Fuels Dominating the Energy Scene

Since the invention of the steam engine about 200 years ago, much of human society has become ever more dependent upon the exploitation of non-renewable energy resources. Today, three fossil fuels account for over 85 percent of the annual sale of the world's most important minerals. These resources were formed from the decomposition of organic materials millions of years ago and have been transformed by heat and pressure into coal, oil and natural gas. They represent the classic, non-renewable resources found in specific locations, and in a variety of forms and conditions. For example, commercial coal deposits are of three types: lignite (brown coal), bituminous coal and anthracite. There are different grades of oil along a scale from light to heavy and individual refineries are designed to process particular grades of crude oil. Natural gas is often found in association with oil, but is also found on its own. Until recently, the natural gas associated with oil was simply flared off. Today, it is often re-injected into the oilfield to enhance oil recovery or used as a hydrocarbon resource in its own right. The mineral content of natural gas also varies. For example, the so-called 'sour gas' has high sulphur content. This sulphur has to be extracted before the gas can be transported by pipeline. The advantage of fossil fuels as a source of energy is that they are readily accessible, easy to convert using proven technologies and cost-efficient in production and use.

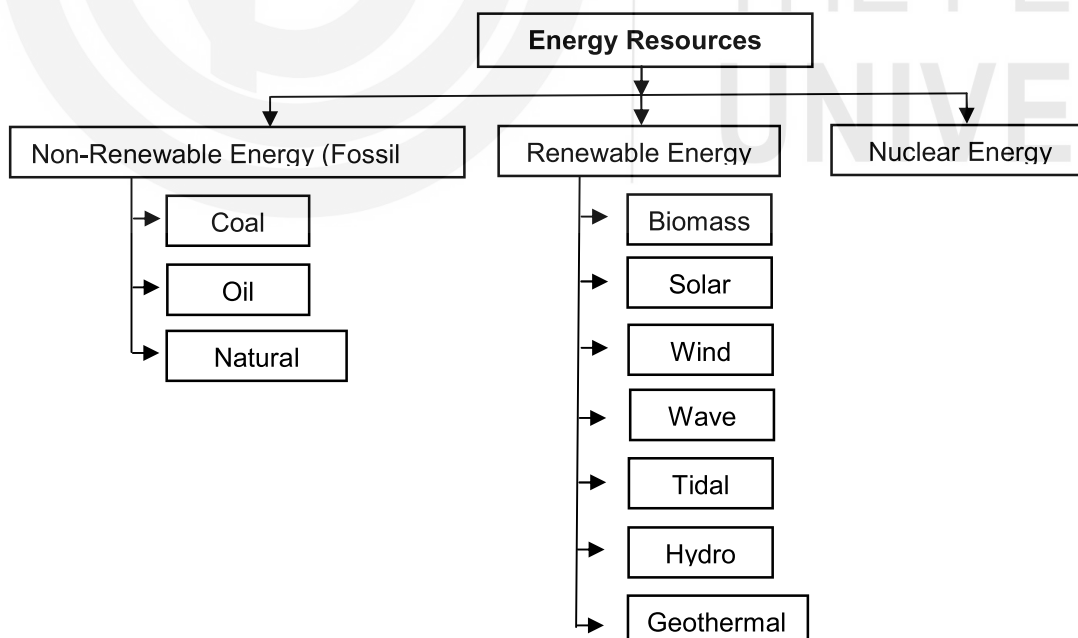


Fig. 7.7: Categories of Energy Resources.

(Source: Adapted from Jones and Hollier, 1997)

SAQ 4

How are fossil fuels formed?

7.10 TYPES OF ENERGY RESOURCES

Oil is the most versatile among all type of energy resources. Today, coal is used in many industrial processes and as a source of heat it remains the most important fuel for electricity generation in thermal power plants. However, it is a relatively bulky resource and in recent years, in developed societies particularly in Western Europe, it has been unable to compete with oil that is more versatile, or with cleaner natural gas. The great advantage of oil is its transport ability. It can be transported over long distances in large volumes by pipelines, it can cross oceans in tankers, or it can be moved in smaller quantities by rail and road tankers. It has spawned a huge petrochemical industry that now produces a vast range of products. Many of these products, such as plastics and textiles, have substituted products based on renewable resources, such as wood and cotton, for products based on non-renewable resources. At the same time, oil has created many resources for which we have yet to develop commercially viable substitutes, such as jet engine fuel. This means that advanced industrial societies are totally dependent upon the continued supply of oil.

In recent years, natural gas has become an increasingly important source of energy. In many advanced industrialised economies, it has even replaced coal and, to a lesser extent, oil as the preferred resource for electricity generation and domestic heating. However, natural gas does not have the same transport flexibility as oil. It is most economic when transported by pipeline, but the infrastructural investment needed requires secure sources of production and stable markets. Natural gas can also be processed to produce Liquefied Natural Gas (LNG), but the liquefaction process requires substantial investment in plant and consumes large quantities of energy. Nevertheless, LNG is becoming an increasingly important fuel, particularly in the Asia-Pacific region. Both the United States and Europe see the expansion of LNG supplies as a means of compensating for declines in domestic production and diversifying their sources of supply.

7.10.1 Alternative Sources of Energy

The finite nature of hydrocarbon fuels, the problems of scarcity, and the environmental consequences of burning fossil fuels together have initiated the use and preference for alternative sources of energy. As Fig.7.1 shows that these alternatives take two forms: first, the development of new ways of harnessing renewable energy sources and secondly the development of nuclear power. At present, all commercial nuclear power stations use so-called '**fission reactors**' in which atoms of uranium-235 and plutonium-239 are split by neutrons, thus releasing energy, mainly in the form of heat, which is then used to generate electricity. In the 1950s, nuclear energy was heralded as a cheap and clean alternative to fossil fuels. However, the nuclear industry has failed to expand as expected. Today, the nuclear option is back on the agenda as it is one source of energy that doesn't generate CO_2 . However, there are many issues like high costs, safety, the disposal of radioactive waste and the decommissioning of power stations relating to the use and expansion of nuclear energy. In the next few years, we can expect a critical debate about the ways in which nuclear power can contribute in

mitigating climate change. The other alternative to fossil fuels is the development of 'new' renewable sources of energy. Many of these renewable sources involve applying new technologies to historic sources of energy supply (see Elliott, 2003). For further discussion of renewable energy sources and their prospects, a brief description of other sources of renewable energy is enumerated as under:

Biomass Energy involves the burning of plant and animal residue to produce heat. In majority of the world, this is still the traditional source of energy. According to the International Energy Agency (IEA)'s Biomass Project, the share of biomass energy in Africa, Asia and Latin America averages 30 percent. However, in some of the poorest countries of Asia and Africa, it can be as high as 80 to 90 percent. It is estimated that for about 2 billion people, biomass is the only available and affordable source of energy. More recently, the use of biomass to produce alternative fuels, so-called biofuels, has gained popularity in the developed world. However, it is also becoming increasingly evident that biofuels production creates as many problems as it solves. The land being taken up to produce crops for biofuel production is either a natural habitat or agricultural land that could be used for food production. At the same time, increased demand for crops such as corn is increasing the cost of animal fodder and basic foodstuffs. Further, much of this production requires the use of fertilizers and pesticides that are hydrocarbon-based and consume considerable amounts of energy, when they are produced. The net result is that many biofuels may actually consume more energy to produce than they generate when used to run a vehicle.

Solar Energy usually involves capturing the Sun's rays in order to warm buildings and heat the water. As the efficiency of solar panels increases and their cost declines, solar energy is becoming a viable small scale local solution. However, it is subject to daily or seasonal variations and is weather-dependent, but it can provide an efficient supplemental source of energy for heating domestic water and so on (www.ises.org).

Wind Power is of historical significance and has now made a return in the form of 'wind farms'. Improved design has increased the efficiency of modern windmills and they are becoming an increasingly common sight in exposed coastal and upland locations in the developed world. Wind farms can generate electricity for local use or for feeding the power grid. However, some would argue that modern wind farms lack the aesthetic qualities of traditional windmills and, therefore, many see them as a source of both visual and noise pollution (www.windpower.org)

Hydro Power generation also pre-dates the industrial revolution, but the watermills that powered the early machines have now been replaced by dams and hydro-electric schemes. In many regions of the world, hydro-electricity has become an important source of energy. But in all except in a few cases, it cannot offer a large-scale solution to any country's energy needs. The hydro power projects exercise both positive and negative impacts. Displacement due to dams in India has been variously estimated (Fernandes, Das and Rao (1989) and Roy (1999).

Other forms of water-power, such as wave and tidal power are also being developed. Again, they cannot provide a viable alternative to fossil fuel power generation. At present, there is only one large-scale commercial tidal power station in the world, the La Rance Tidal Power Plant in Brittany, France. However, almost all the countries in the world offering conducive geographical conditions have started harnessing the tidal power.

Geothermal Energy is another form of non-conventional source of energy. As the name suggests, this form of energy uses naturally occurring heat in the Earth's crust and is only really viable in areas of volcanic activity. There are two forms of geothermal energy. One is wet-rock geothermal energy where steam or hot water is trapped from boreholes or surface vents and used to heat buildings or generates electricity. The other is hot-dry geothermal energy, which is accessed by boreholes drilled into hot dry rocks. The water is then forced down and the steam is used to generate electricity. Geothermal energy, by its very nature, is a highly localised energy source and requires careful management.

In nearly all of the above cases, renewable energy seems to be capable of providing localised, small-scale solutions to ever-growing energy needs. At present, renewable energy sources do not provide a viable alternative to fossil fuels. Furthermore, most of these alternatives require considerable capital investment and access to advanced technology. Therefore, they do not offer a solution to the fast-growing energy needs of the 'developing world'. However, the 'developed world' can afford to develop renewable energy technologies and considerable progress has been made. If fossil fuel prices remain high, it will stimulate investments in renewable energy and it will become a viable alternative for those who can afford it. Therefore, to provide a global solution on large scale, such technologies would need to be made available to the regions experiencing the most rapid increases in energy demand, particularly the global south.

7.11 THE CHANGING ENERGY MIX

It is evident from the preceding discussion that relative importance of the various sources of energy varies across time and space. The balance between the various sources of energy in use is known as the energy mix. During the last century, there was a substantial change in the global energy mix. But as Table 7.4 shows, there still remains a substantial regional variation. The evolution of the energy mix tends to be linked to the development of the industrialised world, simply because it accounts for most of the world's energy consumption.

In Table 7.4, region-wise consumption of Oil, Natural Gas, Coal, Nuclear and Hydro-Electricity power has been shown. Data for the year 2020 reveal that highest consumption i.e., 67.15 exajoules of oil energy is recorded in Asia Pacific region followed by 39.27 exajoules in North America. Commonwealth of Independent States (CIS) consumes 8.19 exajoules and lowest consumption of 7.19 exajoules oil energy is found in Africa region. Facts of natural Gas energy consumption reveal that North America region consumes 37.11 exajoules energy followed by Asia Pacific i.e., 31.02 exajoules. In low consumption category, South and Central America region exhibit 5.24

exajoules energy consumption. Astonishing fact about coal energy consumption is that Asia Pacific recorded highest consumption i.e., 120.97 exajoules among all regions. In contrast, other regions recorded less than 10 exajoules energy consumption in which Middle East region recorded lowest i.e., 0.38 exajoules energy consumption. The statistics of Nuclear energy consumption in 2020 shows that North America region ranks first with 8.35 exajoules energy consumption followed by Europe with 7.44 exajoules. Middle East region, Africa, and South and Central America region recorded less than 0.5 exajoules nuclear energy consumption. Hydro-electricity power energy consumption data reveal that Asia Pacific region consumes 16.41 exajoules energy which is highest among the regions. North America and Europe consumes 6.22 exajoules and 5.82 exajoules, respectively. Africa region and Middle East region consumed 1.27 exajoules and 0.23 exajoules, respectively and characterized with low hydro-electricity power energy consumption category.

Table 7.4: Primary Energy Consumption by Fuel* - 2020 (Consumption in Exajoules)

Major World Regions	Oil	Natural Gas	Coal	Nuclear	Hydroelectric Power	Total
North America	39.27	37.11	9.91	8.35	6.22	100.86
Europe	26.07	19.48	9.40	7.44	5.82	68.21
South and Central America	10.62	5.24	1.48	0.23	5.87	23.44
Africa	7.19	5.51	4.11	0.14	1.27	18.20
Middle East	15.71	19.88	0.38	0.07	0.23	36.27
Asia Pacific	67.15	31.02	120.97	5.82	16.41	241.36
Commonwealth of Independent States (CIS)	8.19	19.38	5.17	1.94	2.36	37.04
World	174.20	137.62	151.42	23.98	38.16	525.39

(Source: BP Statistical Review of World Energy (2021:11), Also available at: www.bp.com)

*Includes commercially traded fuels only. Therefore, excludes wood, peat and animal waste as fuels.

Table 7.5 and Fig. 7.8 show region-wise share of primary energy consumption of selected fuels for the year 2020. Statistics reveal that North America recorded the largest (22.54 percent) oil energy consumption share of the world. Asia Pacific region shares 38.55 percent of world's oil energy consumption. Africa shares lowest consumption i.e., about 4 percent of the world. Data of Natural Gas energy consumption share to total world consumption figures out that North America has highest share (about 30 percent) followed by Asia Pacific (22.54 percent). South and Central America region and Africa region shows 3.91 percent and 4 percent share, respectively. Region's share of the Coal energy consumption to world show that Asia Pacific region has about 80 percent share of consumption to the world consumption and rest 20 percent consumption is shared by North America (6.54 percent), Europe (6.21 percent), South and Central America (0.98 percent), Africa (2.71 percent), Middle East (0.25 percent) and CIS regions (3.41 percent). Worlds total Nuclear energy consumption is shared largely by North America (34.82 percent), Europe (31.03 percent) and Asia Pacific (24.27 percent) while South and Central America, Africa region and

Middle East region record less than 1 percent share to world's nuclear consumption. Commonwealth of Independent States (CIS) share about 8 percent nuclear energy consumption of the world. Data pertaining to Hydro-Electric Power (HEP) energy consumption of world reveal that Asia Pacific region shares 43 percent HEP of world's total consumption followed by North America with 16.30 percent and Europe region and South and Central America region each with about 15 percent. Middle East region records lowest share i.e., 0.60 percent of total HEP consumption.

Table 7.5: Global share of Primary Energy Consumption-2020 (Percent to Total World Consumption)*

Major World Regions	Oil	Natural Gas	Coal	Nuclear	HEP	Total
North America	22.54	26.97	6.54	34.82	16.30	19.20
Europe	14.97	14.15	6.21	31.03	15.25	12.98
South and Central America	6.10	3.81	0.98	0.96	15.38	4.46
Africa	4.13	4.00	2.71	0.58	3.33	3.46
Middle East	9.02	14.45	0.25	0.29	0.60	6.90
Asia Pacific	38.55	22.54	79.89	24.27	43.00	45.94
Commonwealth of Independent States (CIS)	4.70	14.08	3.41	8.09	6.18	7.05
World	100	100	100	100	100	100

(Source: BP Statistical Review of World Energy (2021: pp: 11-12), Also available at: www.bp.com)

*Includes commercially traded fuels only. Therefore, excludes wood, peat and animal waste as fuels.

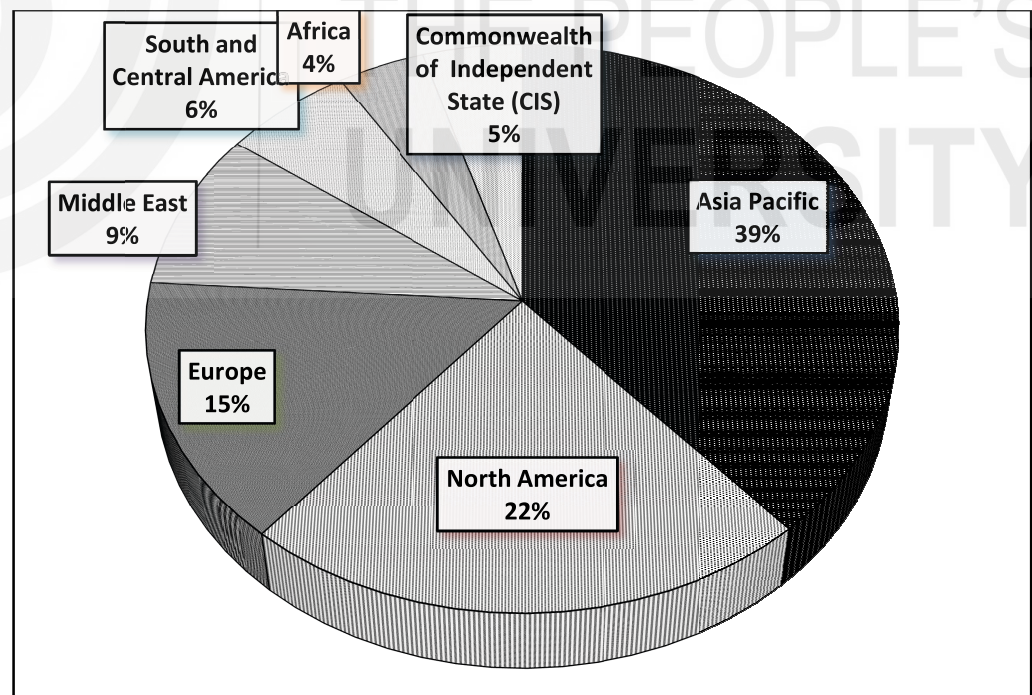


Fig. 7.8: Global share of Primary Energy Consumption, 2020.

At the beginning of the twentieth century, coal was by far the most important energy resource in the industrialised world. The oil industry was still in its early stages. The first modern oil well was drilled in Pennsylvania in the United States in 1859. Natural gas was not recognised as a resource at all. It was not until after the Second World War that the dominance of coal was

threatened. Advances in transportation technology, such as the invention of the jet engine and the emergence of a petrochemicals industry led to a rapid increase in the demand for oil in the post-war boom years. In 1950, coal accounted for 61 percent of the world's commercial energy consumption and oil 27 percent. By 1970, coal had fallen to 30 percent whereas oil had increased to 44 percent and natural gas to 20 percent. The absolute level of coal production did not decline (in fact, at a global scale coal production continues to increase). The rapid economic growth experienced by the developed world was instead increasingly underpinned by oil and, more recently, by natural gas. The recent 'dash-for-gas' in the developed world is being driven by a desire to reduce dependence on oil imported from the Middle East and by the fact that using natural gas to produce electricity produces less greenhouse gases than coal or oil. Thus, in the past hundred years, the energy mix in the industrialised world has gone through two major transitions, from coal to oil and from oil to gas. These energy transitions have not been a universal experience. It is more evident from Table 7.4 that energy mix in the developing world is somewhat different. For the most part, the developing world remains more dependent upon oil for its commercial energy and in some regions, coal remains the dominant resource. For example, in China in 2006, coal accounted for 70 percent of commercial energy production and China accounts for 38.5 percent of global coal consumption. In fact over the past few years, China has met its growing energy needs by burning more coal, which has raised obvious concerns about climate change. Elsewhere dependence upon oil has made the developing world particularly vulnerable to the sudden increases in oil prices, which have been experienced at times over the past three decades.

But, unlike the developed world, these economies lack the capital and technology to develop their own energy potential or to diversify their energy mix. However, as the developed world has depleted its own sources of oil and gas, it has become increasingly dependent upon supplies from the developing world. Thus, there has been a marked change in the geography of energy production and, to a lesser extent, consumption. Thus, for the international oil companies the age of 'easy oil' is over and they must now make do with access to the most technologically and environmentally challenging fields.

SAQ 5

What is energy mix? Discuss with examples.

7.12 CHANGING GEOGRAPHY OF ENERGY PRODUCTION AND CONSUMPTION

In 1950, North America, Europe, and the Soviet Union accounted for nearly 90 percent of world energy demand. However by 1990s, their share had fallen to two-thirds (Jones and Hollier, 1997). In 1997, the member states of the Organisation for Economic Cooperation and Development (OECD) accounted for 58.4 percent of global energy consumption but by 2006, this had fallen to 50.1 percent (Table 7.3). The redistribution of the global pattern of energy consumption has not been due to decline in the developed world. Although,

during 1990s, this has been the case in the so-called 'transition economies', corresponding to increased demand in the developing world.

Table 7.4 provides information on energy consumption and efficiency by major world region and income group. It illustrates the substantial variations that exist in terms of level of per capita energy use and energy intensity. The high-income countries have by far the highest level of energy use. The high levels of usage in the middle-income countries and in Europe and Eurasia reflect the energy legacies of the post-socialist states in Central Europe and the former Soviet Union. Table 7.6 shows that in 2017, per capita carbon dioxide emission for world was 5 metric ton. About 11 metric ton carbon dioxide emissions from cement manufacturing and the combustion of fossil fuels came from the high-income countries. Regional analysis of CO₂ emission data reveals that the largest emitter is the United States exhibiting 16.1 metric ton CO₂ emission per capita. In the developing world, China and India are the major emitters. Over the past decade or so, there has been a global shift in the energy system. The growing populations and developing economies of the countries like Brazil, India and China is driving the growth of energy demand, while the developed economies are seeking to reduce their levels of energy consumption. According to data given in Table 7.6, low income and middle-income regions have about less than 1 metric ton per capita CO₂ emissions. This differential energy consumption and efficiency has major implications for the geography of energy production, consumption and for global geopolitics.

Table 7.6: Energy Consumption and Efficiency

Major World Regions	Energy use per capita (kg oil equivalent)	CO ₂ emissions per capita (Metric Ton)
World	1929	5.0
Low Income	---	0.3
Middle Income	1451	0.6
Lower Middle Income	651	1.4
Upper Middle Income	2192	6.6
High Income	4605	11
North America	6871	16.1
East Asia and Pacific	2137	6.3
Europe and Central Asia	3157	7.3
Latin America and Caribbean	1337	3.0
Middle East and North Africa	2365	6.0
South Asia	576	1.4
Sub-Saharan Africa	701	0.8

(Source: World Bank (2017). The Little Green Data Book 2017. Also available at: www.worldbank.org)

There are at least three elements to the geography of energy production, which include the global distribution of reserves, the distribution of energy production and consumption and the resultant pattern of trade between energy surplus and energy-deficit regions. As indicated earlier, the potential to produce coal, oil and natural gas is geologically determined. But whether or not a given deposit is exploited depends on a whole host of factors.

7.13 ENERGY CONSERVATION STRATEGY

Every human being uses energy everyday for multifarious activities and purposes such as cooking, lighting, heating and cooling, manufacturing and transportation etc. As mentioned earlier, global demand for energy is increasing, particularly in developing countries. Fossil fuel is still at the centre of energy production in these countries. Per capita energy consumption has grown rapidly over the last decades all across the world. It necessitates urgency of conserving energy for sustainable development. Energy conservation refers to the efforts aimed at reducing overall energy consumption. Reducing the use of electricity causes less fossil fuel to be burned to provide that amount of electricity. Thus, energy conservation can result in improving environmental quality and betterment of economy.

7.13.1 Understanding and Changing Modern Life Styles

The modern highly mechanised lifestyle is very much responsible for higher energy consumption, and, thus, emitting more greenhouse gases in the atmosphere. The main objective of energy conservation is using less energy to achieve a lesser energy service. Individual behavioural change towards use of energy is very essential for energy conservation. A slight attitudinal and responsible change in individual habits such as controlling heating system in a room as per temperature change, using more public transport and increasing the use of daylight in the buildings can be very helpful. Scientific inventions are also helping to change behavioural patterns. Setting computers, monitors, and copiers to sleep-mode when not in use helps cut energy costs by approximately 40 percent.

7.13.2 Increasing Efficiency in Energy Use

Efficient energy use is an important tool to achieve energy conservation. There are different sectors which need to promote energy efficiency and conservation all across the world, which include the following three sectors:

- i) Industrial:** It could be achieved through greater use of efficient motors, efficient lighting, heating, compressed air management, ventilation and cooling systems. Energy efficiency in major energy guzzling industries such as cement, steel, aluminium, and fertilizer needs to be increased through large scale adoption of energy efficient technologies.
- ii) Automobiles:** It needs to adopt modern internal combustion engines, which can use fossil fuels blended with bio-fuels (ethanol and biodiesel). Environment friendly body designs, energy-saving tires and optimization of painting processes have increased the overall energy efficiency of automobile and transport, while reducing the amount of CO₂ emissions from combustion.
- iii) Buildings:** Both residential and commercial consumers, account for about one-fifth of the world's total delivered energy consumption. For residential buildings, the size of the structure affects the amount of energy used by its occupants. Although, local weather and climate may also affect the amount of energy consumed. Larger homes generally require more energy to provide heating, air conditioning and lighting. Modern automatic devices can help in

saving energy by using infrared sensors, motion sensors, automatic timers, and dimmers to switch on or off electrical circuits as per the actual requirements.

7.13.3 Reducing Transmission and Distribution Losses

All electricity transmission and distribution systems have inherent energy losses associated with its mechanical equipments. Generally, electrical energy cannot be stored and therefore, it must be generated as much as it is needed. The difference between the total power production and total consumption is called transmission and distribution losses. Therefore, controlling the power generation is an important thing to ensure the optimum use of power. Transmission and distribution loss is the main hindrance to commercial viability of electricity distribution companies. Replacing existing transformers and wires with higher efficiency quality products and end-use consumer improvements can help in reducing transmission and distribution losses. It will help in conservation of energy.

SAQ 6

Briefly tell about energy conservation with suitable examples.

7.14 SUMMARY

In this Unit, you have learnt the following:

- From time immemorial to the present day, human society has been immensely dependent on the Earth's crust and nature for numerous mineral and energy resources.
- Minerals are unevenly distributed worldwide and so is their uneven consumption level.
- The developed nations use and consume much more minerals than developing nations.
- The mineral and energy resources have been categorized in different categories on different bases.
- This categorization provides us broad understanding about the availability, usage, exploitation and conservation of resources.
- Given the fact that the resources available are finite on the planet and their demand is infinitely increasing with increasing population. Therefore, sustainable ways to conserve resources both renewable and non-renewable is need of the hour. We need to use our resources judiciously and save them for our future generations.

7.15 TERMINAL QUESTIONS

1. Describe different types of minerals with appropriate examples.
2. Explain the strategies for conservation of mineral resources.

3. Explain renewable sources of energy. Why are the sources of renewable energy not viable alternative to the growing energy needs of developing world?
4. Elaborate upon changing geography of energy production and consumption over time with examples.
5. Explain the strategies for conservation of energy resources.

7.16 ANSWERS

Self-Assessment Questions (SAQ)

1. A mineral is a pure inorganic substance which occurs naturally in the Earth's crust. It has an orderly internal structure and characteristic chemical composition, crystal form and physical properties.
2. The resources are varied and of many types. Natural resources can be classified on five bases i.e., i) their level of development and use; ii) origin; iii) exhaustibility or stock; iv) distribution and v) stage of development.
3. Non-metallic minerals do not contain any metals in their chemical composition, hence called as non-metallic. These do not shine on their own. These are generally obtained from sedimentary rocks. These are not ductile and brittle.
4. Fossil fuels namely coal, oil and natural gas account for over 85 percent of the annual sale of the world's most important minerals. These resources were formed from the decomposition of organic materials millions of years ago and have been subsequently transformed by heat and pressure into coal, oil, and natural gas. They represent the classic, non-renewable resources found in specific locations and in a variety of forms and conditions.
5. We know there are different types of energy resources. Some of them are non-renewable such as coal, oil and natural gas and some renewable which include Biomass energy, Solar energy, Wind power and Hydropower to name a few. The relative importance of these various sources of energy varies across time and space. The balance between these different sources of energy is known as the energy mix.
6. Energy conservation refers to the efforts made to reduce overall energy consumption without compromising the development of any society. Energy conservation can result in improving environmental quality and economy over a longer period of time.

Terminal Questions

1. Your answer should include the description of different types of minerals with appropriate examples. Refer to Section 7.4.
2. You should cover the key strategies for conservation of mineral resources in your answer. Refer to Section 7.8.

3. Discuss renewable sources of energy and also highlight their viability to meet the energy demand of developing world. Refer to sub-Section 7.10.1.
4. Your answer should include the latest debate on changing geography of energy production and consumption with suitable examples. Refer to Section 7.12.
5. You should cover the key strategies for conservation of energy resources in your answer. Refer to Section 7.13.

7.17 REFERENCES AND FURTHER SUGGESTED READING

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12. Thomson, I and Boutilier, RG. (2011). *Social License to Operate*. In: Darling P (ed) *SME Mining Engineering Handbook*. 3rd Edition. Society for Mining, Metallurgy and Exploration, Inc, Englewood. pp.1779-1796.

13. Wellmer & Becker. (2007). *Global Non-Fuel Mineral Resources and Sustainability*. US Geological Survey Circular 1294, p16.
14. www.preservearticles.com

Useful Websites:

There is a huge amount of material available on the Web that relates to the issues discussed in this Unit. Some of the key reference sources are listed below; additional websites have been referenced in the main text also.

www.bp.com/centres/energy

www.iea.org

www.eia.doe.org

www.worldbank.org

www.wri.org



HUMAN RESOURCES |

Structure

8.1	Introduction	8.6	Employment and Unemployment
	Expected Learning Outcomes	8.7	Summary
8.2	Concept of Human Resource	8.8	Terminal Questions
8.3	Size of Population	8.9	Answers
8.4	Working Population	8.10	References and Further Suggested Reading
8.5	Work Participation		

8.1 INTRODUCTION

Human Resources are considered as ultimate of all resources for any community, society, economy and nation as well. They form the greatest order of asset in any geographical region irrespective of developed and underdeveloped parts of the world. You may easily surmise the case of a developed country on one side whereas developing and less developed countries on the other side. All the natural stuff or in other words, bounties of nature become important only when humans bring these into utilisation and make it useful for attaining their multifarious functional requirements. Their needs, wants, and requirements to live and carry out livelihood activities makes all the forms of natural resources into a valuable resource, otherwise, they just remain either neutral or non-existent. Predominantly, any human society or social group tends to progress and transcend the paths of various stages of economic growth on the basis of their quality, quantity along with diversity of human resources. It varies from one society or nation to other within the same continent and across the continents. The concept of human resources was realised by the human beings and they started transforming themselves with the help of expanding knowledge, technological inputs, capital and others. It gives us a direct measure of the development and quality of life of denizens of a geographical area, society and a nation as well.

In the previous Units 5 to 7 of this Block 2, you have studied and learnt about the concept and classification of resources, natural resources including land, soil, forest, and water along with minerals and energy etc. In Unit 8, we will describe about the human resources and its various dimensions. In order to provide a systematic idea, we have dealt with the concept of human

resources in Section 8.2. Next three Sections 8.3, 8.4, and 8.5 have been devoted to the study of size of population, working population and work participation. Last Section i.e., 8.6 deals with the very important twin concepts of employment and unemployment and their associated issues and problems. As a whole, this Unit provides you a brief idea about the nuanced understanding concerning the human resources.

Expected Learning Outcomes

After studying this unit, you should be able to:

- explain the concept of human resources;
- discuss the size of population;
- describe the working population and work participation; and
- explain the nuances related to the twin issues of employment and unemployment.

8.2 CONCEPT OF HUMAN RESOURCES

It is believed that the seeds of modern economy-based development are sown on the basis of resources, primarily presupposed to be natural resources in its myriad forms which you have learnt in Unit 6 of Block 2 of this course. However, all of you are also well aware that natural resources attain the economic value only when harnessed and utilised by the human agencies, since the very beginning of human civilisation. All these parameters differ across the human societies and nations of the world. Therefore, needless to say that it is of paramount importance to learn the concept of human resources. It deals with the issues of quality, quantity and diversity related aspects.

Human resources are defined not only in terms of their sheer numbers, but it also includes certain specific qualitative traits. These may include qualities as possessed by the humans, which is being created and cultivated through formal education (which may include trio of academic, vocational and professional qualities), along with both formal and informal trainings. It is on the basis of these qualities, which makes it possible to harness and utilise the resources both natural and human to satisfy human needs and wants. Typically, human resources may encompass knowledge, skill, religious and spiritual values and technological prowess along with many others. All of these together may help to define the broader contours of modern economic development in any geographical region on the surface of planet Earth. It is not a difficult question for all of us to think and visualise the two instances of modern economic development of any country on the basis of above-mentioned factors. You may think of few Asian giant nations on the one hand and countries of African continents on the other hand. As we know that human beings act both as a producer as well as consumer of resources. His/her role in terms of producer may circumvent around the factors of labour, skills, cognitive and physical capabilities, etc. Human being is well known to evolve methods as well as technology to enhance the productivity of goods and services. With the help of cultural ingenuity and diversity, man produces umpteen resources. His/her role in terms of consumer is of paramount importance which leads to the initiation of whole process of resource creation

to satiate and satisfy their needs and wants. In this process, human resources are employed to produce many kinds of goods and services, for the purpose of proper consumption. In this prism, human beings are located at the centre, from where they act both as a producer and consumer alike. Therefore, human beings not only act in a two-way lane of producer and consumer relationship, however, they are equally known for their cognitive capability which enables them to plan and utilise resources in a befitting manner.

In this way, we can say that human beings play a two-fold role to harness and develop both kinds of the resources, including natural and human from its intrinsic state to active state.

SAQ I

Define the concept of human resources.

8.3 SIZE OF POPULATION

We know that all of you are familiar with the meaning of size of population as learnt in your second semester course titled 'Human Geography'. You learnt that it is indicative of the total number of people residing in a particular geographical region, place or an administrative unit. Human beings are considered as both consumers and producers of resources. Study of their numbers and other characteristics are very essential to assess the human-resource relationship in any geographical region or administrative unit of one particular nation. This relationship tends to inevitably vary over space and time. Three known factors responsible for heralding a population change are birth, death, and migration. Natural increase of population indicates the difference between birth rate and death rate. You have learnt in third semester course that there are varied sources of population data which varies on the basis of use and need of a researcher, academician, and scientists or a professional. Population data is usually collected through the Census Surveys on a regular and periodical basis by a large number of countries in the world. Besides, few important international agencies such as United Nations also generate population data in case of few select demographic variables. You may refer the website of United Nations (www.un.org) for further information. Besides, you may also explore the website of Census of India (COI), to know about the same and its regional dimensions as well.

As you are aware that population increase and its effects are quite unevenly distributed across the countries or nations of the world. Such uneven patterns of cause-and-effect relationship is believed to be taking place on account of uneven distribution of natural resources as well as human resources on the only inhabitable planet Earth. Both of these are characterised by their diverse nature and varieties. In turn, it also gets influenced and further accentuated by the availability and level of technological prowess which enables the people to generate altogether newer human resources to make the living increasingly better in a sustainable manner as enshrined in the Sustainable Development Goals (SDGs) by the UNDP.

The population is considered as the ultimate resource as it is only on account of ingenuity of humans which makes possible to harness the natural resources for betterment and so-called modern development as mentioned earlier. It depends not on the whole gamut of availability of natural resources including land, water, soil, natural vegetation and mineral etc., but also largely depends on the cultural and social characteristics of the people, who utilise resources by performing economic activities. In this process of human-nature resource relationship, however, it also gives birth to the issues of resource exploitation in terms of misuse, abuse and overuse, which often exceeds the limits of natural replenishment levels. Alongside, the issue of resource degradation also hampers the quality of resources as well. There are certain parameters, which can be used to quantify or in other words to measure the size of population. Two of the common parameters are total population and the number of people residing per unit of area, which is also known as **‘density of population’**.

Many scholars postulated their ideas centered on the concept of population and its size while dealing with population theory and policies. One of the pioneering writings goes back to the German Professor, named Karl Winkelblech (1810-1865), who tried to classify the nations into three categories on the basis of size of their population as under:

- (1) Under-populated nations;
- (2) Over-populated nations; and
- (3) Nations with normal populations, which means a favourable population size conducive for best possible output.

The above discussion may ignite your cognitive domain to ponder over the crucial issue of ideal size of population. You may think about few fundamental questions. Will it be possible to have uniform density of population across the nations of the world? What are the important factors including both physical and human, which helps to decide the size and density of population across the geographical realm from macro to micro levels? Whether the growth of population is not good? If yes, then why fertility is being worshiped in one or the other form across varied cultural mosaics? What are the factors which propels some geographical regions to face the issues of imbalance in their population size and high density of population during the contemporary times? What are the central and key filaments that augur and establish the so-called ideal or sustainable relationship between resources on one side and population size on the other side? Is it necessary that ever-increasing contours of technological prowess in its multi-faceted forms may help to rear much bigger size of human population on the only inhabitable planet i.e., planet Earth in the solar system? The whole idea may rest upon the key question as how to address the issues of ever-depleting natural resources of the planet Earth to evoke and sustain the concept of sustainability in a harmonious manner. You will agree with us that these issues are extremely important so as to keep the future of future generations secure.

Besides, you also learnt about the concept of ‘optimum population’ which is categorised into three important types such as under population, over population and optimum population, each characterised with its distinctly

associated human features. Now, we will discuss about the population size and life expectancy in major regional areas of the world.

Table 8.1: Population Size and Life Expectancy in Major Regional Areas of the World, 2022

Major Regional Areas	Population (in Millions)	Life Expectancy (in Years)	
		Male	Female
Arab States	393	70	74
Asia and the Pacific	4,149	71	75
Eastern Europe and Central Asia	251	71	78
Latin American and Caribbean	661	73	79
East and Southern Africa	649	62	67
West and Central Africa	483	58	60
More developed regions	1,277	77	83
Less developed regions	6,677	70	74
Least developed countries	1,107	64	68
World Total	7,954	71	76

(Source: <https://www.unfpa.org/data/world-population-dashboard>)

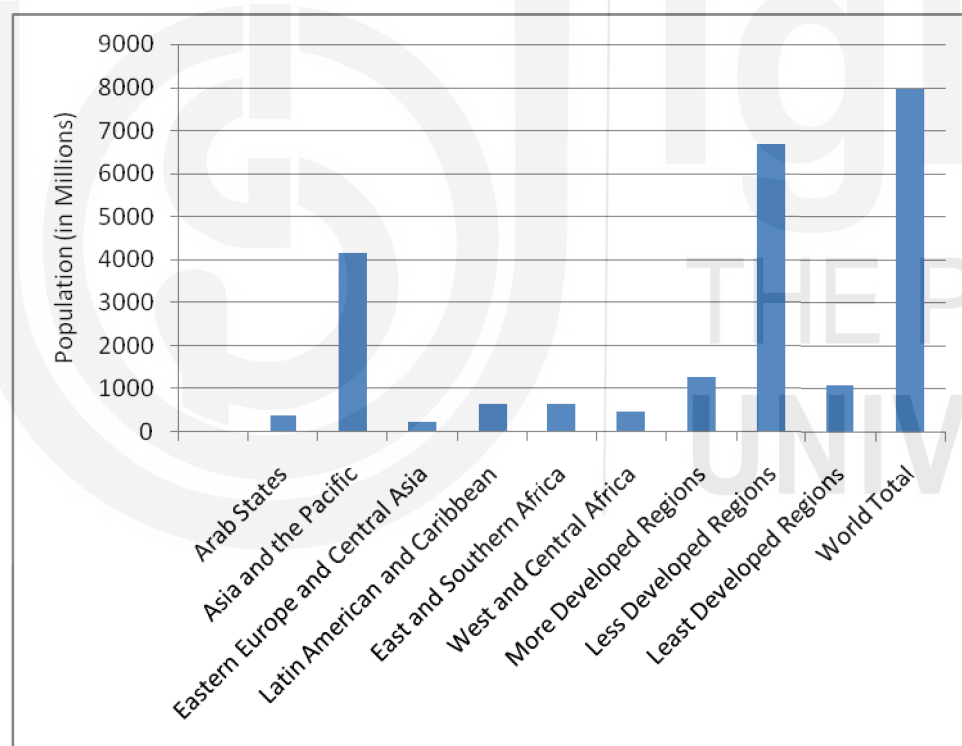


Fig. 8.1: Population Size in Major Regional Areas of the World, 2022.

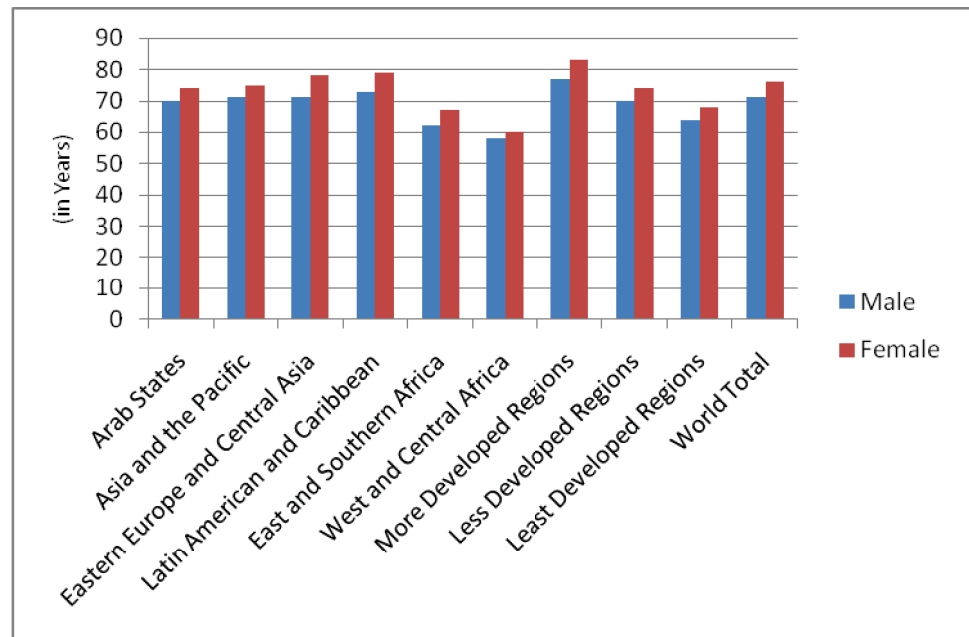


Fig. 8.2: Life Expectancy in Major Regional Areas of the World, 2022.

It is evident from Table 8.1 and Fig. 8.1 that nearly three-fourth proportion of population size is concentrated in the less developed regions of the world. On the other hand, both including more developed regions and less developed countries occupied nearly 10 percent of total population of the world. If we examine the broad regional level concentration of population size, Asia and Pacific regions tops the list whereas Eastern Europe and Central Asian regions are positioned at the bottom of the list. Approximately, an equal proportion of next highest population size is concentrated in two regional areas including Latin American and Caribbean regions along with East and Southern Africa. These are followed by West and Central Africa and Arab states in the descending order of population size. Life expectancy is also much better in developed parts as compared to less developed and least developed nations of the world in case of both genders i.e., male and females as shown in Table 8.1 and Fig. 8.2. Economy of developed nations is characterized by large proportion of educated and professional workers engaged in tertiary, quaternary and quinary sectors whereas it is largely both educated (could be at different levels) and uneducated workers engaged in primary and secondary sectors in case of developing and least developed nations of the world.

SAQ 2

What is the size of population?

8.4 WORKING POPULATION

In ancient times, human being's role in terms of human resources were not accorded its due importance and proper attention, by and large. However, soon after the concept of resource was coined by Zimmermann, the role of human beings got a boost as far as the process of resource creation is concerned. He opined that "man's own wisdom is his premier resource—the key resource that unlocks the universe". It means that it is the human being

who makes the host of precious resources to acquire its utility, which otherwise is a neutral stuff lying in the precinct of natural environment as discussed earlier.

International Labour Organisation (ILO) defined working-age population above the legal working age of population. However, it includes all persons above a specified minimum age threshold, who are involved in economic activity as far as statistical purpose is concerned. The working-age population is often defined as all persons aged 15 and older which may differ from one nation to other nation according to their own laws and economic practices (few nations make use of upper age limit). In 2019, there were around 5.7 billion persons in the entire world, who were under the bracket of eligible working age population as per ILO. Out of these, around 3.3 billion (57 percent) were employed whereas remainder 2.3 billion (39 percent) were left out of the labour force, per se. The potential of 473 million working age population remains untapped and unharnessed corresponding to their volume. In case of youth working age population i.e., 15-24 years as defined by ILO, it is 1.2 billion. Out of this, 36 percent comprising 429 million youth were in employment, 42 percent comprising 509 million youth were undergoing educational pursuits coupled with training. And, 22 percent comprising 267 million youth were neither under employment nor under education and training, etc. Therefore, it portrays a difficult picture as nearly one fourth of the youth working age population is not meaningfully engaged.

As per the definition coined by Organisation for Economic Co-operation and Development (OECD), it refers to “the working age population defined as those aged between 15 to 59 years”. However, in case of developed parts of the world, this value is taken between 15 to 64 years. This indicator measures the share of the working age population out of total population. Working population means the proportion of population, who are either employed in some specific professional activity or are looking for employment avenues.

SAQ 3

What is working population?

8.5 WORK PARTICIPATION

Needless to say, that labour forms a very important factor as far as productions of articles/products in an economy are concerned. Two aspects of labour are considered as a backbone of any economy. First one is quantity (in terms of size of labour) and second one is qualitative aspects (skills, capabilities and associated aspects) of labour force. Their engagement into varied range of economic activities gives us a clue to guess the levels of development of a particular area/region of the world. You have learnt the distinct features of range of diverse economic activities, their classification along with types in Unit 3 of this course. Among the major branches of geography, physical or human both exhibit a characteristic pattern evident in the overall arrangement of things, objects, events and phenomenon etc. Such patterns are also evident in the socio-economic traits of population, which have remained a nodal point of population geography. Here, it is concerned

with the economic characteristics of population, like work participation rate. It can be seen in terms of share of workforce or labour force to that of total population engaged into economic activities for eking out their livelihood and sustenance. Albeit, these two terms namely work force and labour force are used interchangeably. However, there is a subtle difference between the two. Work force refers to the absolutely or actually employed proportion of workers whereas labour force refers to the proportion of working population which can potentially be employed in one or other corresponding type or set of economic activities. It acts as a kind of indicator to gauge the economy of a human community, society or we can say a nation. Work participation rate of any region is determined by range of factors like physical, historical, socio-cultural, demographic, economic and institutional, etc.

There are various methods available to measure the work participation rate. Such kinds of measures provide us an idea about the proportion of various categories of working population engaged into the economic activities. Few of such commonly known measures along with their formulae to calculate work participation rate are discussed as below:

1. Crude Work Participation Rate: It is also known by acronym CWPR.

$$\text{CWPR} = \frac{\text{TW} \times 100}{\text{TP}}$$

Where, TW means total workers available in the population at a given time; TP means total population at that time.

It can be calculated for other binaries of human beings, in terms of gender-wise, area-wise (whether rural or urban habitat), caste-wise and by certain other indicators. However, it is just a crude measure of workforce as it considers the total population as a denominator. Total population does not exclude the children as well as senile group of population or senior citizens from the measure, which actually remains outside the ambit of definition of workforce, per se.

Therefore, a room for refinement gives way to another better measure. However, it depends upon the availability of suitable and appropriate secondary or primary data as per the question under investigation. It is known as work participation rate or WPR.

2. Work Participation Rate: It corresponds to the working population, or in other words, working age-groups, which is 15-59 years in case of developing countries whereas it is considered as 15-64 years in case of developed countries of the world. This second measure provides a better picture as compared to CWPR.

$$\text{WPR} = \frac{\text{Total workers between the age-group 15-59 years}}{\text{Total population between the age-group 15-59 years}} \times 100$$

As like first measure, it can also be calculated for other physiological, socio-cultural and economic aspects as mentioned earlier. Likewise, it can also be calculated in case of labour force as discussed below.

3. Labour Force Participation Rate: As stated earlier, this indicates the total number of workers (actually and actively employed) plus who are actively

searching for avenues of work. It can be expressed as a percentage of working age population.

$$\text{LFPR} = \frac{\text{No. of workers available in labour force}}{\text{Total population between the age-group 15-59 years}} \times 100$$

In other words, we can say that LFPR indicates the twin concepts of employment and unemployment. Those workers, who are actually and actively employed in economic activities and are getting paid along with self-employed category of workers, refers to the situation of employment on the one hand. Other situation indicates to the case of unemployment whereby the significant proportion of working age-group is without work and are actively seeking or searching and eagerly willing to work. These two concepts are far from simple. Hence, we are separately discussing these two in the next Section to understand it in a better manner.

Besides, one more prominent measure which is known as 'workforce structure' is commonly employed to calculate the percentage of economically active population being employed across sectors of the economy. It refers to the three traditionally defined sectors of economy by a renowned scholar named 'Collin Clark' in 1951. These are known as primary, secondary and tertiary as studied by you in Unit 3 of this course, as mentioned earlier. Later on, tertiary sector was further sub-divided into two higher order sub-sectors namely quaternary and quinary sectors.

SAQ 4

What is labour force participation rate?

8.6 EMPLOYMENT AND UNEMPLOYMENT

Twin concepts of employment and unemployment are closely interwoven with each other. Proportion or size of both invariably depends and governed by the levels of development of a concerned region under question. In other words, we can say that whenever the output in terms of production of goods and services accelerates in an economy, it leads to the corresponding increase in the employment size and vice-versa. Higher proportion of employment indicates higher levels of development whereas lower proportion is indicative of the under-utilisation of available labour force, per se. Thus, it exhibits the weakness of an economic system of a concerned nation to provide ample avenues of employment to the eagerly willing proportion of persons, who form the part of capable labour force. Usually in most of the least developed parts of the world, the nature of unemployment is found to be open and of disguised nature, characterized by structural deficiencies of myriad forms. These may result into serious issues related to the absorption of labour into any sort of gainful or productive economic activities (of various types corresponding to their nature and types).

Before initiating the discussion, let us get acquainted with the concept of these two as defined by apex international level organisation known as 'International Labour Organisation'.

1. As defined by ILO, 'employment comprises all persons of working age who, during a specified brief period (e.g., one week or one day), were found engaged under the following two categories:

- a) **Paid Employment:** Whether at work or having a job but not at work; or
- b) **Self-Employment:** Whether at work or with an enterprise but not at work.

It provides statistics of employment in terms of employment to workforce ratio for its 189 nations procured from their national sources. In other words, it refers to work participation rate (WPR) only.

2. As per ILO 'unemployment refers to a situation when all persons of working age were defined under the following heads:

- a) **Without Work during the Reference Period** i.e., were not in paid employment or self-employment;
- b) **Currently Available for Work** i.e., were available for paid employment or self-employment during the reference period; and
- c) **Seeking Work** i.e., had taken specific steps in a specified recent period to seek paid employment or self-employment.

Besides, it has also defined unemployment in terms of future starters. It includes persons who did not look for work but have a future labour market stake on account of skills, training or retraining schemes within employment promotion programmes.

Table 8.2 along with Fig's 8.3 and 8.4 shows the proportion of employment, unemployment, and labour force participation rate (LFPR), in major regions of the world for 2021. Alongside, the proportionate data for same indicators has also been provided in terms of income-group for 189 countries of the world. According to ILO, it includes four income-groups namely, lower income countries, lower-middle-income countries, upper-middle-income countries and high-income countries. As a whole, first indicator of employment to population ratio, which refers to workforce participation rate (15 years and above) is 57 percent (over 60 percent combined with Labour Force). Unemployment rate is 5.5 percent. In case of labour force participation rate, it is 60.3 percent in case of the total. However, it is remarkably higher among the males (73.8 percent) as compared to females (46.8 percent). This conforms to the patriarchal belief that it is the responsibility of male member, as a bread-earner for his family. However, this situation is comparable in developed parts of the world, where both male and female seems to be sharing this responsibility. In case of youth, LFPR stands at 40.7 percent, which itself indicate the prevailing magnitude of unemployment in the world.

Table 8.2: Proportion of Employment, Unemployment and Labour Force Participation Rate (LFPR) in Major Regions of the World, 2021

World/Income - Groups/Major Regions	Employment Ratio (15 years and above)	Unemployment Rate	LFPR			
			Total	Male	Female	Youth
World	57.0	5.5	60.3	73.8	46.8	40.7
Lower Income Countries (32)*	67.7	4.0	70.5	78.3	63.0	55.4
Lower-Middle-	52.1	5.3	55.1	75.6	34.0	34.5

Income Countries (45)						
Upper-Middle-Income Countries (53)	59.5	6.2	63.4	73.8	53.1	42.4
High-Income Countries (59)	57.4	4.9	60.3	67.9	52.9	45.1
North Africa (07)	40.3	11.7	45.6	69.2	22.2	27.1
Sub-Saharan Africa (47)	63.6	5.9	67.6	72.6	62.7	48.0
North America (02)	59.3	4.2	61.8	67.8	56.1	51.8
Latin America and the Caribbean (31)	58.6	8.2	63.9	76.5	51.8	48.5
Arab States (12)	46.9	8.1	51.1	77.4	17.9	27.2
East Asia (08)	63.6	4.2	66.4	74.1	58.5	44.5
South East Asia and Pacific (22)	65.0	3.2	67.1	78.4	56.1	47.0
South Asia (09)	47.9	5.4	50.6	76.8	23.0	31.2
Northern Southern and Western Europe (30)	53.6	6.9	57.6	63.6	52.0	43.3
Eastern Europe (10)	55.3	4.8	58.1	66.4	50.9	30.4
Central and West Asia (11)	52.6	9.3	58.0	72.5	44.3	42.5

(Source: World Employment and Social Outlook, Trends 2020, ILO, Geneva)

Note: Figures indicated in brackets shows the number of countries including both under income-groups and major regions of the World.

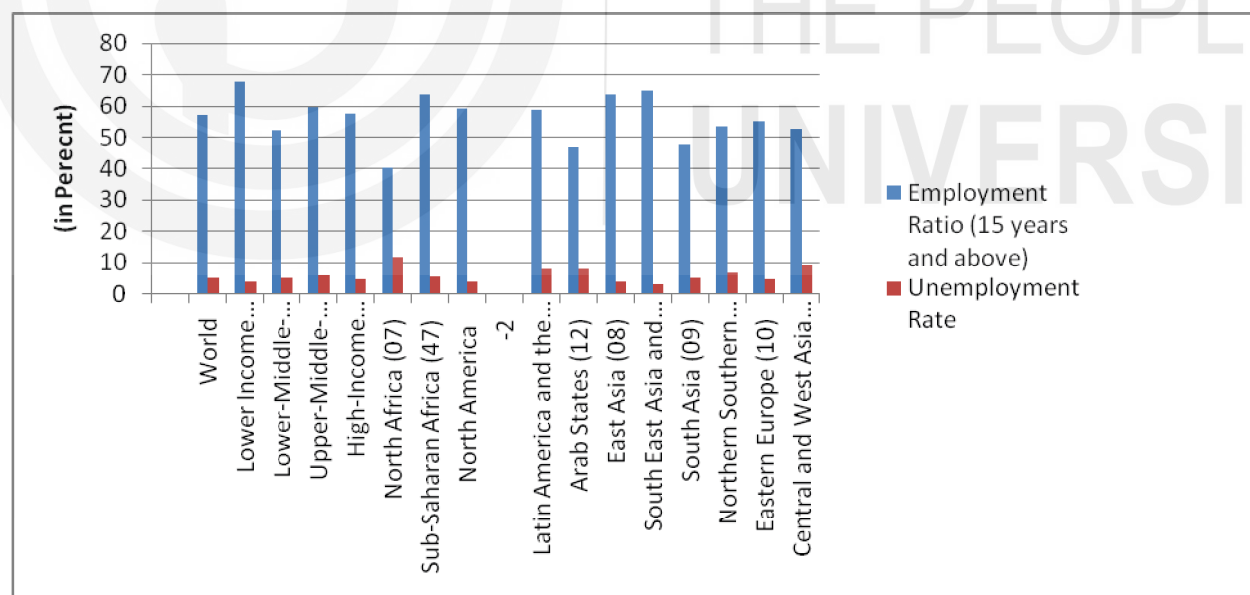


Fig. 8.3: Proportion of Employment and Unemployment in Major Regions of the World, 2021.

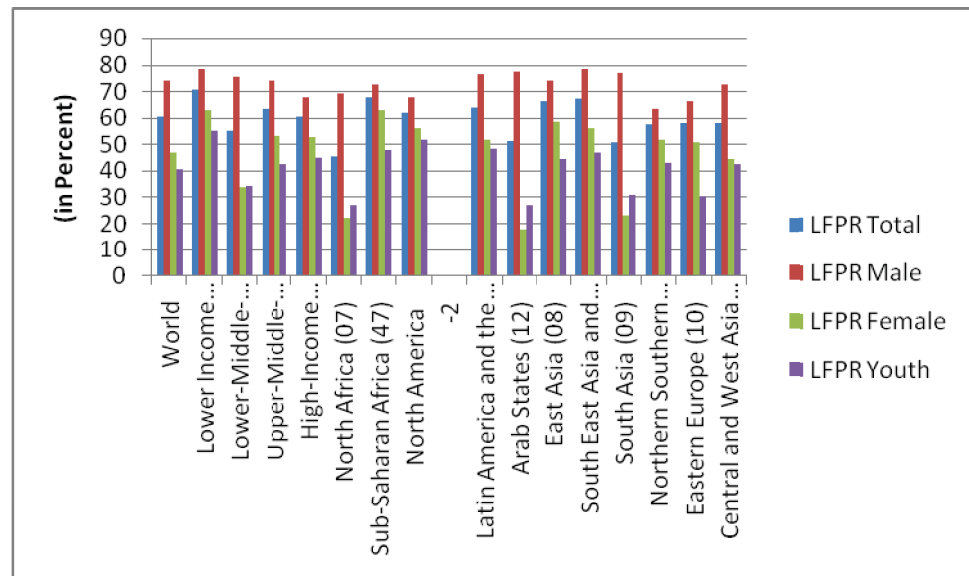


Fig. 8.4: Proportion of Labour Force Participation Rate (LFPR) in Major Regions of the World, 2021.

Among the different income-group countries, employment ratio is found to be highest in case of low-income countries whereas lowest in case of low-middle-income countries on one hand (due to prevalence of subsistence economy and ongoing pandemic which has further worsened the situation). On the other hand, both upper-middle-income countries and high-income countries show almost comparable proportion lying between highest and lowest percentage values. Unemployment rate is found to be highest in case of upper middle-income countries and lowest in case of low-income countries whereas lower-middle-income countries and high-income countries oscillated between these two extremes. Proportion of LFPR is found to be highest in case of low-income countries as far as total, male and female along with youth are concerned. However, the proportion of lowest and middle figures shows a variable picture. Now, we will discuss the situation pertaining in case of same indicators for major regions of the world.

On one hand, countries of North African region registered the lowest value of 40.3 percent followed by Arab States region with 46.9 percent and South Asian region with 47.9 percent in case of employment ratio. On the other hand, countries of South East Asia and Pacific region witnessed highest value of 65 percent followed by Sub-Saharan African and East Asian region, each with an equal value of 63.6 percent. Rest of the major regions of the world remained between these two values. Unemployment rate is found highest in North Africa closely followed by Central and West Asia, Latin America and Caribbean along with Arab States whereas lowest in South East Asia and Pacific region closely followed in equal proportion by North America and East Asia. Remainder of the regions stood between highest and lowest proportions. Proportion of total LFPR is found to be highest in case of countries of Sub-Saharan Africa (67.6 percent) closely followed by South East Asia and Pacific region (67.1 percent). Lowest figures are found in North America followed by South Asia and Arab States. In case of male, it is recorded highest in the countries of South East Asia and Pacific followed by Arab States and South Asia and lowest in Northern, Southern and Western Europe followed by Eastern Europe. In case of female, it is recorded highest

in the countries of Arab States followed by North Africa and South Asia whereas lowest in Sub-Saharan Africa and followed by East Asia. As far as LFPR for youth is concerned, countries of North America followed by Latin America and the Caribbean registered highest proportion whereas countries of North Africa and Arab States region show lowest proportions.

Besides these above-mentioned indicators of labour force, ILO also provides statistics for its member nations related to unemployment rates in terms of different variables. These encompass gender-wise, age-group wise, caste-wise, by rural and urban areas and by disability status along with education levels, different sectors of economy (as per three-fold classification scheme), etc. If you are further interested to know about different aspects and indicators of labour force, then you can explore the website of ILO (www.ilo.org), as already mentioned in previous Sections.

To compute the rate of unemployment, the proportion of unemployed persons is divided with that of total number of persons who comprise the labour force. As stated earlier, labour force denotes the total number of persons who are actually employed and the number of persons who are unemployed, but searching for work. In other words, we can say that in order to compute and measure the unemployment rate, we need to take into account both the components of employment and unemployment as well.

ILO has propounded a method to calculate unemployment rate (UR) as under:

$$\text{UR (\%)} = \frac{\text{Persons unemployed}}{\text{Labour force}} \times 100$$

$$\text{UR (\%)} = \frac{\text{Persons unemployed}}{\text{Persons employed} + \text{persons unemployed}} \times 100$$

Above-mentioned methods give us a clue to see the magnitude of prevailing situation of unemployment in an economy of a particular nation.

In India, National Sample Survey Office (NSSO) is the government agency, which has defined the twin concepts of employment and unemployment by taking cognizance of the ground reality through the conduct of sample surveys. After the survey, samples are split into two categories:

1. **First category** pertains to the persons who form a part of labour force and are looking for work. Those persons who are able to find employment (designated as a part of the workforce) and those persons who remain unemployed (designated as a part of the labour force).
2. The **second category** pertains to the persons who are not a part of the labour force, per se. It is concerned with the persons who are not looking for work on account of various reasons. Such reasons may include pursuing higher education, medical ailments, domestic and personal reasons etc.

Census of India (COI), has also classified the employment into two broad categories of workers as under:

1. **Workers:** It refers to any employable person who took part in any form of economically productive activity. Such work may be with or without compensation, wages or profit anytime during the preceding one year from

the enumeration date (taken as reference year). Such persons are classified as workers.

It is further divided into two sub-types as main workers and marginal workers. However, this division is based on the total number of days in a reference year, when a person/worker was engaged into employment or work.

- a) **Main Worker:** When a person/worker engages herself/himself for more than 183 days in a year.
- b) **Marginal Worker:** When a person/worker engages herself/himself for less than 183 days in a year. It conforms to the situation of partial unemployment in economy. The classic examples could be agriculture sector, construction and manufacturing activities, etc.

2. Non-workers: It is just the opposite of workers and simply refers to the persons who didn't work at all, are being classified as non-workers.

As you know that labour force is the aggregate term being used to denote the pool of human resources, who are ready and willing to get absorbed in the meaningful economic pursuits, work force is a part of the same. Therefore, any kinds of changes in one may affect the other in one way or other.

Besides this, 'National Sample Survey Office' (NSSO) has also propounded three concepts of unemployment. It is considered appropriate to the prevailing ground conditions of the country, since 1972-73. It is based on the Expert committee's recommendations on unemployment to develop and standardise the concepts and definitions entailing three closely related and inseparable issues of labour force, employment and unemployment. As understood, all of these three issues not only invariably govern but also facilitates to delineate the contours of well-being of the denizens as well as development of economy of a nation. These three concepts of unemployment are as under:

- 1. **Usual Status Unemployment:** This concept helps to determine the usual activity status of an employable person, which is counted in terms of employed or unemployed or outside the ambit of labour force in a reference period (usually taken as a year).

It refers to a '**Person Rate**' and indicates the chronic nature of unemployment in an economy. It counts all those persons as unemployed, who are found to be unemployed in the reference year (at the time of survey).

- 2. **The Current Weekly Status:** This concept helps to determine the activity status of an employable person with reference to a period of past one week. It takes into account all those persons as unemployed who are searching for employment, but are not able to get it, even for one hour on any day during reference period (past one week).

It refers to a '**Person Rate**' as like that of first concept.

- 3. **Current Daily Status Unemployment:** This third concept takes into account the activity status of an employable person for every single day for a reference period of past one week. If a person works for one hour but less than four hours (during any day in the reference period), is counted as worked for half day. Contrary to this, if a person works for four hour or

more (during any day in the reference period), is counted as worked for one full day.

It indicates a '**Time Rate**' against the person rate of first and second concepts of unemployment. Hence, it provides a better and appropriate measure as far as policy framework is concerned to address the chronic issues of open, partial and disguised forms of unemployment as mentioned earlier. In India, both the issues of chronic as well as discontinuous form of unemployment poses a challenge in front of the planners, academicians and scientists, policy makers and administrators alike.

We are sure that foregoing discussion on different aspects of human resources has not only acquainted you with the same, but it may also help you to comprehend the subtle details of myriad forms of economy and strengths and weaknesses along with existing gaps. It is not a difficult task for you to surmise that as to how one nation marches on the path of better development whereas many others are still lagging behind due to the prevalence of combination of unfavourable circumstances, inappropriate approaches and policies along with missed opportunities.

SAQ 5

Name two categories of employment and unemployment as defined by NSSO in India.

8.7 SUMMARY

In this unit, you have learnt the following:

- Concept of human resources along with its nuanced understanding.
- Size of the population and its importance.
- Nitty-gritty of working population and work participation in an economy, society and nation.
- Twin issues of employment and unemployment that affects the overall growth and development of a nation or a concerned geographical realm of the world.

8.8 TERMINAL QUESTIONS

1. What are human resources? Explain with apt examples.
2. Discuss the size of population.
3. Explain the work participation rate.
4. Define the concepts of employment and unemployment.

8.9 ANSWERS

Self-Assessment Questions (SAQ)

1. Human resources refer to the quality, quantity and diversity related aspects in their multifarious dimensions.

2. Size of population indicates the total number of people who are residing in a particular geographical region, place or an administrative unit.
3. Working-age population refers to the segment of total population, ready and capable for taking up gainful work or employment, above the legal working age of population.
4. LFPR refers to the total number of workers (actually and actively employed) and also those persons/workers who are actively searching for avenues of work.
5. First category refers to the part of labour force (persons searching for work) whereas second category refers to those persons, who are not a part of the labour force.

Terminal Questions

1. Your answer should include the meaning and explanation of human resources with suitable examples. Refer to Section 8.2.
2. Your answer should include the discussion on size of population. Refer to Section 8.3.
3. Your answer should include the explanation on the work participation rate. Refer to Section 8.4.
4. Your answer should define the concepts of employment and unemployment. Refer to Section 8.5.

8.10 REFERENCES AND FURTHER SUGGESTED READING

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5. MacKinnon, D. and Cumbers A. (2019). *An Introduction to Economic Geography Globalisation, Uneven Development, and Place*. Third Edition. Routledge. 2 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN.
6. www.oecd.org
7. www.ilo.org

GLOSSARY

Arable Land	: Land that can be used for ploughing.
Broad-leaved Deciduous Forests	: Vegetation type with broad-leaved trees that shed leaves seasonally and occurs between approximately 25° and 50° latitude in both hemispheres.
Broad-leaved Evergreen Forests	: Vegetation type with broad-leaved evergreen trees that occur between approximately 25° and 50° latitude in both the hemispheres.
Classification	: A process in which objects are differentiated and categorised based on appropriate criteria.
Conservation	: It means the judicious utilisation as per the actual requirement of human societies along with stopping the excess use or over-utilisation of natural resources so as to preserve and conserve it for the use of future generations.
Degradation	: Wearing down or deterioration of the quality, particularly of land.
Ecosystem Services	: The conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life.
Employment	: It refers to the proportion of workforce who is actually employed in one or other form of monetarily gainful economic activity.
Energy Mix	: It shows the balance between different sources of energy.
Energy Resources	: It refers to the renewable sources of energy like wind and solar energy, non-renewable sources of energy including fossil fuels and nuclear energy.
Fallow Land	: Land that was ploughed and successive crops harvested once, if not sown anymore and left uncultivated for a period of time, is known as fallow land.
Fossil Fuels	: Coal, oil, and natural gas are the major kinds.
Ground Water	: Water that is found beneath the surface of the earth the source of which is the seepage from rain, snow and ice melts that are stored in aquifers.
Human Resources	: It refers to the particular skills, abilities and capabilities in its multiple forms, which people of a particular cultural community or nation or geographical regions possess.
Land Cover	: Natural visible features of surface of the Earth.
Land Use	: Human modification of land covers into agricultural fields, farms, infrastructure, settlements and such built-

up space.

Mineral Resources	: It refers to a pure inorganic substance which occurs naturally in the Earth's crust.
Resource	: Things that have a use value that could be materials, energy, services, knowledge or any assets.
Size of Population	: It indicates the total number of people residing in a particular geographical region, place or an administrative unit.
Unemployment	: It refers to the proportion of labour force who is ready, available and searching for work, but not absorbed in any monetarily gainful economic activity, just the opposite of employment.
Waste Land	: Land that are barren and difficult to transform to cultivable use such as water-logged land, marshy land, degraded forest land, saline land and industrial waste land.
Wetland	: Ramsar convention defines wetlands as areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metre.
Working Population	: It refers to the working age population lying between 15 to 59 (developing and least developed parts) and 15 to 64 years (developed parts).
Work Participation	: It denotes the number of people who are either engaged or could potentially be engaged in the labour force.