UNIT 6 IMPACT OF MAN ON ENVIRONMENT

Structure

6.1 INTRODUCTION

In the previous units you have been introduced to the concept of environment, both natural and man-made, components of the environment and the types of ecosystems. Man is one of the species who inhabit the earth and constitutes a major component in a number of natural ecosystems. However, he is the only one who has interfered with various natural processes for use of both biological and physical resources to meet his multiple demands. There has been a steady encroachment on natural resources, resulting in lasting changes in the land use and landscapes. This has been done to fulfil the growing aspirations of mankind for having a better and satisfying life style. As a result of this intervention many natural processes have been interrupted, some have been accelerated and a few slowed down. As long as the population was small, the ecosystem was able to cope with the effects of human interventions. However, during the last two centuries, human population has been increasing tremendously. The increasing demand over the available supply has been creating scarcity of almost every resource, e.g., land, water, forests, etc. thus dangerously upsetting the balance in the natural environment.

This over-exploitation and improper utilisation of natural resources, consequently, lead to a decline in the diversity and productivity of flora and fauna. Sustainability of physical resources, particularly of land and water also declines.

In this context, it is necessary to study and understand the various ways in which human activities have been affecting the natural bio-physical system. This would enable us to develop policy guidelines, action plans and management techniques to achieve the goal of sustainable development, along with conservation and preservation of environment. In this unit, you will study, the finite nature of resources. We will also introduce you to the various human activities which have led to environmental degradation. You will be studying these in detail in the subsequent units.

Objectives

After studying this unit you should be able to :

- explain the finite nature of non-living and living resources
- justify the need to conserve non-living and living resources of the earth
- explain how the finite nature of the resources determines carrying capacity, and
- explain how human activities like agriculture, energy production, mining and industries affect the environment and in turn man himself.

6.2 FINITE NATURE OF RESOURCES

In this section we will study about the non-living resources like, land, water, energy and minerals, and living resources, the flora and fauna of India. It is well known that growth and development of human society, even the very existence of man, requires many natural resources, both physical and biological. In an ecosystem, one can find communities of organisms living on the surface of the earth, a little below and also a little above. The ecosystem includes constant interactions of the organisms with physical environment like land, water, air, solar energy and also among themselves. For all practical purposes, land is limited. Water, though replenishable over a period of time, can also become scarce. Air is seemingly inexhaustible but becomes unusable due to severe deterioration of its quality through drastic changes in its composition. Energy in its natural form, like sun rays, appears abundant but it is critically in short supply at consumer level. The fossil fuels like coal, petroleum, natural gas and the radioactive elements are definitely finite. Their increasing use is resulting in their fast depletion. In India, the per capita availability of these resources, has been declining. Unless scientific and technical innovations and breakthroughs take place, the situation may become critical. This is mainly due to population increase, and also due to loss of basic resources or their impairment through human interventions.

Rate of increase in population in India in recent decades is shown in Table 6.1.

Table 6.1: Population Growth in India

Year	Population (Millions)	Increase in a Decade (Millions)
1951	361.1	—
1961	439.2	78.1
1971	548.2	109.0
1981	685.2	137.0
1991 (Estimated)	819.4	134.2

In addition to the increase in human population, there has also been a phenomenal increase in developmental activities. All these have been at a pace which demanded faster exploitation of natural resources, without allowing enough time for nature to absorb the impact through its assimilative capacity. In other words, exploitation has been so much, that the nature itself has not been capable of balancing the situation through its dynamism. The situation in India which has only 2% of the world's land surface with 15% of world population is far more critical.

In Unit 3 you have studied that there is a constant interaction between the living and non-living components of the environment. As such there exist internal linkages between various components of the environment. Due to over-exploitation and improper utilisation of resources, the internal linkages among various components of environment have been disrupted, as reflected in the following ways, e.g.,

- heat regimes of the earth
- water balance of an area
- availability of physical and biological resources, i.e. soil, water, flora and fauna
- biological and land productivity of a landscape.

In the context of hard facts relating to demographic explosion, the availability of resources as it is today, and the experience gained by mankind so far, it is necessary to study details of the resources available. Consequences of man's interventions should also be examined to learn lessons and chalk out an appropriate action plan for the future to sustain the generations to come. Broad philosophical principles of all major religions of the world also implicitly

provide a basis for sustainable use of resources, with a clear contention that resources are limited and care should be taken to ensure their regeneration or replenishment. This really is important, if we view religion as not only laying down social and moral code but also reflecting pragmatic practices of a particular time.

6.2.1 Non-living Resources

Some of non-living resources like land, water, energy are discussed below:

I) **Land** : Land is the base for the emergence and development of all living forms including human beings. Of the total surface area of the earth, 51,000 million hectares (M ha), only 14,960 M ha or 29.22% is land, the rest 36,100 M ha or 70.78% 's oceans. Less than 30% of the land surface includes steep mountains, inhospitable deserts, marshy swamps etc., and so is not suitable for agriculture and productive purposes.

Compulsions of production of food grains and other commodities and accelerated developmental activities have placed competing and increasing demands on land. On one hand with increasing population there is increasing demand for food. On the other many of the developmental activities like housing, building of roads, dams etc. encroach on productive land. Fig 6.1 shows the changing pattern of distribution of the available land area in India under various utilisation classes over the last five decades.

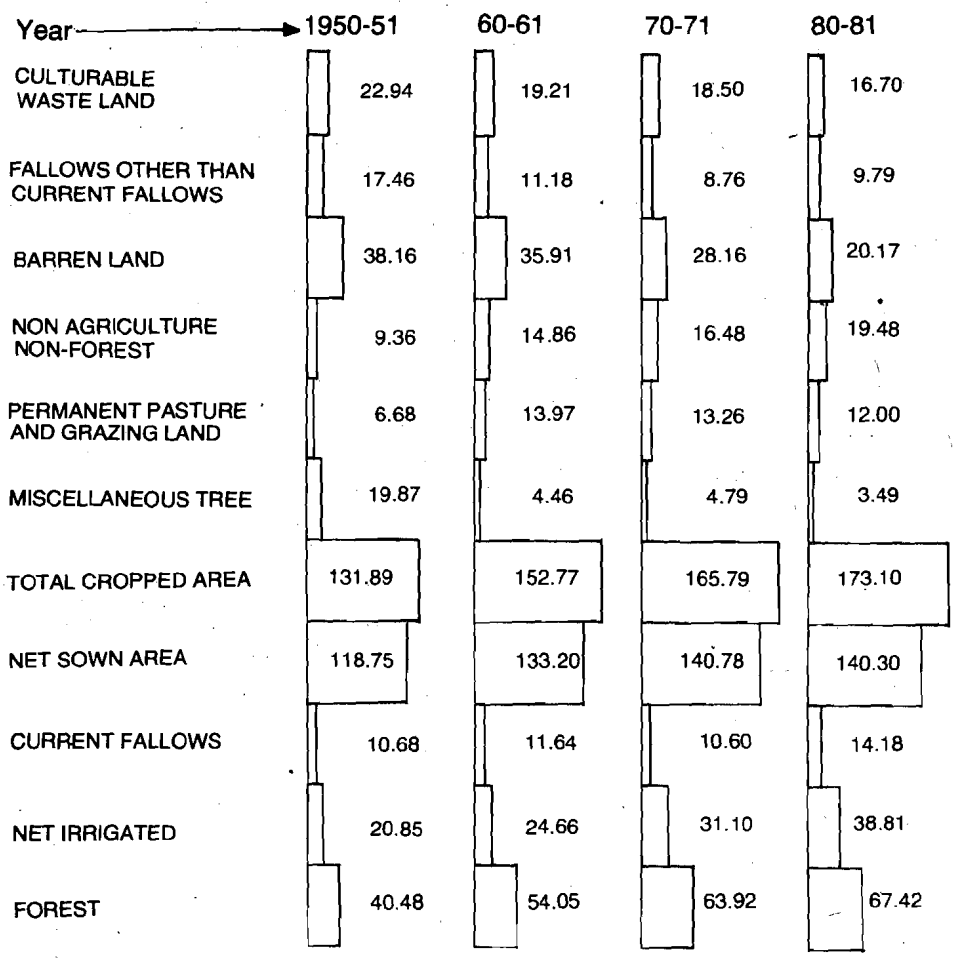

Fig. 6.1: Interchanges in land utilisation classes during the decades (Area – M ha)

(**Source** : National Land Use and Soil Conservation 1988.)

It is evident from Fig 6.1 that there have been significant shifts over the decades under different **land utilisation classes** (LUC). You can see that there is

- 31.2% increase in total or gross cropped area

- 18.1% increase in the net sown area
- 86.2% increase in the net irrigated area
- 66.5% increase in the forest area
- 107.4% increase in non-agricultural and non-forest areas e.g., urban centres, shopping complexes, industries, educational institutions etc.

However, there is 78.8% decrease in grass lands, 20.3% decrease in fallows and cultivable wastelands and 44.2% decrease in non-cultivable barren land.

The expansion of crop lands has been done by clearing forests. At the same time, crop lands have also got diverted to non-agricultural use due to urbanisation and industrialisation. Nevertheless, there is enlargement in forest lands due to post-Independence reorganisation of the ownership of private forest lands and then through plantation programmes.

There has been a steady increase in the demand for producing more food for the growing population, fodder for the livestock, firewood and industrial raw materials. The projected requirement of major land-based produce, in India for 2000 A.D. for a population of one thousand million compared to figures for 1980-81 is given in Fig. 6.2.

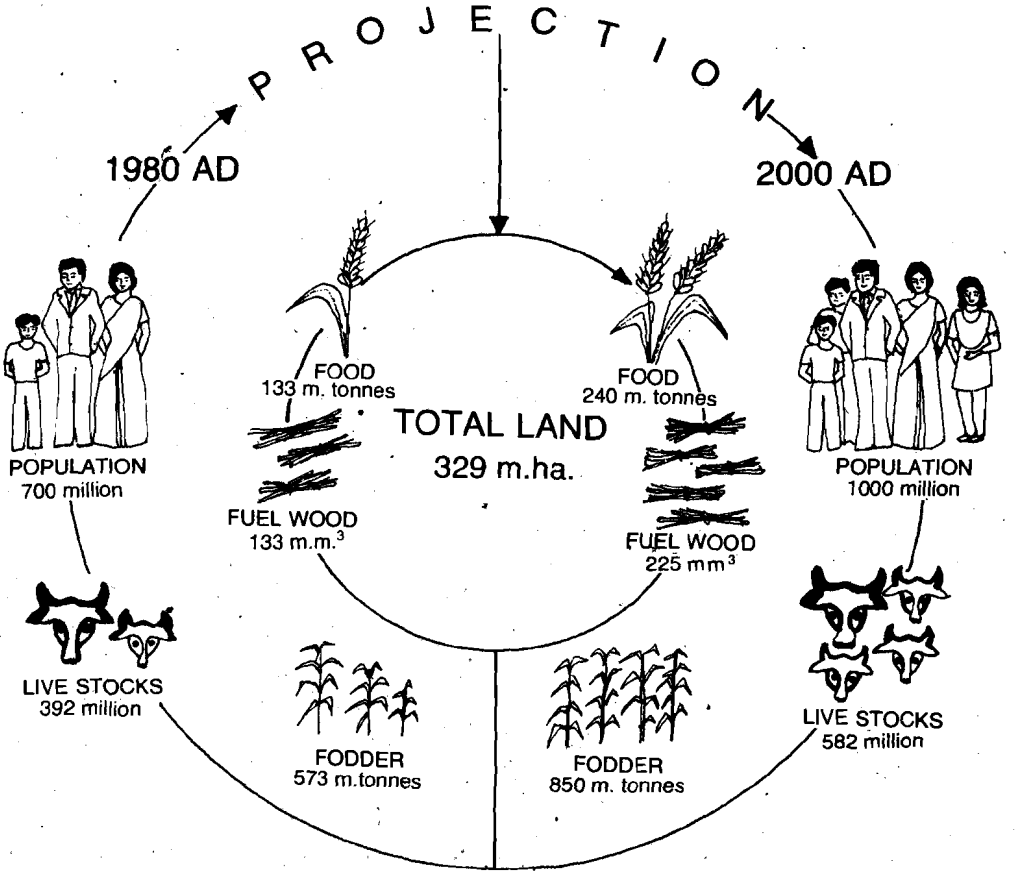

Fig. 6.2 : Population and demand projections at 2000 A.D.

(**Source** : National Land Use Conservation Board, 1988.)

Table 6.2 gives the relative figures for the per capita land available in India for the last two decades and the projections for the next two decades.

You can see that the per capita land available has decreased to almost half and is likely to decline further for all uses such as cultivation, grazing and fodder and also for meeting social priorities.

Table 6.2 : Per Capita Area Available in India

Available area per capita	(ha/person)		
	1950	1980	2000 AD (Projected)
Total	0.89	0.50	0.33
Human population			
Cultivated land (including forests & trees)	0.48	0.20	0.15
Animal population			
Grazing land (including forests)	0.51	0.32	0.24

As shown in Table 6.2 the changes taking place in the per capita land available would result in significant modification of the environment. There will be higher demand for other inputs like water, nutrients and energy. The land budget must also be supplemented by corrective and additive measures to prevent or counter possible disruptions in various components of the environment. This becomes essential in the face of on-going processes of land degradation and widespread problem of soil erosion throughout the country.

II) **Water** : If land is a pre-requisite to man's existence, water is the most crucial and essential input to all uses of land. It is also essential for many other human needs. The evolution of human civilisation has been closely linked with the availability of this natural and replenishable resource. In spite of significant advancement in science and technology even now life continues to revolve around water.

Water is required to enhance the productivity of land whether it is under crop, fodder including grazing base, horticultural plants or plantations. It is also the single key factor which determines the environment, regulating the health of the soil and also the availability of nutrients for plants. Management of water resources as a natural resource, will have to be taken into consideration in an integrated view of various aspects of human life as well as conservation, development and management of land production programmes, social priorities, economic activities etc.

The global distribution of water resources reveals that less than 3% of the total quantity is fresh water. A breakup of the total fresh water among various sources and its availability is shown in Table 6.3.

Table 6.3 : Global Distribution of Fresh Water

Types of Fresh Water	% of Fresh Water	% Available
1) Frozen	80.00	
2) Liquid	20.00	
Ground water	19.7	98.4
Lakes	0.2	1.0
Soil	0.04	0.2
Rivers	0.02	0.1
Atmosphere	0.02	0.1
Biological (Metabolic)	0.001	0.005

It is evident from the above Table that only one fifth of the fresh water is available in the liquid form. This limited amount is replenishable and therefore, has been relied upon for recurrent use by man. More than 90% of this scarce commodity is in the form of ground water, while only 1.0% is in the lakes and ponds. The soil profile carries only 0.2%, but double the amount is held either by rivers or atmosphere.

India, in terms of total annual rainfall, is very fortunate. It receives an average annual rainfall of more than all the continents except South America (Table 6.4).

Table 6.4: Average Annual Precipitation (mm) of various Continents and India

Country	Precipitation
South America	1596
India	1150
North America	808
Europe	769
Africa	725
Asia (Excluding India)	630
Australia	456

In relative terms, India has 6% of world water resources but has to meet the consumption needs of 15% of the world's population. India's water wealth is about equal to that of USA, though its land surface is only 40% of that of USA. In spite of this apparent abundance, India's per capita annual consumption is only 3,200 ha-m against 17,500 in USSR, 6,500 in Japan and 6,200 in USA. World's per capita available water is expected to get further reduced by 21% by 2000 AD. The reduction is likely to be more in many African and Asian countries including India. It is in this context that the assessment of total available volume of water becomes more urgent.

According to one estimate about 105 M ha-m of the country's available water is utilisable, comprising 70 M ha-m of surface water and 30 M ha-m of ground water. However, the latest assessment indicates that total surface water in the country is about 180 M ha-m, out of which 68.4 M ha-m or 38% is utilisable. The replenishable ground water is estimated at 60 M ha-m, of which 42 M ha-m or 70% is utilisable. Thus a total 110.4 M ha-m or 46% of the total estimated water (240 M ha-m) of the country is utilisable.

Consumption demands are particularly from three sectors, irrigation, domestic settlements including livestock and for industries. Annual requirements of water in India at four different points of time are given in Table 6.5.

Table 6.5: Annual Requirement of Water in India : Total and Sectoral

Year	Irrigation	Total other uses cities/ industries/villages*	Total
1974	35 (89.3)	3 (10.7)	38
1985	36 (66.7)	18 (33.3)	54
2000 (estimated)	50 (66.7)	25 (33.3)	75
2025 (estimated)	77 (73.3)	28 (26.7)	105

* In Mha-m, Figures in parenthesis give percentages.

You can see that the total requirement has increased steadily from 38 M ha-m in 1974 to 54 M ha-m in 1985. The projected figure for 2000 AD is 75 M ha-m. However, the increased and diversified needs of land based commodities of food, fodder, firewood and industrial raw-materials have been reassessed with a view to support a population of 1,000 million by 2000 A.D. The gross plant biomass that has to be produced annually by 2000 AD is estimated to be 2000 M.tonnes (Mt). National Council on Agriculture and National Land Use and Wastelands Development Council (NLWC) have projected that irrigated area should be around 110 M ha by 2000 AD (Table 6.6).

Table 6.6 : National Land use Policy and Desirable Land Budget

Category		(Million ha) 1980 AD	2000 AD (Projected)
1)	Net Sown Area		
	(a) Rainfed	101.0	40.0
	(b) Irrigated	39.0	110.0
2)	Forests	67.4	115.0
3)	Pastures/grasslands	12.0	22.0
4)	Urbanisation (Settlements + non-Agricultural other than forest uses)	19.5	25.5
5)	Other non usable	90.1	16.5
	Total :	329.0	329.0

Actually, the area irrigated in the year 1984-85 was only 41.78 M ha Extending irrigation to another 68 M ha in a span of 16 years from 1984-85 appears to be an impossible task. The corresponding water requirement would be of the order of 58.6 M ha-m. Apart from this practical necessity, there will be a severe water scarcity, as the total usable annual water resources in the country are only 105 M ha-m. At the same time one can visualise a faster growth in the demand of industrial sectors, power generation and urbanisation. The estimated requirements of non-agricultural sectors for 2000 AD are given in Table 6.7.

Table 6.7: The Estimated Requirement of Water for Non-agricultural Sectors for 2000 AD. (India)

Use		Mha-m
Domestic		
Urban		4.99
Rural		2.22
	Total	7.21
Industries		0.47
Power generation, Mining etc.		6.00
	Grand Total	13.68

Thus for agriculture, the net resources available will be only 91.32 M ha-m without keeping any cushion to meet the additional demands in subsequent years for further growth of industries. Further examination has been made in the light of the National Water Policy and it was found that the available water for irrigation is expected to provide irrigation to at least 75% of the cropped area. In accordance with the land budget this will mean that 112.5 M ha. out of the projected 150 M ha of net sown area as indicated in Table 6.6 should be irrigated.

III) **Energy**: Energy is needed both for production as well as consumption. Dynamism of physical as well as biological components of the environment, is characterised by a multitude of activities. All activities demand energy. Under natural environment, man has been sharing available energy sources with other organisms. However, he soon started intervening in natural processes to improve his living style — his society. He had to undertake new activities, for which additional energy was needed. So, he looked for newer and

larger supplies of energy by exploring new resources. This depleted many of the resources, which a few decades earlier appeared abundant. But today with the challenge to support a population of 1000 million, at a better standard of living, human society confronts severe limits for many of these sources by 2000 AD. A few resources seem to be dwindling, while others, if used too freely, may become injurious to other natural resources like forests, land, water and air. Therefore, it is necessary to understand the limits of our energy resources.

Demands of energy from various sources have been estimated variously for 2000 AD as indicated below :

1) **Fuelwood**: In India, it is the traditional and the most important source of energy for vast majority of rural population as well as the poor and less privileged in the urban centres. In 1978-79, urban firewood consumption was estimated to be around 16 Mt. Out of this, 14 Mt. are purchased annually, indicating an urban firewood market of Rs. 500-600 crore. This provides employment and income, at least partially, to large sections who are otherwise underemployed or belong to the low income group. The demand for firewood has been increasing very fast even in metropolitan cities although there is a significant development of other energy sources. In Delhi alone, between 1971 and 1981, supply of firewood increased by 200% only through one point, i.e. Tughlakabad Railway siding. Against the earlier projections of 225 Mt made by National Commission on Agriculture (NCA) for 2000 AD, the National Advisory Board on Energy (NABE), put this as between 300 and 320 Mt; and for urban centres the corresponding projected demand is 70 Mt.

2) **Dung cake**: Total rural and urban consumption of cow dung cakes per year is between 70 and 75 Mt of dry dung. Of this nearly 5 Mt are burnt every year in urban areas. Cow dung collection, cake making and selling the same in cities provide employment and income to rural or urban poor. The projected demand by 2000 AD is put at 200 Mt.

3) **Agricultural residues**: Agricultural residues like straw, sugarcane chaff, weeds etc. form a very significant source of energy for rural poor and landless persons. The projected demand is 100 Mt by 2000 AD.

4) **Fossil fuels**: Coal, lignite, petroleum, and natural gas are called fossil fuels, as they are derived from prehistoric plants and animals under the effect of intense heat and pressure under the earth's crust. Coal and lignite are supposed to be formed from plants buried *in situ* or drifted in from outside to a place covered by sedimentary deposits. Origin of petroleum is supposed to be mainly the prehistoric marine animals. About 60% of the country's commercial energy consumption is met by coal and lignite. Coal is used as a fuel for domestic uses, locomotive engines, various types of furnaces in the industries, thermal power generation, extraction of metals and minerals, production of coal gas, tar etc. The reserves of coal in the country have been assessed as 1,59,299.1 Mt. However, reserves of good quality coal and those that can be extracted economically are estimated at 25,000 Mt. Coking coal is limited mostly to Jharia reserves.

India now stands fifth in the world as a coal producing country. Coal production in India reached 165.8 Mt by 1986-87, which is an increase by five times during the last 40 years. The projected demand of coal and lignite by 2000 AD is placed between 450 and 540 Mt including 70 Mt of coking coal and 206-302 Mt of coal for power generation. The rest is for other uses. Taking an average of 500 Mt as the annual need, the reserves of good coal may last only for 50 years. Though the total reserves for the country appear to be quite abundant, the scarcity of good quality coal, especially the coking coal, would greatly hamper the industrial efforts in future.

5) **Mineral oil or petroleum**: It is the most important source of energy in the modern world. It is a complex mixture of hydrocarbons that are found in the earth, often associated with natural gas. The production of petroleum in the country in 1947 was 0.25 Mt while the consumption was 3.4 Mt. This deficit has been steadily rising. By 1986-87, the production rose to 30.5 Mt, the consumption also continued to increase and was of the order of 43.4 Mt During the last three decades, efforts were made to explore indigenous sources. Thus recoverable balance of crude oil reserves increased from 366 Mt in 1980 to 580 Mt in 1987. However, the projected demand for the country by 2000 AD is between 440-1230 Mt. Even in an optimistic assessment, including finding additional deposits these reserves appear to be critically limited.

6) **Natural gas:** The origin of natural gas, which consists mostly of lower hydrocarbons, is similar to petroleum. Almost every petroleum well gives off some gaseous products, but in addition there are large deposits of gas without any liquid petroleum being associated. The production as well as consumption demands of natural gas have been rising both on domestic as well as industrial front. About 2,300 million cubic meters (Mm^3) of natural gas was produced and consumed during 1980-81 while it rose to 9,812 Mm^3, a four fold increase, in 1986-87. The country's balance of recoverable reserves of gas also rose during the same period from 3,40,000 Mm^3 to 5,41,000 Mm^3. Keeping with the trend, the demand by 2000 AD is likely to be about 15,000 Mm^3 per year, while the annual consumption rate may touch 25,000 Mm^3. Even then the reserves appear to be adequate.

7) **Alternate sources:** The energy scene received critical examination in view of the country's own reserves, strain on foreign exchange and the inputs required for the growing population and economic development. A number of alternate sources are being explored, viz., biogas, solar energy, fuelwood, wind energy etc. About 84,800 biogas plants have been put into operation till 1987. It is estimated that 22 million rural households out of an estimated 128 million can meet their energy needs from biogas plants. Solar energy also has vast potential in this country. Industries use solar energy equivalent to nearly 3,500 MW annually for heating water. About 7,200 solar cookers are at present in use in the country. Utilisation of wind and tidal energy is still at an experimental stage. There is, however, scope for more efficient utilisation of available resources, which may also reduce pollution. Smokeless **chulhas** are one such step in this direction.

8) **Electricity:** This is the form in which energy is mostly utilised by industries, transport and communication, and for many other socio-economic activities. In addition to hydel plants, electricity is generated by using fossil fuels as well as radioactive minerals. Till 1947, the installed capacity in the country was 1900 MW. Programmes have been launched since the First Five Year Plan to increase this capacity. By 1986-87, the installed capacity rose to 50,059 MW.

The projected installed capacity by the turn of the century has been put between 1,39,000 and 1,88,000 MW. The proposed target is to be achieved through hydel, thermal, nuclear and solar generation. The hydel projects include both major as well as mini or micro ones. Thermal generation will be coal based, lignite based and combined cycle-lean-gas based. These sources would produce around 1,76,000 MW and the rest is expected to be achieved through alternative sources. The comparative installed capacity generation during 1986-87 is 50,000 MW and that projected for 2000 AD is placed at 1,75,845 MW (Table 6.8).

Table 6.8 : Installed Capacity of Generation of Electricity (MW) in 1986-87 and that Projected for 2000 AD. (India)

Mode of Generation	1986-87	2000
Hydel Projects		
Major		59,450
Mini/Micro		3,000
	16,681	62,450
Thermal Projects		
Coal based		95,000
Lignite based		6,570
Combined Cycle-Lean-Gas based		1,750
	32,048	103,320
Nuclear	1,330	10,000
Solar	—	75
Grand Total	50,059	1,75,845

9) **Animal energy:** In spite of the technological development, animals continue to be the sheet anchor of India's rural economy. Animals are also meeting significant demand from the industrial sector, particularly for hauling and transportation of various commodities. India has about 80 million work animals which include 70 million bullocks, 8 million buffaloes, 1 million each of horses and camels. Besides these, ponies, donkeys, elephants and yaks are also being used. The equivalent power generation at the rate of 0.5 hp per animal comes to about 40,000 hp or 30,000 MW. For generating equivalent amount of electricity, this country would need Rs.30,000 crores, while the investment in these work animals is put at only Rs.10,000 crores. Bullock carts, a multi-purpose transport for rural India, increased in number from 10 million in 1956 to 15 million in 1978. The investment of these carts is estimated at Rs. 3,000 crore. Animal carts carry about 50,000 Mt of freight. A countrywide survey reveals that 60% of the rural traffic was being managed by animal carts. Another survey puts 72% of the total traffic within the village and 66% of that outside the village as the share of animal carts. This energy source, however, does not seem to have been accounted for in any energy budget of the country.

III) Minerals

Minerals are obtained from various types of deposits in the earth and are necessary inputs to human society for its economic, social and cultural growth and sustenance. Minerals are the primary source for:

- Energy generation
- Developing and designing of industrial plants and machinery
- Settlements and housing
- Weapons and armaments
- Transport and communication
- New Chemicals including medicines and alloys for various purposes.

Since chemical and organic interactions are limited to their mass within the earth, these cannot regenerate themselves. Emergence of new deposits calls for drastic geological changes which occur on a geological time scale and as such cannot be relied upon to replenish the resources. It is, therefore, necessary to assess with reasonable precision, the existence of various minerals and their location so as to understand their potential with relevance to environmental safety and stability. Some of the important minerals are discussed below :

1) **Fossil sources:** You have already learnt about this group which includes coal, lignite, oil, natural gas etc. as the major source of energy. Coal and lignite are concentrated in West Bengal, Bihar, Orissa, Madhya Pradesh, Andhra Pradesh as well as in Assam and Tamilnadu. Oil and natural gas are exploited both from inland and off-shore sites. Some of the major reserves are located in the west coast, Gujarat, Assam, Godavari and Krishna Delta on the east coast.

2) **Radioactive minerals:** Modern society depends on a number of Hi-Tech innovations. One of them is exploitation of nuclear energy. Radioactive minerals are needed for generation of nuclear energy. Monazite which is the main source of thorium is found in commercial quantities on the Travancore coast between Kanya Kumari and Quilon, while uranite or pitchblende mineral of uranium is found in Gaya (Bihar), Ajmer (Rajasthan) and Nellore (Andhra Pradesh). Utilisation of radioactive minerals is expanding and investigations are being carried out on such deposits to provide definite indications of magnitude, and potential for exploitation.

3) **Metal ores and minerals:** Ore is the form in which a metal occurs in nature. An ore is called a mineral if it can be profitably exploited for extraction of the mineral. Some metals and their ores or minerals are described below :

Aluminium: Bauxite is the main ore of aluminium. Bauxite deposits are located extensively in Bihar, West Bengal, Maharashtra, Madhya Pradesh, Tamilnadu and Kashmir. The total reserves are estimated at 2653.7 Mt. Aluminium is being extensively used for domestic purposes, transport, communication and in many other industrial activities. Aluminium alloys are light and can be made extremely strong; therefore they find use in aircraft and spacecraft construction. Appropriately aluminium is said to be the metal of the

century. In the last few years enough aluminium is being produced in the country, some of which is being exported to earn precious foreign exchange.

Iron: The chief ore of iron is hematite with 60-69% of iron. It is located extensively in Bihar, Orissa, Madhya Pradesh, Andhra Pradesh, Tamilnadu, Karnataka, Maharashtra and Goa. Magnetite is another ore of iron. Total reserves are assessed to be around 17,570 Mt which are enough for the requirements identified so far. Iron and its alloys are one of the main structural materials, which find use in armament and transport industry and in almost every aspect of everyday life. India now produces this metal on a very large scale.

Copper: Deposits of copper pyrites or the sulphide ore are found mainly in Rajasthan, Bihar, Karnataka, Madhya Pradesh, West Bengal, Andhra Pradesh and Uttar Pradesh. Copper has application in telecommunication, electronics, in making domestic and industrial containers, and for making alloys like brass, bronze etc. Reserves assessed so far have ores worth 578 Mt and recoverable metal is estimated at 4.38 Mt. The availability of copper is quite limited compared to the needs of the country, therefore a part of the requirement is met through imports.

Others: Assessed deposits for a few minerals of India are given in Table 6.9.

Table 6.9: Assessed Deposits of a Few Important Minerals of India.

Minerals		Reserves (million tonnes)
1)	Chromium	5.00
2)	Nickel Ores	231.70
3)	Baryites	73.90
4)	Dolomite	3950.00
5)	Fire Clay	492.80
6)	Lead-zinc ores	358.50
7)	Kaolin	1040.00
8)	Lime Stone	73200.00
9)	Gypsum	1248.60
10)	Manganese ores	135.00
11)	Phosphatic Mineral (Rock Phosphate)	187.40

Concluding Remarks: The above discussion reveals clearly that physical resources which supports human society are finite. The most important natural resource of the physical environment, i.e. land is becoming very scarce in the face of increasing population. Similarly, water, which though replenishable, is limited in supply. Moreover its availability to various sectors is likely to decline further. On the other hand, man in his desire to meet diverse and increasing requirements has initiated numerous activities which has increased the need for energy and materials. The fossil sources of energy and the deposits of some minerals seem to be inadequate and also depleting fast; therefore, these resources would not be able to meet the future demand. The exceptions may be coal, lignite, iron, aluminium and a few others.

It is, therefore, imperative that we should realise that none of these resources should be used for meeting only short term requirements of the society. It is, therefore, necessary to rely on replenishable and regenerative resource base as well as technology for their efficient utilisation.

6.2.2 Living Resources

As mentioned earlier in section 6.2 that, various types of organisms which form a part of the biosphere are our living natural resources. So far, life as we know it is a unique feature of earth amongst all planetary bodies. The physical resources in the geological past have been changing and organisms, which have adapted to such changes, have survived, while those,

which could not, became extinct. Organisms influence the physical environment and may also mutually influence each other. These interactions are known as **interacting processes**. Thus both the physical resources and organisms are changing under evolutionary forces and, therefore, are dynamic. The physical and organic evolutionary changes are continuous and have become complex through the emergence of a large number of organisms. As you have already studied in section 6.2 that life forms are found in compatible and mutually sustaining communities of plants and animals. These communities are components of a system called an eco-system. Natural cluster of such communities or ecological groupings live in a symbiotic relationship. While meeting their collective requirements through natural processes, they regenerate and replenish the natural resources.

Mankind is also one of the dynamic ecological communities. It, indeed, is completely dependent upon nature's great bio-geo-chemical cycle for its survival, productivity and improvement. For survival human society has to live in a symbiotic relationship or harmony with about 1.3 millions varieties of plants, animals and microbial organisms living around it. In this ability of mankind rests the chance of its survival. However, from the point of view of mankind, environment has always been a set of relationships in nature. Human society is dependent upon three other relationships; physical, biological and sociological factors to provide air, water, food, warmth and socio-cultural fulfilment.

The main and immediate priorities for mankind, from prehistoric times, are those which provide food for the society. Food, however, comes from plants and animals. As population in the society increased and its diversified demands grew, new plant and animal species had to be located, and cultivated. Animals had to be tamed and domesticated. There was also a need to find out new organisms or modify the existing ones through cross-breeding to augment the supply of food for the society. In this process, the natural genetic diversity has always been helpful to man. Man then exercised a selective pressure under which some species have benefited in variability and their population increased. This resulted in depletion in the variability of other species. The case in point is the promotions of dogs and their genetic manipulation by man which has resulted in appearance of many new varieties of dogs and their numbers have certainly increased under the protection of man. A negative selection pressure of man can be exemplified by the case of members of the eat family. The number as well as diversity of panthers, leopards, tigers and lions has decreased not only because of hunting, but also due to man's interventions in their living grounds. Therefore, it is necessary to preserve the existing species before they are lost. Species once lost cannot be replaced. In order to familiarise you with the flora and fauna of India, some of these are briefly discussed below.

I) **Flora**

The Indian region is considered as one of the twelve centres of genetic diversity of the world. Out of a total of 45,000 species of plants 15,000 are of vascular plants and 30,000 are of non-vascular or non-flowering plants like fungi, algae etc. About 7,000 species of plants are endemic to India, i.e. these are found only in India. Again, nearly 3000 endemic species are found in Khasi-Jayantia hills and 2000 species in the Deccan Peninsula. Rest of the endemic species are found in other regions, mostly the Himalayas, arid North West and the coastal areas. Nearly 800 plant species have been identified to be of ethnobotanical interest, i.e. usefulness of these plants for various purposes has been identified, mainly in medicine, pest control etc.

Through years of evolution under domestication and due to the process of selection, an enormous diversity has accumulated. These comprise primitive or native cultivars or cultivated varieties as well as the wild and weedy species related to these. About 150 cultivated species and about 320 wild and weedy counterparts exhibit preponderence of variable forms. Most of these are concentrated in the humid region of the Western Ghats and the Eastern or North-Eastern plains and hills, and represent the ethnic diversity of these areas. These belong to different groups useful to man like, cereals, millets, legumes, fruits, vegetables, oil seeds, medicinal and aromatic plants, spices etc.

The number of known wild relatives of the cultivated varieties are given in the following Table 6.10.

Table 6.10: Wild Species of the Native Plants

Group	Number of species
1) Cereals	51
2) Legumes	31
3) Fruits	109
4) Vegetables	54
5) Oilseeds	12
6) Fibre Plants	24
7) Spices	27
8) Others including sugarcane	26

Areawise distribution of the species is given in Table 6.11.

Table 6.11: Distribution of Wild Species of Native Plants in India

Region	Number of species
North Eastern Region	134
Western Ghats	146
Western Himalayas	125
Deccan Plateau and Eastern Ghats	93
Gangetic Plain	66
North Western Plain	45

The latest information indicates that of the above, about 250 wild plants have agricultural or horticultural importance and 60 of them are rare or endemic. India's natural stock of forage, legumes and grasses is very rich. Of about 2,000 such species, two thirds are grasses. Nearly 1,250 species of orchids occur in India, out of which 300 are endemic to Khasi Hills in the North East.

II) Fauna

The natural fauna of India consists of around 75,000 species. It includes 2,500 species of fishes, 150 species of amphibians, 450 species of reptiles, 2,000 species of birds, 850 species of mammals and 69,050 species of invertebrates like worms, insects, crustaceans, etc.

Among the animals of socio-economic value, cattle, buffalo, sheep, goat, pigs and poultry are needed to meet the food requirements, horses, ponies, mules etc. are used for transportation. The livestock population according to the latest statistics (1982) available is given in Table 6.12.

Table 6.12: Livestock Population in India (Number in Millions)

Class	Number (Millions)
Cattle	192.4
Buffaloes	69.8
Sheep	48.8
Goats	95.2
Horses and Ponies	0.9
Camels	1.1
Pigs	10.1
Mules	0.13
Donkeys	1.0
Yak	0.12
Poultry	207.7

India produces nearly 46 Mt. of milk and is the third largest milk producing country in the world, after U.S.S.R. and U.S.A. The cattle and buffaloes are the main source of milk. There are 26 breeds of cattle and 7 of buffaloes. However, 75% of the total cattle population are of non-descript type. Yak is important to hill societies as it caters to their multiple needs of milk, transport etc. Its hide is useful as a protection against severe cold.

Sheep and goat are of great importance to India's rural economy in terms of meat and wool. The natural wool production is of the order of seventeen Mkg. Exact information on the genetic resources of sheep is not available. There are 17 distinct breeds of goat in India. There are wild varieties of pigs as well domesticated ones, the exact data is not available. Chicken form 90% of India's poultry population. Ducks constitute 6%, while turkey and geese comprise 2%. India is one of the original habitats of the red jungle fowl. It is thought that all domesticated poultry birds found today might be descendants of this bird. Eighteen types of indigenous breeds of chicken have been reported. However, in terms of population these are meagre compared to the exotic ones. Genetic resources of other poultry birds are being evaluated.

In spite of the rich diversity of fish fauna, only a few have been cultivated, such as, major carps. While a few of the exotic ones, such as, Chinese carps, tilapia, trouts, gourami etc. are being cultivated in the country. India has a long coastline of over 7,000 km, including that around islands, with economic zone extending upto 200 km into the sea and over 60,000 inland water bodies, i.e. lakes, ponds etc. with water spread of about 3 M ha. The potential catch is over 10 Mt. Currently about 56% of the annual catch of about 30 lakh tonnes is from the sea, mostly along the west coast.

Before we study the extent of environmental degradation caused by human activities, we would like to discuss about the carrying capacity of an ecosystem in the light of the finite, nature of resources. You have already been introduced to this concept in Unit 3.

SAQ 1

a) Fill in the blank spaces given below :

i) Mankind is one of the dynamic ecological communities. It, indeed, is completely dependent upon nature's great ..... cycle for its ..... , productivity and ..... For survival human society has to live in a ..... relationship with about 1.3 million varieties of plants, animals and ..... organisms living around.

ii) In India the per capita availability of resources decline due to ..... increase and also due to loss of ..... through human interventions.

6.3 CARRYING CAPACITY

The concept of carrying capacity or the ultimate limit of tolerance has been in use for some time in engineering designs, particularly those relating to materials subject to loads. Every material has a limit of load that it can bear, which if exceeded, it fails or breaks. To ensure a cushion, a safe limit, lower than the maximum load, is taken as the ultimate one or tolerance or bearing capacity. In respect of productive potential of land, this concept has been used to indicate the number of cattle or cattle equivalent of other livestock that it can sustain throughout the year on one hectare of range or pasture land. The simplistic diagram on logarithmic scale (Fig.6.3) for periods of one year to one million years before 2000 AD attempts to reconstruct the growth of world population that lived on earth from the period when man used technique of hunting-gathering, to farm mechanisation and then to application of fertilisers. It is apparent from the figure that population increased with advancement in the technique for obtaining food, i.e. population has increased with the increase in food production. In other words the spurts in the curve correspond to innovations, which result in an increase in the carrying capacity of the system.

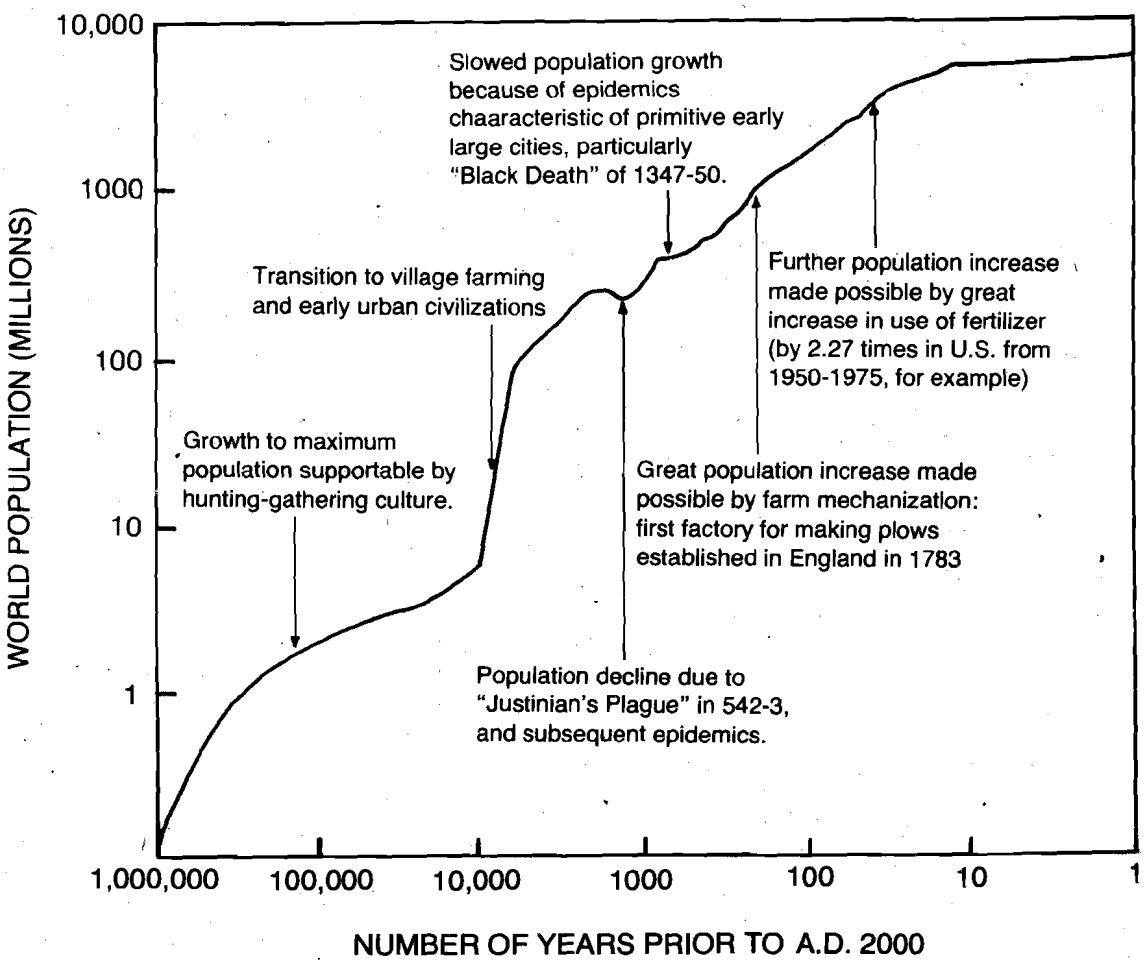

Fig.6.3: World population growth at different time frame. (Watt, KEF. 1988. Understanding the environment. Allyn and Bacon Inc. Boston. P.134.)

In human environment, carrying capacity is influenced by

- level of science and technology
- institutional innovations
- increasing aspirations of the communities for better and different life style.

In any ecosystem, the carrying capacity depends on the available resources and the ability of the system to cope with the residual waste. The conceptual model for carrying capacity thus comprises.

- **Supportive capacity,** viz. the ability to allow withdrawal of resources like raw materials, water, human infrastructure, without causing lasting damage to environment, and
- **Assimilative capacity,** viz., the ability to absorb without ill effects, a certain amount of wastes without ill effects.

Carrying capacity of a region is described as the number of persons that can be supported by a unit area of land while assimilating the wastes. The linkages of carrying capacity with various developmental activities are shown in Fig. 6.4. These activities have necessitated an ever increasing demand on resources.

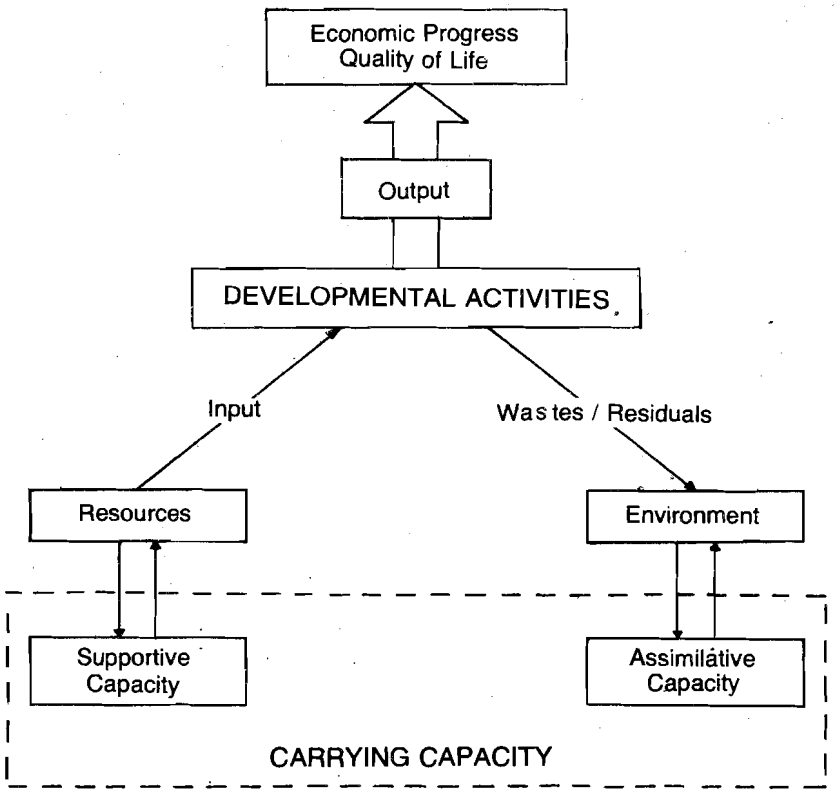

Fig. 6.4: Elements of regional carrying capacity

As you can see in Fig. 6.3, human population has shown manifold increase which necessitated an ever increasing demand on resources. Consequent over-consumption of resources was often satisfied by consuming the productive resources, the base itself, a biological equivalent of deficit financing. The associated interventions, have been disruptive and destructive to the environment, as evident by widespread shortage of fuelwood and water, decline in land productivity, erosion in the diversity of flora and fauna etc. The assimilative capacity can absorb wastes, to some extent but cannot regenerate the land productivity or replenish the water regimes or restore the lost genetic diversity. There is a pressing need for some positive counter-interventions like afforestation, land reclamation, preservation of wild life etc.

Carrying capacity, like most other environmental attributes, is subject to change. This could be in consequence to natural evolutionary forces transforming both physical resources and composition of life forms. This could also be a result of changes in the human society due to either introduction of new technology, institutional innovations, government policy or factors such as minimum per capita income and material requirements. Further, the changes in carrying capacity could be both positive as well as negative. Thus, there is a need to develop objectives for preparing an alternate plan for sustainable development. Production inputs like fertilisers, pest control, power, high yielding cultivars and resource conservation measures increase the carrying capacity for some time.

The genetic diversity, particularly that of wild relatives of the cultivated ones, would provide the strains that would continuously upgrade production limit through breeding and selection. Today, the main food supply for the world comes from about twenty crop species and most of the milk, meat, wool, hide and energy also come from twenty odd live-stock species. Similarly, only eight species of trees provide most of the world's wood and timber. One of the ways to meet the challenge to support more people is to identify new species with greater yield potential and broaden the crop base. The other is to maintain variability within the species for constant selection. Cross breeding helps in for improving the species and breaking production barriers. Taking the case of rice, there are an estimated 120,000 types or varieties of rice in the world. In India about 50,000 local varieties are still in cultivation, while only about 15,200 varieties are being maintained in the national rice gene bank. This

variability provides the source to obtain resistant varieties by breeding. In a world wide search for a rice variety resistant to grassy-stunt-virus, about, 6,723 varieties were screened. The single resistant variety out of the above was from India. This now helps to save crop over 30 Mha in South East Asian countries.

Long term resource conservation, both biological and physical, ensures minimising the loss of the principal while making available higher annual increase in production. In other words, it should :

- minimise the loss of genetic diversity through genetic erosion and extinction.
- prevent the loss of land productivity through soil erosion, land degradation and hydrologic deterioration such as drying up of springs, lakes, ponds, rivers etc.
- improve regenerative capacity such as soil fertility and replenishment of depleted water resources through positive measures.

To meet consumption demands of a far larger population, larger increase in supportive capacity has to come from irrigation. With increasing inputs of fertilisers, there will be an overwhelming dependence on irrigation. This is not at all a safe state of affairs, firstly, because the limited quantum of water available for irrigation has set a limit of 110 M ha as the ultimate net irrigated area. Secondly, enlarged irrigation also brings some adverse side-effects like water logging, salinity, genetic erosion etc. which would reduce the carrying capacity. On account of growing socio-economic demands the projected supportive capacity for 2000 AD needs to be trimmed suitably so that less of land and other natural resources such as water, minerals, and energy are used for achieving the desired supportive capacity. The finite resources thus released can act as the base for regeneration and replenishment of natural resources. This would also provide higher assimilative capacity to neutralise the negative fall out of human interventions.

SAQ 2

i) What is meant by carrying capacity of a region ?

.....

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ii) Put the numbers of the definitions which match the concepts in the brackets.

Concepts		Definitions
a) Carrying capacity of a region	[ ]	i) The ability to allow withdrawal of resources like raw materials, water, human infrastructure, without causing lasting damage to environment.
b) Supportive capacity	[ ]	ii) The ability to absorb certain amount of wastes without causing ill effects.
c) Assimilative capacity	[ ]	iii) The number of persons that can be supported by land while assimilating the wastes.

6.4 HUMAN ACTIVITIES AND ENVIRONMENTAL DEGRADATION

Like any life form, man also has to depend on the natural resources, for his survival. He has to transport materials available in nature and transform them into desired forms and quality. To achieve this, man has to work; human labour is the driving force for exchanges between nature and society. These exchanges have to recur constantly. Man is, therefore, under pressure to accelerate the exchanges to sustain as well as to develop. However, he has not been doing enough to maintain a balance between these exchanges. Almost all activities of

the human society have, as a result degraded the environment physically, chemically, biologically and even ethically. Though, there has been considerable awareness at various levels about conservation of resources, there seems to be no perceptible holistic approach to achieve the twin objectives, viz., preservation along with utilisation. The problem arises due to two reasons :

1) because of continuous human intervention in the dynamic natural evolutionary processes, steady-state-environment is not attainable,

2) perfect compatibility is also in conflict with man's continuous effort to innovate and improve the state of affairs in his own interest.

Man is also, albeit mistakenly, sensitive to the right of freedom to use natural resources, and so, there has to be a continuous struggle to accept the need to discriminate use of a resource in proportion to its availability, without destroying the base or the source. However, with his zeal and drive and the compulsions to meet increasing consumption needs, man has been resorting to multiple activities over larger and larger areas of the earth. We will briefly introduce here, various human activities which are the cause of environmental degradation. For convenience we have grouped them into two types, activities necessary for survival and other activities associated with large scale urbanisation. You will study their effects in detail in later units.

6.4.1 Activities Necessary for Survival

Amongst various human activities agriculture, horticulture, plantation, livestock management, fisheries, even forestry and mining provide raw material while industries provide processed items for survival. Let us look at each of these.

1) **Agriculture:** Till the middle of this century, enlargement of agriculture had been the easy option for meeting increased consumption needs of a growing population. This meant large scale invasion of natural resources, forests, grasslands, river valleys, seacoast etc. It was projected that if this trend continued, the area under cultivation will rise from 700 M ha in 1970 to 2000 M ha in 2000 AD.

Technological inputs such as High Yielding Varieties (HYV), chemical fertilisers, mechanisation etc. have brought Green Revolution. As a result of these innovations, production in India rose from 50 Mt to 150 Mt during the period between 1950 to 1985. However, these technological inputs have brought multiple environmental problems, some of these are as follows :

i) **Fertilisers:** To increase productivity more and more chemical fertilisers have been used. This has resulted in depletion of micro-nutrients such as zinc, causing imbalance in major nutrients in the high yielding irrigated belt of Punjab and Haryana, depressing the productivity of the land. Application of high doses of chemical fertilisers is likely to leach down in root zone, reaching the ground water, thereby increasing the concentration of nitrates in drinking water. The ill effects of which are discussed in Units 8 and 11 of this course.

ii) **High yielding varieties:** Spectacular break-through has been achieved in productivity as well as production using HYV seeds. About half of the wheat cultivated in Bangladesh and 85% of rice in Philippines are HYVs, which have a potential to grow under rainfed conditions. Cultivation of HYVs causes serious genetic erosion, as all varieties other than those cultivated are treated as weeds or unwanted. Further, the use of HYVs greatly reduces the traditional integrated and interdependent farming system comprising cultivated crops and companion plants like trees — shrubs — bush — grass, to meet the multiple needs of fodder and firewood. The straw to grain ratio in HYVs becomes smaller than in other indigenous varieties, which greatly affects the fodder available.

iii) **Pesticides:** Different pests including insects have some positive biological role in keeping environment safe and balanced. But as a result of enlarged and intensive land husbandry practices, particularly cultivation, these seem to cause enormous loss of production. The total annual loss to crops due to various pests was estimated at Rs. 3,274.5 crore in 1976. Therefore throughout the world there has been increasing application of chemicals in various forms to control the pests organisms. Pesticides find their way into soil and water bodies. Some of them finally enter the food chain and thus become a threat to genetic resources of the world including human beings.

Thus, though the application of chemicals has been ensuring higher agricultural yields and economic growth, it has also caused an increase in non-target pests, particularly insects and has helped emergence of new pest species, which were formerly "innocuous varieties", and lived unnoticed in the ecosystem. This excessive use of pesticides has been described as a profit-oriented poisoning of the ecosystem.

iv) **Other land husbandry and biological degradation :** Intensive and unregulated utilisation of land surface by cultivation, grazing or exploitation of plant material has adversely affected the plant population and their composition as well as regeneration capacity. Intensively cultivated areas finally lose all natural flora except the few which are weeds as far as production programmes are concerned. In the areas subjected to shifting cultivation, natural flora and fauna are exposed to even total extinction. At least ten tree species and some parasites have become scarce in the North-Eastern States of Meghalaya and Arunachal Pradesh while many areas are being increasingly invaded by low value trees, bushes and weeds. Similarly, about seven mammalian species of North-Eastern India are now considered endangered.

Overgrazing and other types of exploitations have caused compaction and thus reduced operative soil depth and the volume of soil for moisture storage. Soil moisture is necessary for regeneration of desirable plant population. Fall in total regrowth of plant biomass and compaction has reduced regeneration of soil fertility, so vital for sustained productivity of the land through organic recycling. In turn, the conditions of desertification and degradation have been distorting the microclimate and thus adversely affecting the feed conversion ability of animals and production of animal products.

2) **Mining and industries:** India is not very rich in mineral and fossil deposits except coal, iron, bauxite and manganese which are concentrated in eastern and central regions. These areas are under extensive extraction, resulting in many environmental problems. Some of them are of far-reaching consequences both for physical as well as biological resource base such as defacing landscapes, desertification, hydrologic deterioration, and air pollution.

i) **Defacing landscape:** The process of mining can be of two types; i) surface or open casting, ii) underground mining. In both the cases, vegetation and top soil have to be removed to get access to the deposits. The area thus lost is quite large and is increasing every year. Soil dumps and overburden subsidence are other adverse consequences of mining.

ii) **Desertification:** In arid and semi-arid regions, loss of trees, bushes etc. which are naturally scarce, mining accelerates the process of desertification. Total destruction of vegetation due to this activity in many lime-rich areas has ushered in desertification and caused salinity around Barmer, Jodhpur and Udaipur in Rajasthan.

iii) **Hydrologic deterioration:** One of the most pronounced and long lasting effects of mining is qualitative and quantitative deterioration of water resources. Mining disturbs natural hydrologic processes and disrupts flow lines and ultimate storage of underground water. Industries add toxic wastes to the water bodies making them unusable.

iv) **Air pollution:** Burning of mined coal by industries is likely to raise levels of atmospheric carbon monoxide, carbon dioxide, sulphur dioxide, nitrogen oxides etc. Carbon dioxide along with other gases traps energy from the sun thereby increasing atmospheric temperature. This phenomenon is known as **"greenhouse effect"**. The gases responsible for greenhouse effect are known as greenhouse gases. Carbon dioxide is the most important of the greenhouse gases.

Higher global temperatures would cause glaciers to melt and also lead to an expansion of the oceans because warm water occupies larger volume than cold water. If the levels of greenhouse gases in the atmosphere doubles sea, level will rise affecting coastal areas, where about a billion people, a quarter of the world's population now live. Further, the marine ecosystem will also be greatly affected. You will study about air pollution in detail in Unit 10.

It can thus be seen that it is not a question of availability of land to cultivate or support increased number of livestock, but one of what this increase will do to the life sustaining system, and the vast absorbers of carbon dioxide like the seas and the atmosphere. It is also not a question of choosing a better source of protein in the livestock than vegetation. But the problem is that increased number of livestock would also need food and fodder and compete

with their consumer, i.e. man for essential life supporting air and water. It is also not the question of the country's ability to extract minerals, produce energy and develop an industrial base to give a higher standard of living. But the issue is that in the process oxygen and water may become unavailable and unusable. Therefore, with increasing population and consequent pressure on environment, human society may have to explore other sources for food, for instance, the sea can meet about 15% of the global food requirements. Biotechnology offers new avenues in microbial synthesis of proteins and other nutrients. Similarly other renewable, non-polluting source of energy which do not depend on burning of fossil fuel will have to be explored.

SAQ 3

i) Fill in the blank spaces given below:

The use of HYVs greatly reduces the traditional integrated and interdependent farming system comprising of ..... and ....., thus reducing the straw to grain ratio which greatly affects the ..... for livestock.

ii) Fill in the blank spaces given below :

Burning of mined coal by industries is likely to increase atmospheric ..... level, which along with other gases traps energy from the sun thereby increasing ..... temperature. The phenomenon is known as .....

6.3.2 Other Activities

Human society has a third dimension, namely its cultural environment besides the physical and biological environment. Once the problems of sustenance and survival are solved, the society can strive to provide comfortable life style and entertainment. These activities can be broadly classified into five groups, namely :

i) **Habitat:** Total design of settlements covering shelters and other constructions within community patterns.

ii) **Shelter:** Structures of different shape, size, type and materials created for security, privacy and protection of the society and individuals within the community.

iii) **Infrastructure:** Complex network of transport, designed to facilitate operations such as communication and other institutional or societal functions.

iv) **Services:** Components required by the community for fulfilment of its functions as a society, e.g., transport, water supply, electricity, education, health etc.

v) **Well-being:** Opportunities and accommodation for recreation, leisure, art etc.

All innovations to achieve these objectives necessitate the physical and biological resources of nature. The attendant activities also demand more energy, thus they put further strain on the existing resource base.

Human settlements or habitats are one of the major factors that bring drastic change in the natural environment. Depending upon size of the population, area, industrial and cultural growth, each settlement has its own sub-ecosystem. The pace at which these settlements emerge and take shape is much faster compared to the natural evolutionary processes. With economic growth accompanied by social demands the settlements have grown and many more are expanding into large settlements. These are known as urban settlements and the process is called **urbanisation.** As towns grow, they invade the productive crop lands and rich forests. Both intra-city and regionally open lands are converted into built-up land. Thus the land with all its biological resources is irreversibly lost.

Water requirement of the urban population also increases many times, and almost all of it has to be met through the water supply system. Due to the extensive built-up areas, the local ground water recharges decline and cities draw water from outside from long distance sources at the cost of cultivation and rural demands. Since water is drawn from long distances, it follows different paths than the natural hydrologic routes and therefore, will affect the ecosystem.

Growth of a city also means construction of houses and other structures, which need large quantities of building materials, such as bricks etc., which are provided from the adjoining areas comprising fertile land thus causing further damage to good land.

The worst outcome of urbanisation and industrialisation is slums. People from the surrounding rural areas come to industrial urban set-ups in search of livelihood. Since the living accommodation in the cities is too expensive, they establish slums. Slum dwellers live in an environment with inadequate living space, water supply and sewerage facilities. This causes steady deterioration of surrounding regions as well as human health.

Urbanisation and industrialisation are also responsible for water pollution as well as air pollution. Cities discharge large quantities of waste water into the natural water bodies like rivers, lakes etc. The sewerage either seeps into the soil and pollutes ground water or it flows through streams and rivers and pollutes surface water.

The major air pollution in urban locations results from the discharge of sulphur dioxide, nitrogen oxides, hydrogen sulphide, suspended particles such as fly ash etc. coming from automobiles, industries, and kitchens. Air pollution causes considerable damage to plants, animals and also to human health. You will study in detail about the effects of urbanisation on environment in Unit 9 of this block.

Man must accept that he belongs to nature and so he must learn to live with nature and not at the cost of nature.

SAQ 4

Mention briefly in the space given below how urbanisation and industrialisation are responsible for water pollution ?

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6.5 SUMMARY

In this unit we have tried to view the impact of man and his interventions on environment both physical and biological. We have learnt that:

- man is one of the millions of life forms on this earth which has limited resources both living and non-living. However, man is the only one who has interfered in the natural process for his survival as well as for the growth and development of his society. Human activities have been degrading environment in different ways,
- carrying capacity changes due to change in the physical and biological resources and also due to man induced developments,
- HYVs are causing genetic erosion and fall in production of agricultural residues used as fodder etc. Fertilisers and pesticides are contaminating soil, water, living resources and their products finally affecting human health. Overgrazing and intensive cultivation are causing loss of better species and emergence of undesirable ones,
- mining has been causing defacement of land, deforestation and deterioration of hydrological resources,
- energy generation, industries, and automobiles contribute towards greenhouse effect, causing rise in global temperature as a consequence of which large areas along the coasts are likely to be submerged,
- large-scale urbanisation degrades environment by encroaching on agricultural and forest lands and also increases health hazards. Industrial effluents and discharge of sewage pollute water bodies. Pollution of air results from automobile, industrial and kitchen emissions,
- resource crunch brings strain on physical resources and increasingly both man and live-stock appear to be mutually competing and are jointly destructive to nature.

6.6 TERMINAL QUESTIONS

A) Answer very briefly :

1) What are the various sources of energy ?

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2) What are the causes of the following kinds of environmental degradations ?

i) **Air pollution:**.....

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ii) **Compaction of soil:**.....

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iii) **Slums:**.....

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B) Match the types of environmental degradation given in column B caused by the increasing use of technological inputs given in column A.

Column A		Column B
1) Fertilisers	[ ]	a) Pollute the soil and water bodies, finally enter food chain becoming threat to genetic resources of the world including human beings.
2) HYVs	[ ]	b) Deplete micro-nutrients in the soil, leak down in root zones and reach ground water thereby increasing concentration of nitrates in drinking water.
3) Pesticides and ..... insecticides	[ ]	c) Cause genetic erosion, reduces traditional integrated and interdependent farming, decreasing straw to grain ratio which greatly affects the fooder for cattle.

6.7 ANSWERS

Self Assessment Questions

1) i) bio-geo-chemical, survival, development, symbiotic, microbial.

ii) population, basic resources.

2) i) Carrying capacity of a region is described as the number of persons that can be supported by land absorbing certain amount of waste without ill effects.

ii) a) [iii]

b) [i]

c) [ii]

3) i) Cultivated crops, companion plants, fodder.

ii) carbon dioxide, atmospheric, greenhouse effect.

4) Urbanisation and industrialisation are responsible for water pollution, since cities pour large quantities of waste water into the natural water bodies. Sewerage either seeps into the soil and pollutes water or it flows through streams and rivers.

Terminal Questions

A) 1) Energy is obtained from various sources. They are: fuel wood, dung cakes, agricultural residues like straw, sugarcane chaff, weeds etc., fossil fuels like coal, lignite, petroleum, biogas, solar energy, wind energy, electricity and animal energy i.e. animals are used for hauling and for transporting various commodities.

2) i) Air pollution results from burning of mined coal by industries and discharge from automobiles and kitchens.

ii) Compaction of soil is caused by over-grazing which reduces the operative soil-depth and the volume of soil for moisture storage, necessary for the survival of plants.

iii) Slums are established as a result of urbanisation and industrialisation. People from the surrounding rural areas come to industrial urban set-ups in search of livelihood. Since the living accommodation in cities is expensive, they establish slums.

B) 1) [b]
2) [c]
3) [a]