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Introduction to Environmental Economics

SEMESTER - VI

ECONOMICS

BLOCK - 2

KRISHNA KANTA HANDIQUI STATE OPEN UNIVERSITY

Subject Experts

1. **Professor Madhurjya Prasad Bezbaruah,** Dept. of Economics, Gauhati University
2. **Professor Nissar Ahmed Barua,** Dept. of Economics, Gauhati University
3. **Dr. Gautam Mazumdar,** Dept. of Economics, Cotton University

Course Coordinator: Bhaskar Sarmah, Ph.D., KKHSOU

SLM PREPARATION TEAM

Unit		Contributors
8, 13 & 14	:	**Dr. Jayanta Saud,** Dibru College.
9 & 10	:	**Dr. Arati Bharali,** Tezpur College.
11	:	**Dr. Durdana Ovais,** The Bhopal School of Social Sciences, Bhopal.
12	:	**Dr. Pooja Gupta,** i- Nurture Education Solutions Pvt. Ltd. (Ajeenkya D. Y. Patil University), Lohergaon, Pune.
5 & 6	:	**Dr. Jyotisikha Dutta,** Gauhati University.

Editorial Team

Content (English Version)	:	**Dr. Gautam Mazumdar,** Department of Economics, Cotton University
Language	:	**Labiba Alam,** Research Associate, Department of Foreign Language, Tezpur University
Format, Structure & Graphics	**:**	**Bhaskar Sarmah,** Ph.D. KKHSOU

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Head Office : Patgaon, Rani Gate, Guwahati-781017

City Office : Housefed Complex, Dispur, Guwahati-781 006; Web: www.kkhsou.in

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BLOCK INTRODUCTION

This is the second and last block of the course 'Introduction to Environmental Economics'. This block contains eight units, starting from Unit 8 to Unit 15. The eighth and ninth unit of the course are on Economics of Natural Resources. In these two units, certain important concepts like the different types of natural resources, managing exhaustible resources, resource extraction and environmental cost, different types of renewable resources, a comparison between renewable vs non-renewable resource economy have been discussed. Apart from those, concepts like sustainable yield and the economically optimum rate of harvest have also been discussed. The next two units, i.e., Units 10 and 11 are on sustainable development. In Unit 10, the history of sustainable development, the concept of weak and strong sustainability, different indicators of sustainable development and the measurement of sustainable development have been discussed. In the next unit different environmental regulations from the Indian context have been discussed. These Acts include: Environment Protection Act, 1986, the Air (Prevention and Control of Pollution) Act, 1981, Water (Prevention and Control of Pollution) Act, 1974, the Wild Life Protection Act, 1972, and the Forest Conservation Act, 1980. Objectives, and the major provisions of these Acts have been discussed in this Unit. Unit 12 has been entitled Green Accounting. Here, the concept of green accounting, its objectives, functions, different elements, types, importance and scope have been discussed. Further, the concept of green accounting has also been discussed from the Indian perspective, Towards the end of the unit, alternative indicators of sustainability have been discussed. In Unit 13, certain global environmental issues have been deliberated upon. Here, burning topics like climate change, its implication, different ways for mitigation of climate change, greenhouse gas concentrations and stabilisation, global warming, its impacts as well as different measures to check global warming and a few related have been discussed. The units ends with an important discussion on environment and human health. In unit 14, a few domestic environmental policies have been discussed from the Indian context. Please note that in the earlier unit 11, we had introduced these policies in the context of sustainable development. In this unit, we are discussing them with a focus on the regulatory aspects. The major discussion made in this unit include: evolution of environmental policy in India, different environmental legislations as has already been introduced in Unit 11. Apart from these legislations, concepts like environmental impact management, its objectives, and the cycle and procedures have also been discussed. The last unit of the course, i.e., the fifteenth unit has been entitled Community and Environment. Here, relationship between women and environment, different

international agreements, and some of the environmental movements seen in India, viz., the Chipko Movement and the Narmada Bachao Andolan have been discussed. In a nutshell, this course shall provide you an insight into Environmental Economics, both from the theoretical perspective as well as with certain field based data and activities relating to the protection of our environment.

While going through a unit, you will notice some along-side boxes, which have been included to help you know some of the difficult, unseen terms. Some "ACTIVITY' (s) have been included to help you apply your own thoughts. Again, we have included some relevant concepts in "LET US KNOW" along with the text. And, at the end of each section, you will get "CHECK YOUR PROGRESS" questions. These have been designed to self-check your progress of study. It will be better if you solve the problems put in these boxes immediately after you go through the sections of the units and then match your answers with "ANSWERS TO CHECK YOUR PROGRESS" given at the end of each unit.

UNIT 8: ECONOMICS OF NATURAL RESOURCES - I

UNIT STRUCTURE

8.1 Learning Objectives

8.2 Introduction

8.3 Types of Natural Resources

8.3.1 Renewable Resources

8.3.2 Non-renewable Resources

8.4 Managing Exhaustible Resources

8.5 Resource Extraction and Environmental Cost

8.6 Let Us Sum Up

8.7 Further Reading

8.8 Answers to Check Your Progress

8.9 Model Questions

8.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- discuss what is natural resource
- discuss about types of natural resources
- explain about management of exhaustible resources
- describe resource extraction and the environmental cost associated with it.

8.2 INTRODUCTION

Our life, along with the life of all living objects in the Earth, requires a large number of goods and services of the 'Nature' for our day-to-day activities. When we wake up in the morning, the first thing we need is water, which we get from nature. Next, we need food for breakfast, which again comes from nature. To breathe, we need oxygen which comes from nature. Even when we walk in the evening, we need the service of nature. Thus, from morning to night, at every step of our life, we are depended on nature.

Water, Air, Forest, Minerals, Coal, Soil, Wild life are examples of Natural Resources.

We receive energy and minerals from nature which are used in the production of goods and services to satisfy human needs. Therefore, a society should know how to exploit resources efficiently and at what rate, so that the stock of resources can regenerate over time without hampering its natural rate of regeneration.

In this unit, we will discuss the types of natural resources. As the exhaustible resources will be depleted so long as the extraction rate is positive, we need to know what should be the strategy for optimum utilisation of the resources. We will also discuss the resource extraction and the environmental cost associated with it.

8.3 TYPES OF NATURAL RESOURCES

Natural resources are broadly classified into two categories, viz., renewable resources and non-renewable resources.

8.3.1 Renewable Resources

Renewable resources are those natural resources, which can be regenerated. The popular definition of renewable resource is "renewable resource is resource that is replaced by a natural process at a rate that is equal to or faster than the rate at which that resource is being consumed." In other words, renewable resources are those resources which are regenerative within a given span of time and inexhaustible in nature. Examples of renewable resource are forest, wildlife, hydro power, wind energy, biomass energy etc. Solar energy is also a renewable form of energy and it is the main driving force of the eco-system.

An important point to remember here in case of renewable resource is that although water, forest, wetland, grassland etc are considered to be renewable, they are renewable only within a certain limit. They may lose their capacity to regenerate if over-utilised or degraded beyond their natural regenerative capacity.

We can use the renewable resources directly and sometimes indirectly. Indirectly, these are used to create other more convenient forms of energy. We use renewable resources directly in solar ovens, water and wind mills, geothermal heating etc. You might see wind turbines or production of fuels such as biogas or ethanol from biomass. So, in production of wind energy, biogas etc., we indirectly use renewable resources or energy.

8.3.2 Non-renewable Resources

Non-renewable resources is that stock of resources whose exact quantity is not known but whatever be the amount of stock, it is fixed and cannot be re-grown in one's lifetime. Thus, once we exhaust these reserves, the same cannot be replenished. Fossil fuels such as coal, petroleum and natural gas are considered non-renewable resources. These resources are opposed to renewable resources such as forest, timber, which can regenerate naturally.

Major non-renewable resources include: forest resources, water resources, mineral resources, food resources, energy resources and land resources.

Ø Forest Resources: Forests are self-sustained wooden tracks with biotic community dominated by trees. Dense Forests are defined as those with a canopy cover of more than 70 percent, open forests as those with canopy cover between 40 to 70 percent and shrub as those with canopy cover of 10 to 40 percent. Evergreen Forests are those forests compromising thick and dense canopy of all trees, which predominately remain green throughout the year. Mangrove is described as a dense thicket or woody aquatic vegetation of forest cover occurring in tidal waters, near estuaries and along the confluence of delta in coastal areas.

Some of the major uses of forest resources are as follows:

- Supply of timber, fuel wood, fodder and a wide range of non-wood products.
- Natural habitat for bio-diversity and repository of genetic wealth.

- Provision of recreation and opportunity for ecotourism
- Forests ensure environmental functions such as biodiversity, water and soil conservation, water supply and climate regulation.



LET US KNOW

Forestry in India: As in 2010, the Food and Agriculture Organization of the United Nations estimates India's forest cover to be about 68 million hectares, or 22% of the country's area and by 2015 FAO Global assessment observers the forest cover increasing to 70.68 million hectares occupying 23.8% of the total land area of the country. The 2013 Forest Survey of India states its forest cover increased to 69.8 million hectares by 2012, per satellite measurements; this represents an increase of 5,871 square kilometers of forest cover in 2 years. However, the gains were primarily in northern, central and southern Indian states, while north eastern states witnessed a net loss in forest cover over 2010 to 2012.

Deforestation: Deforestation, clearance, or clearing is the removal of a forest or stand of trees from land which is then converted to a non-forest use. Deforestation can involve conversion of forest land to farms, ranches, or urban use. The most concentrated deforestation occurs in tropical rainforests.

Since time immemorial, humans have depended heavily on forests for food, medicine, shelter, wood and fuel. With growing civilisation the demands for raw material like timber, pulp, minerals, fuel wood etc. have shot up resulting in large scale logging, mining, road-building and clearing of forests. Excessive use of fuel wood and charcoal, expansion of urban, agricultural and industrial areas and overgrazing have together led to over-exploitation of our forests leading to their rapid degradation.

- *Water Resources:* Water resources in India include data on precipitation, surface and groundwater storage and hydropower

potential. India experiences an average precipitation of 1,170 millimetres (46 in) per year, or about 4,000 cubic kilometres (960 cu mi) of rains annually or about 1,720 cubic metres (61,000 cu ft) of fresh water per person every year. Some 80 percent of its area experiences rains of 750 millimetres (30 in) or more a year. However, this rain is not uniform in time or geography. Most of the rains occur during its monsoon seasons (June to September), with the north east and north receiving far more rains than India's west and south. Other than rains, the melting of snow over the Himalayas after winter season feeds the northern rivers to varying degrees. The southern rivers however experience more flow variability over the year. For the Himalayan basin, this leads to flooding in some months and water scarcity in others. Despite extensive river system, safe clean drinking water as well as irrigation water supplies for sustainable agriculture is in shortage across India. Our country harnessed 761 cubic kilometres (183 cu mi) (20 percent) of its water resources in 2010, part of which came from unsustainable use of groundwater. Of the water she withdrew from its rivers and groundwater wells, India dedicated about 688 cubic kilometres (165 cu mi) to irrigation, 56 cubic kilometres (13 cu mi) to municipal and drinking water applications and 17 cubic kilometres (4.1 cu mi) to industry.

Some of the major uses of water resources are as follows:

- About 70 percent of the fat free mass of the human body is made of water. To function properly, the body requires between one and seven litres of water per day to avoid dehydration; the precise amount depends on the level of activity, temperature, humidity and other factors. Most of this is ingested through foods or beverages other than drinking straight water.
- Water plays many critical roles within the field of food science. It is important for a food scientist to understand the roles that water plays within food processing to ensure the success of their products.

- Hydroelectricity is electricity obtained from hydropower. Hydroelectric power comes from water driving a water turbine connected to a generator. Hydroelectricity is a low-cost, non-polluting, renewable energy source.
- Approximately 70 percent of the 4,000 km3 of water humans withdraw from freshwater systems each year is used for irrigation.

Ø Mineral Resources: Minerals are naturally occurring, inorganic, crystalline solids having a definite chemical composition and characteristics physical properties. There are thousands of minerals occurring in different parts of the world. However, most of the rocks, we see every day are just composed of a few common minerals like quartz, feldspar, biotite, dolomite, calcite, laterite etc. These minerals, in turn, are composed of some elements like silicon, oxygen, iron, magnesium, calcium, aluminium etc.

Minerals find use in a large number of ways in everyday use in domestic, agricultural, industrial and commercial sectors and thus form a very important part of any nation's economy. The main uses of minerals are as follows:

- Development of industrial plants and machinery.
- Generation of energy e.g. coal, lignite, uranium
- Construction, housing, settlements.
- Defense equipments - weapons, armaments.
- Transportation means.
- Communication- telephone wires, cables, electronic devices.
- Agriculture- as fertilizers, seed dressings and fungicides.

India has a large number of economically useful minerals and they constitute one-quarter of the World's known mineral resources. India is rich in 35 minerals like iron, aluminium, manganese, chromium, limestone, Dolomite, Mica etc. India is deficient in lead, copper phosphate, potassium, nickel, gold and silver.

Minerals are limited in quantity and are being depleted very fast. Following are the steps for conservation of mineral resources:

- Application of ecofriendly mining methods.
- Reuse and recycling of metals.
- Search for new deposits.
- Recovering all possible elements as co-product or by by-products.
- Optimum and economic use of minerals.
- A complete data base of reserve, production and expected future demand of minerals.

Ø *Food Resources:* Food is a biological drive. Each organism needs food. All relations that exist among living organism are oriented towards food. Nature offers different source of food. Therefore, for food security, man has to be dependent on natural food resources.

Primitive societies obtained food through hunting and gathering. Today man obtains food from cultivated plants and domesticated animals. Although some food is obtained from ocean and fresh water, 95 percent of human population's protein demand is met from agricultural crops and animals. Most of our food comes from plants.

LET US KNOW



World Food Problems/ Food Crises: During the last 50 years World grain production has increased almost three times, thereby increasing per capita production by about 50%. But at the same time, population growth increased at such a rate in LDCs that it outstripped food production. Every year 40 million people die of undernourishment and malnutrition. That means that every year our food problem is killing as many people as were killed by the atomic bomb dropped on Hiroshima during World War – II

The World Food Summit, 1996 has set the target to reduce the number of undernourished to just half by 2015, which still means 410 million undernourished people on earth.

Ø *Energy Resources:* Energy consumption of a nation is usually considered as an index of its development. This is because almost all the developmental activities are directly or indirectly dependent upon energy. We find wide disparities in per capita energy use between the developed and the developing nations. The first form of energy technology probably was the fire, which produced heat and the early man used it for cooking and heating purposes. Wind and hydropower have also been in use for the last 10,000 years. In 1970's due to Iranian revolution and the Arab oil embargoes the prices of oil shot up. This ultimately led to exploration and use of several alternative sources of energy.

A source of energy is one that can provide adequate amount of energy in a usable form over a long period of time. These sources can be of two types:

- *Renewable Resources* which can be generated continuously in nature and are inexhaustible e.g. wood, solar energy, wind energy, tidal energy, hydropower, biomass energy, bio-fuels, geo-thermal energy and hydrogen. They are also known as non-conventional sources of energy and they can be used again and again in an endless manner.
- *Non-renewable Resources* which have accumulated in nature over a long span of time and cannot be quickly replenished when exhausted, e.g. coal, petroleum, natural gas and nuclear fuels like uranium and thorium.

Let us now discuss various forms of renewable and non-renewable energy resource.

Ø *Renewable Energy Resources:* This includes:

- *Solar Energy*: Sun is the ultimate source of energy, directly or indirectly for all others forms of energy. The nuclear fusion reactions occurring inside the sun release enormous quantities of energy in the form of heat and light. The solar energy received by the near earth space is approximately 1.4 kilojoules/second/ m^2 known as solar constant.

Traditionally, we have been using solar energy for drying clothes and food-grains, preservation of eatables and for obtaining salt from sea-water. Now we have several techniques for harnessing solar energy.

- *Wind Energy*: The high speed winds have a lot of energy in them as kinetic energy due to their motion. The driving force of the wind is the sun. The wind energy is harnessed by making use of wind mills. The blades of the wind mill keep on rotating continuously due to the force of the striking wind. The rotational motion of the blades drives a number of machines like water pumps, flour mills and electric generators. A large number of wind mills are installed in clusters called wind farms, which feed power to the utility grid and produce a large amount of electricity. These farms are ideally located in coastal regions, open grasslands or hilly regions, particularly mountain passes and ridges where the winds are strong and steady. The minimum wind speed required for satisfactory working of a wind generator is 15 km/hr.

  Wind energy is very useful as it does not cause any air pollution. After the initial installation cost, the wind energy is very cheap. It is believed that by the middle of the century wind power would supply more than 10% of world's electricity.

- *Hydropower:* The water flowing in a river is collected by constructing a big dam where the water is stored and allowed to fall from a height. The blades of the turbine located at the bottom of the dam move with the fast moving water which in turn rotates the generator and produces electricity. We can also construct mini or micro hydel power plants on the rivers in hilly regions for harnessing the hydro energy on a small scale, but the minimum height of the water falls should be 10 metres. The hydropower potential of India is estimated to be about 4×10^{11} KW-hours. Till now we have utilized only a little more than 11% of this potential.

Hydropower does not cause any pollution, it is renewable and normally the hydro power projects are mutli-purpose projects helping in controlling floods, used for irrigation, navigation etc. However, big dams are often associated with a number of environmental impacts.

- *Tidal Energy*: Ocean tides produced by gravitational forces of sun and moon contain enormous amounts of energy. The 'high tide' and 'low tide' refer to the rise and fall of water in the oceans. A difference of several meters is required between the height of high and low tide to spin the turbines. The tidal energy can be harnessed by constructing a tidal barrage. During high tide, the sea-water flows into the reservoir of the barrage and turns the turbine, which in turn produces electricity by rotating the generators. During low tide, when the sea-level is low, the sea water stored in the barrage reservoir flows out into the sea and again turns the turbines.
- *Biogas:* Biogas is a mixture of methane, carbon dioxide, hydrogen and hydrogen sulphide, the major constituent being methane. Biogas is produced by anaerobic degradation of animal wastes in the presence of water. Anaerobic degradation means break down of organic matter by bacteria in the absence of oxygen.

  Biogas is a non-polluting, clean and low cost fuel which is very useful for rural areas where a lot of animal waste and agricultural waste are available. India has the largest cattle population in the world and has tremendous potential for biogas production.
- *Coal:* Coal was formed 255- 350 million years in the hot, damp regions of the earth during the carboniferous age. The ancient plants along the banks of rivers and swamps were buried after death into the soil and due to the heat and pressure gradually got converted into peat and coal over millions of years of time. There are mainly three types of coal, namely anthracite (hard

coal), bituminous (soft coal) and lignite (brown coal). Anthracite coal has maximum carbon (90%) and calorific value (8700kcal/kg). Bituminous, lignite and peat contain 80%, 70% and 60% carbon, respectively. Coal is the most abundant fossil fuel in the world.

- *Petroleum:* It is the lifeline of global economy. There are 13 countries in the world having 67% of the petroleum reserves which together form the OPEC (Organisation of Petroleum Exporting Counties). About 1/4th of the oil reserves are in Saudi Arabia.

  At the present rate of usage, the World's crude oil reserves are estimated to get exhausted in just 40 years. Some optimists, however, believe that there are some yet undiscovered reserves. Even then the crude oil reserves will last for another 40 years or so.

- *Liquefied Petroleum Gas (LPG):* The main component of petroleum is butane, the other being propane and ethane. The petroleum gas is easily converted to liquid form under pressure as LPG. It is odorless, but the LPG in our domestic gas cylinders gives a foul smell. This is, in fact, due to ethyl mercaptan, a foul smelling gas , added to LPG so that any leakage of LPG from the cylinder can be detected instantaneously.

  Oil fields in India are located at Digboi (Assam), Gujarat plains and Bombay high, offshore areas in deltaic coasts of Godavari, Krishna, Kaveri and Mahanadi.

- *Natural Gas:* It is mainly composed of methane (95%) with small amounts of propane and ethane. It is a fossil fuel. Natural gas deposits mostly accompany oil deposits because it has been formed by decomposing remains of dead animals and plants buried under the earth. Natural gas is the cleanest fossil fuel. It can be easily transported through pipelines. It has a high calorific value of about 50KJ/G and burns without any smoke.

- *Nuclear Energy:* Nuclear energy is known for its high destructive power as evidenced from nuclear weapons. The nuclear energy can also be harnessed for providing commercial energy.

Ø *Land Resources:* Earth's one-fourth area is covered by land which is largely covered with natural forests, grasslands, wetlands and man-made urban and rural settlements along with agriculture. Out of total land surface11 percent is cultivated, 52 percent is under forest cover, meadows and pastures, 20 percent deserts, 2.6 percent is occupied by human settlements, while rest is covered by ice, glaciers etc. Nearly 80 percent land is covered by soil. In India, agriculture occupies 43 percent land, forest 23 percent, pastures 4 percent and human habitation 8 percent. Land availability in India is 0.34 percent hectre per person. To prevent land degradation judicious land use is must.

Land is a basic natural resource that provides habitat and sustenance for living organisms, as well as being a major focus of economic activities. Land has the following functions:

- It is the basis for many life support systems, through the production of biomass that provides food, fodder, fiber, fuel, timber and other biotic materials for human use, either directly or through animal husbandry including aquaculture and inland and coastal fishery.
- Land is the basis of terrestrial biodiversity by providing the biological habitats and gene reserves for plants, animals and micro-organisms, above and below ground.
- Land and its use are a source and sink of greenhouse gases and form a co-determinant of the global energy balance as reflection, absorption and transformation of radioactive energy of the sun, and of the global hydrological cycle.
- Land is storehouse of raw materials and minerals for human use.
- Land has a receptive, filtering, buffering and transforming function of hazardous compounds.

- **m** Land provides the physical basis for human settlements, industrial plants and social activities such as sports and recreation.

8.4 MANAGING EXHAUSTIBLE RESOURCES

Exhaustible resources will be depleted so long as the extraction rate is positive. Are our exhaustible resources being depleted too rapidly? To answer question like this we need to know the optimal rate at which to extract/deplete exhaustible resources. With that in view we will present here some simple and intuitive results involved in the theory of depletion.

What are the conditions that must hold while depleting an exhaustible resource over time, that is, along an optimal depletion path? The supply (and extraction) behaviour of a ***price-taking owner*** of an exhaustible resource such as oil differs from that of an ordinary good or resource. An exhaustible resource is limited in quantity and is not producible like an ordinary good. Ordinary goods produced in the economy using available methods of production can be replicated. Since exhaustible resources are created by geological processes with geological time spans, they can be regarded as fixed in quantity, although the total quantity available may not be known.

A ***price-taking firm*** supplying ordinary goods will adjust production in all periods so that its marginal cost (mc) of production in each period equals price (p) in that period. If the *mc* is less than *p,* the supplier can raise current profits by increasing production. However, when the firm is the extractor of an exhaustible resource, such behaviour might require extraction of more stocks than is available to the firm.



Price-Taking owner:
Competitive owner who sells his natural resources in a market where he does not have a large enough market share to be able to influence market prices.

Cases like this, then, require some modifications of the standard theory. Since an exhaustible resource is limited in quantity and is not producible, extrication and sale of a unit today involves an *opportunity cost:* the value that might have been obtained at some future date. This opportunity cost is usually given the name *user cost (UC).* The presence of user cost is central to the economics of exhaustible resources. User cost does not

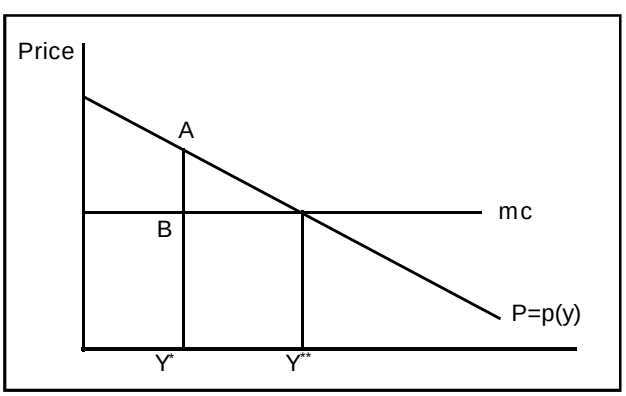
exist for conventional reproducible goods since the consumption of an amount now does not reduce the quantity that can be consumed in the future; additional quantities can always be produced. However, a barrel of oil extracted today is a barrel unavailable for extraction in the future. In deciding whether to extract and sell an additional barrel today, the extractor must consider not only the cost of pumping the barrel, but also the cost of foregoing the highest return that could have been earned if the oil had instead been pumped and sold in the future. Hence, it is necessary to have a more inclusive definition of marginal cost and we call it *augmented marginal cost (amc)*. The augmented marginal cost (amc) is, then, defined as the marginal cost of extraction (mc) plus the user cost (uc).

When *mc* is redefined in this way, it is optimal for a competitive resource owner (firm) to extract the resource in each period to the point where its *amc* equals the market price (p). Instead of the usual efficiency condition, price (p) = marginal extraction cost (mc), we have:

$$p = mc + uc$$

This is the first condition of optimal depletion. As shown in Figure 8.1, it implies that less of the resource will be extracted today than if it were a producible ordinary good or a resource. Given the inverse demand function p = p(y), where p is the price and y is the quantity extracted, only Y* units (rather than Y** where p=mc) will be extracted by a resource planner or a price-taking firm seeking to allocate extraction efficiently over time. This leaves a positive difference AB (the opportunity cost/user cost) between p and mc.

Figure 8.1: Marginal Extraction Cost



Beneath the apparent simplicity of this rule lies a wealth of subtlety. The rule implies, for example, that the current extraction rate by a private owner of a natural resource depends not only on the current price, as in the standard theory, but also on expectations about future prices. These price expectations determine the opportunity cost of additional current extraction. A competitive supplier that expects future prices to be sufficiently low compared with the current price may extract and sell intensively in the current period, judging the opportunity cost of additional extraction to be small. But if future prices are expected to be sufficiently high, the same current price may induce no extraction whatsoever, today.

For some further results, let us, for simplicity, assume just two periods: the resource owner either extracts and sells the resource today, in period O, or retains it in the ground until the next period 1. Let the price he can obtain for a unit of the resources today be p0 and the price he expects to prevail for a unit in the next period be p1. The cost per unit of extracting the resource and delivering it to be the buyer is C, which is not expected to vary between periods 0 and 1, that is C = mc remains constant.

Because the owner has a fixed stock (to be supplied from) of the resource, any unit sold in period O will reduce the quantity that can be sold in period 1. If he sells the unit in period O he will receive net revenue of p0 - C but forgo revenue of p1 - C in the following period. The value in period O of the net revenue foregone is its present value (p1-C)/(1+ r) where r is his discount rate.

Hence his return from selling a unit today will be:

$$(p0 - C) - (p1-C)/(1+ r)$$

(p1-C)/(1+ r) is the opportunity cost of his decision to sell a unit today. It is the user cost of his decision. It arises because he is faced with the alternative of selling it in the following period. If

$$(p0 - C) > (p1-C)/(1+ r)$$

He will be better off selling his resources in the current period. If, on the other hand,

$$(p0 - C) < (p1-C)/(1+ r)$$

He will be better off by leaving it in the ground. His optimum amount of current extraction is given where

$$(p0 - C) = (p1-C)/(1+ r) \quad (1)$$

This implies that $p0 = C - (p1-C)/(1+ r)$ (2)

Equation (1) states that our earlier result that the current price of the resource when it is extracted optimally, should be equal to the mc plus the user cost (uc).

With reproducible resources there is no element of user cost since resources are produced in each period to satisfy the demand in that period and there is no carry over from period to period. Hence, as we have seen earlier, for a reproducible resource the optimum output is given where p0 = C.

Transposing equation (1) , we have

$$(p1-C)/ (p0 - C) = 1 + r \quad (3)$$

Which implies that $(p1-C) = (p0 - C)(1+ r)$ (4)

This equation (3 & 4) is the second condition of optimal depletion and is usually described as the fundamental equation of exhaustible resource extraction.

A numerical example may help to illustrate this fundamental condition. Suppose the interest rate is 10 percent and the net price (p - mc), that is, user cost per unit of the resource is Rs. 20. If the net price (user cost) is not expected to grow by 10 percent to Rs. 22 next year, it pays to extract more of the resource in the current period, because the resulting income from sales will earn 10 percent interest if invested in interest bearing assets. If the net price is expected to go above Rs. 22 that is, to grow faster than the rate of interest - the producer will have no incentive at all to extract in the current period. This is because any unit extracted today will (even after interest earning) be worth less in a year than a unit extracted and sold a year from now.

If mc of extraction is small relative to the price of the resource, equation (3) & (4) approximate to

$p1/ p0 = 1 + r$ or $p1 = p0 (1 + r)$

Thus, along the optimum path resource prices grow at the discount rate. The higher the discount rate the faster will the price of the resource

rise along the optimum path. A higher discount rate reduces the user cost of the resource and causes mine owners to deplete their resource at a faster rate. In reality, of course, extraction costs are never zero. Whenever they are positive, a price increase equal to the interest rate would cause the net price to rise by more than the interest rate.

8.5 RESOURCE EXTRACTION AND ENVIRONMENTAL COST

Extraction of a natural resource may impose an environmental cost on society. In situations like this property-rights are not usually well-defined and hence this cost is not internalised by the extractors. The aesthetic costs of strip mining, the occupational health hazards associated with coal mining, and the acids leached into streams from mine operations are all examples of associated environmental costs. The cost of extraction and sale (including user cost) is borne by the resource owner and taken account of (internalised) in the calculation of how much of the resource to extract. The environmental damage, however, is an external cost and is not borne by the owner and as such it will not be part of the extraction decision. It is important to know how the market allocation, based on only the former cost would differ from the optimal allocation (depletion), which is based on both.

The inclusion of environmental costs results in higher resource prices, which tend to lower demand. All other things being equal, it would allow the resource to last longer. On the other hand when environmental side-effects are ignored by the resource extracting firm, the price of the exhaustible resource would be too low, demand too high, and the resource would be extracted too rapidly over time.

The presence of environmental costs, in this way, forms an important intersection between the fields of environmental economics and natural resource economics. Arguments developed above confirm that environmental and natural resource decisions are intimately and inextricably linked.



CHECK YOUR PROGRESS

Q 1: What are the types of natural resources?

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Q 2: What is meant by renewable resource?

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8.6 LET US SUM UP

- Natural resources are classified into two categories, viz., Renewable resources and Non-renewable resources
- Renewable resources is that natural resources, which can be regenerated. The popular definition of renewable resource is "renewable resource is resource that is replaced by a natural process at a rate that is equal to or faster than the rate at which that resource is being consumed."
- Non-renewable resources is that stock of resources whose exact quantity is not known but whatever be the amount of stock, it is fixed and cannot be re-grown in one's lifetime.
- Forests are self-sustained wooden tracks with biotic community dominated by trees. Dense Forests are defined as those with a canopy cover of more than 70 percent, open forests as those with canopy cover between 40 to 70 percent and scrub as those with canopy cover of 10 to 40 percent.
- Water resources in India include information on precipitation, surface and groundwater storage and hydropower potential.
- Mineral are naturally occurring, inorganic, crystalline solids having a definite chemical composition and characteristics physical properties.
- Food is a biological drive. Each organism needs food. All relations that exist among living organism are oriented towards food.
- Energy consumption of a nation is usually considered as an index of its development.

- Earth's one-fourth area is covered by land which is largely covered with natural forests, grasslands, wetlands and man-made urban and rural settlements along with agriculture.
- Extraction of a natural resource may impose an environmental cost on society.



8.7. FURTHER READING

(1) Bharucha, E. (2005). *Environmental Studies for Undergraduate Courses.* New Dehli: Universities Press

(2) Bhattacharya, R. N. (2001). *Environmental Economics: An Indian Perspective*. New Delhi: Oxford University Press

(3) Purkayastha, G. (2006). *Environmental Economics: Theory, Problems and Solutions*. New Delhi: Kalyani Publishers

(4) Singh, R. P. & Islam, Z. (2012). *Environmental Studies*. New Delhi: Concept Publishing Compay (P) Ltd.



8.8 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1: Natural resources are to two types, viz., renewable resource and non-renewable resource.

Ans to Q No 2: Renewable resources is that natural resources, which can be regenerated. The popular definition of renewable resource is "renewable resource is resource that is replaced by a natural process at a rate that is equal to or faster than the rate at which that resource is being consumed."



8.9 MODEL QUESTIONS

Q 1: Differentiate between renewable resource and non-renewable resource.

Q 2: Explain the optimal rate at which exhaustible resources are to be extracted in the context of managing exhaustible resource.

Q 3: Explain the environmental cost in relation to resource extraction.

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UNIT 9: ECONOMICS OF NATURAL RESOURCES - II

UNIT STRUCTURE

9.1 Learning Objectives

9.2 Introduction

9.3 Renewable Resources

9.3.1 Renewable Vs Non Renewable Resource Economy

9.4 The Biological Growth

9.5 The Growth Curve

9.6 Sustainable Yield

9.6.1 Maximum Sustainable Yield

9.7 The Economically Optimum Rate of Harvest

9.8 Let Us Sum Up

9.9 Further Reading

9.10 Answers to Check Your Progress

9.11 Model Questions

9.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- define renewable resources
- distinguish between renewable and nonrenewable resource
- explain the 'sustainable yield'
- know the economical as well as biological efficient yield
- determine the optimum rate of harvest for the renewable resource.

9.2 INTRODUCTION

All means of satisfying human needs at a given point of time and place are called resources.The natural resources are those resources which occur naturally. They cannot be produced.Natural resources can be classified in different ways. On the basis of origin it can be categorised as biotic and abiotic. On the basis of distribution it can be categorised as ubiquitous and localised. On the basis of ownership it can be categorised

as individual, community level, national and international. On the basis of the stages of development it can be said as potential, actual, reserve and stock.On the basis of renewability there are two important types of resources i.e. Renewable resources and Non Renewable resources. Resources from a human use perspective are classified as renewable only so long as the rate of replenishment or recovery exceeds that of the rate of consumption. In this unit we will discuss the renewable resource.

9.3 RENEWABLE RESOURCES

Renewable resources are those which have regenerative capacity within an economically reliable time horizon. They are capable of self reproduction and interactive in nature. This is in the sense that the size of these resources are determined and influenced by the biological forces and human activities. If the biological forces is small or renewable resources are over used, then there is a chance of exhaustion of these resources.

But the line dividing the distinction between exhaustible resources and renewable resources is always not clear. However renewable resources are different from exhaustible resources because they are naturally regenerated on a time frame that is relevant to human exploitation. Like the exhaustible resource, renewable resource cannot be reproduced. Hence along with the intervention by human activities, the stock of the renewable resource depends on the population dynamics of a stock. The essential feature of renewable resource is its capacity to regenerate itself, its stock may increase or decrease on a time frame that is related to human exploitation. All varieties of exploited plants and animals are common examples of renewable resources.

9.3.1 Renewable Vs Non Renewable Resource Economy

The economic analysis of renewable resource differs from that of non renewable resource in two ways,

- It is not concerned with the finite availability of the resource and the time when a resource industry ceases to exist. A renewable

resource can remain productive indefinitely, although it may be drawn down to extinction if it is over exploited.

- The issue of market structure and the potential for cartelisation is not a prominent feature of renewable resource literature: market power is prone to being competed away by the close substitutability between one resource stock to another.



CHECK YOUR PROGRESS

Q 1: What is meant by the term 'resource'? (Answer in about 20 words)

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Q 2: Define natural resource. (Answer in about 20 words)

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Q 3: What do you mean by Renewable resource? (Answer in about 30 words)

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Q 4: Will the renewable resource exhaust? Give arguments. (Answer in about 60 words)

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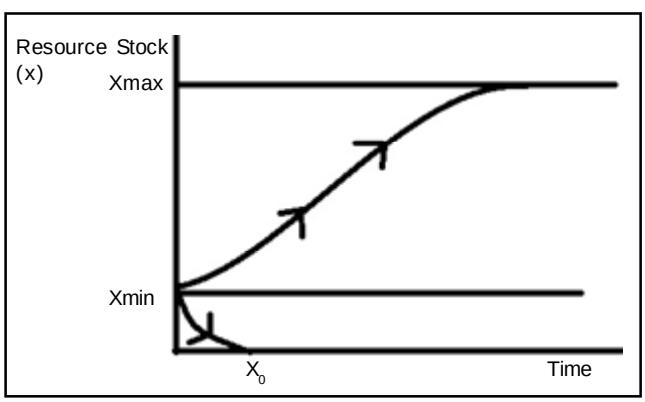
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9.4 THE BIOLOGICAL GROWTH

Catching a fish or cutting a tree does not reduce the population of fish or tree in any period. But if through human activities or by some other reasons the population is drawn down below the critical threshold, the species will become extinct. Therefore biological population belong to a class of renewable resource is called interactive resource, where the size of the resource stock (population) is determined jointly by the biological considerations and by actions taken by society. The size of the population in turn determines the availability of the resource in future. On the other hand, the stock of renewable resource will decrease if the rate of exploitation exceeds the natural growth rate. The stock of renewable resource is generally affected by two factors i.e. biological and manmade factors. The biological forces of affecting the size of renewable resource are endogenous factors. The exogenous factors like the human activities can also affect the size of the fish stock. The biological factors influencing the stock of a renewable resource such as fish are birth rate, death rate, in-migration of the new fish to the habitat and out-migration of the existing fish from the old habitat. The biological growth of the renewable resource can be explained with the help of Figure 9.1.

Figure 9.1: The Growth Curve



For simplicity, to understand the phenomenon we take the example of a single fish species which is a renewable resource. The growth in any natural biological event (a natural fish stock or forest) will depend on the stock of the event. Thus the increase in the fish stock in a natural water

body depends on the initial stock of fish in the natural water body. For a hypothetical fish stock the growth rate will follow a cumulative growth shape by assuming the size of the stock as a function of time. In figure the curve G (X) shows the size of the stock as a function of time. At low levels of the stock the fish multiply, but as they begin to compete for food their rate of growth slows down and eventually the stock converges on some maximum level Xmax. This is the economy's carrying capacity for a particular species (Fish) in the absence of human intervention. This cumulative curve thus takes the general logistic shape with at first successively large increments, then successively smaller one. The growth curve begins at Xmin which is known as the 'critical minimum level of population'. If the size of the stock falls below this level then there is a possibility of extinction of the species leading to Xo. The natural biological growth rate of the resource will not be able to increase the size of the stock once again, if the stock once falls below the critical minimum level of population. In that case the species will become eventually extinct.



CHECK YOUR PROGRESS

Q 5: Why the renewable resources are called interactive? (Answer in about 20 words)

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Q 6: State whether the following statement is True (T) or False (F)

The biological forces of affecting the size of the renewable resources are exogenous factors. (T/F)

Q 7: What is the shape of the biological growth curve of renewable resource? (Answer in about 70 words)

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Q 8: What is the carrying capacity? (Answer in about 50 words)

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Q 9: Define critical minimum level of population. (Answer in about 50 words)

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9.5 THE GROWTH CURVE

Again, the optimal depletion for renewable resource can be analysed with the concept of growth function of a renewable resource, for example, fish. The growth of a resource stock is a function of the size of the stock itself in the absence of any change in the ecological characteristics of the ecosystem. This is known as 'density dependent growth' and can be illustrated as a logistic function.

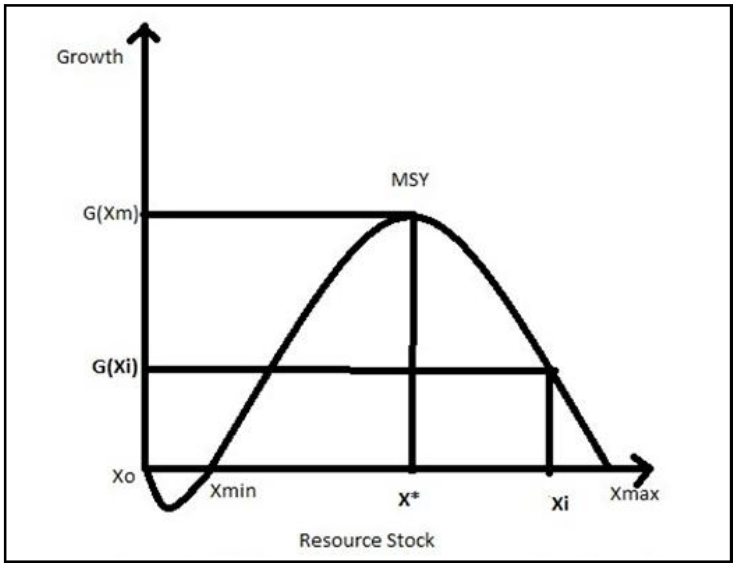
If the initial stock of fish in a natural water body in a given time period is 'X', then the growth of the fish stock 'G' in water body may be functionally expressed as,

$$G = G(X)$$

This implies that the growth is a function of the initial resource stock. The nature of growth can be shown with the help of Figure 9.2.

In the figure we measure the size of population on the horizontal axis and the growth of the population on the vertical axis. The growth curve suggests that there is a range of population size (Xmin to X*) where population growth increases as the population size increases and a range

Figure 9.2: Relationship between Resource Stock and Growth



(X* to Xmin) where initial increase in population size lead to eventual declines in growth of the population. Xmax is known as the natural equilibrium. In the absence of any human intervention and left to the nature alone, any renewable resource stock like a fish will have some population which is known as natural equilibrium. This is a ***stable equilibrium*** point. This is stable because any reduction of the stock of resource due to some factors like mortality or outmigration from that particular habitat will exactly offset by the new birth and in migration of population from a different habitat to that particular habitat.

A ***stable equilibrium*** is one in which movements away from equilibrium stock level set forces in motion to restore it.

If any forces tend to reduce the population stock below the natural equilibrium Xmax for some time, it will restore itself once again along the growth curve G(X) due to the new birth and in migration. Again, if the size of the population exceeds the natural equilibrium for a short period of time, then it will cross the limit of that particular habitat. The excess stock will have competition among themselves for food and space. Hence some will die and others will migrate in search of new habitat by keeping the natural equilibrium as stable.

There is another point which is unstable. This point is known as minimum viable population. This is unstable because the size of the population will not sustain at that point for a longer period of time. If the size of the population increases beyond this, then the stock will increase by



CHECK YOUR PROGRESS

Q 10: What is density dependent growth? (Answer in about 20 words)

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Q 11: State whether the following statements are True (T) or False (F)

(a) Natural equilibrium point is stable. (T/F)

(b) Minimum viable population is stable. (T/F)

9.6 SUSTAINABLE YIELD

With human intervention when catch (yield) level equals the growth of the stock, it is known as sustainable yield. In the sustainable yield, the stock size, the growth rate and hence the catch, all remain constant. It is sustainable resource stock depicted in diagram as G(Xi) for the resource stock Xi (Figure 9.2).

9.6.1 Maximum Sustainable Yield

On the other hand, the particular stock size at which the growth rate of the resource stock is maximum is known as the maximum sustainable yield (MSY). MSY is the largest perpetual yield that could be obtained from the resource. Beyond the MSY, the growth rate of the resource stock will decline. MSY is depicted in the diagram as X*.

The size of the resource stock can be maintained for a long period of time, if the catch or yield level of the resource is at MSY. The resource stock can replenish itself over a long period of time at this level. If it takes one year to regenerate, MSY can be harvested in each year. Harvesting the resource stock at MSY can be considered as economically optimum harvest level. The biologists say that we can go up to the maximum sustainable yield. But the economically optimum or efficient sustainable yield is less than the biologically maximum sustainable yield. This is because biologists are concerned only in stock and yield of the resource. But the

economists are concerned with the marginal cost of harvesting or catching also. The marginal cost of harvesting rises as the level of yield increases. As a result, economically optimum sustainable yield is less than the maximum sustainable yield.

9.7 THE ECONOMICALLY OPTIMUM RATE OF HARVEST

After determining the maximum sustainable yield, the main concern is to determine the optimum rate at which harvesting can be made. Allocation to be efficient, it has to equate the marginal costs of harvest with its marginal benefit i.e. the maximum net benefit.

The level of harvest or yield depends on 'effort'. Effort is the resource and time devoted to harvesting the resource. It is expressed as,

$X = Y/ E$

Or alternatively,

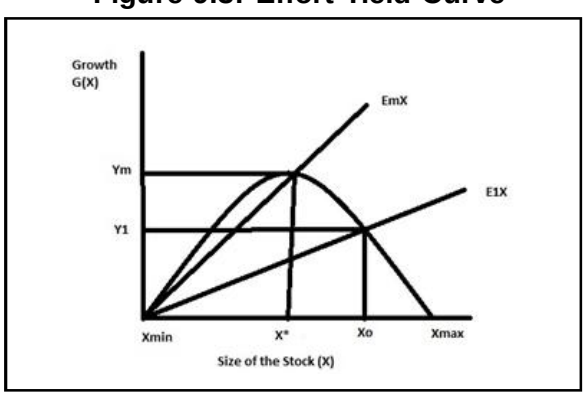
$E = Y / X$

The bigger the effort (E), the larger the proportion of the stock (X) that would be harvested (Y). Rewriting the equation,

$Y = EX$

The rate of harvest can be shown in the following diagram. For simplicity, we merge the point Xo to Xmin of the above diagram. The choice of effort (E) will determine the equilibrium harvest (Y) and the stock level (X). This in turn will determine the characteristics of the growth curve. Hence, $EX = G(X)$.

Figure 9.3: Effort Yield Curve



In the above diagram the growth of the resource stock G(X) as well as harvest (Y) is represented in the vertical axis and the size of the stock (X) is represented in the horizontal axis. For any resource stock the effort will determine the amount of harvest as well as the remaining stock of the resource.

For the resource stock Xo, with the effort level E1, Y1amount of harvest can be made. This is the sustainable level of harvest. If effort is made beyond this level, then more harvesting can be made. This will reduce the availability of stock in the habitat. Remember, sustainable yield is where harvest equal to growth rate. Again if the effort is less than the sustainable yield, then the resource stock will grow to reach the sustainable yield.

If the effort level is more than E1, then maximum harvesting can be made out of that habitat at the effort level E*.

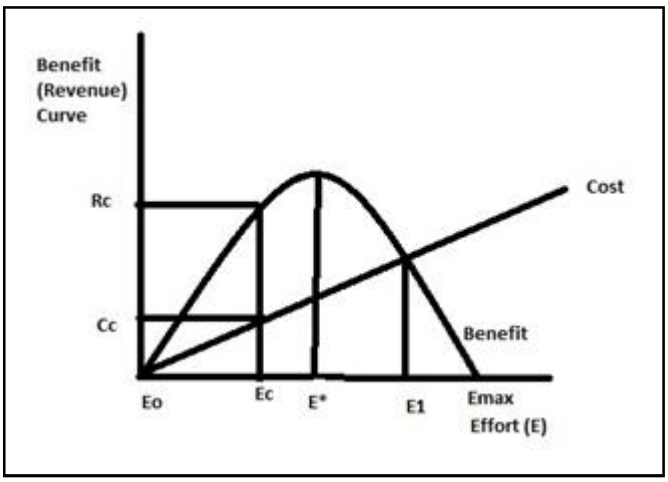
Now, the effort yield curve can be illustrated into costs and revenue. If we assume that effort is only factor of production, then the total cost (TC) will be equal to the level of effort times the price of effort, which may be taken as the wage rate. Assuming a constant wage rate and a constant price, total cost can be shown as a linear function. Total revenue (TR) is,

TR = P X Harvest

And thus harvest curve becomes TR curve. Optimum sustainable yield corresponds to level where marginal cost of harvesting is equal to marginal revenue from harvesting i.e. MC=MR. This means that the slope of TR should be equal to the slope of TC. So, the efficient or optimum level of effort is achieved when the vertical distance between benefits and costs is maximised.

As sustainable levels of effort are increased, eventually a point is reached E* where further efforts reduce the sustainable catch (yield) and revenue for all years. This point is the maximum sustainable yield.The net benefit is depicted as the vertical difference between the benefit and costs. The efficient (optimum) level of effort is Ec, where the vertical distance between benefits and costs is maximized. Here MC = MR. This efficient level of effort determines the efficient level of yield. This is the static efficient sustainable yield. Please refer to alongside Figure 9.4.

Figure 9.4: The Efficient (Optimum) Sustainable Yield for a Renewable Resoure (Fishery)





CHECK YOUR PROGRESS

Q 12: Define sustainable yield. (Answer in about 30 words)

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Q 13: What is meant by maximum sustainable yield? (Answer in about 20 words)

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Q 14: How the allocation becomes efficient? (Answer in about 30 words)

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Now from the above information, we can come to the conclusion that maximum sustainable yield is not efficient. The maximum sustainable yield would be efficient, if the marginal cost of additional effort were zero. Since this is not the case, the efficient level of effort is less that necessary to harvest the maximum sustainable yield. Thus static efficient level of effort

leads to a larger fish population than the maximum sustainable yield of effort and hence maximum sustainable yield does not appear to be a socially desirable objective to strive for. Thus, what is economically efficient sustainable is not maximum sustainable yield and efficient sustainable yield is less than the maximum sustainable yield.



9.8 LET US SUM UP

- The natural resources are those resources which occur naturally. They cannot be produced. Natural resources can be classified in different ways on the basis of origin, distribution, ownership, development and renewability.
- Renewable resources are those which have regenerative capacity within an economically reliable time horizon. They are capable of self reproduction and interactive in nature.
- Renewable resources are different from exhaustible resources because they are naturally regenerated on a time frame that is relevant to human exploitation. Like the exhaustible resource, renewable resource cannot be reproduced.
- Biological population belong to a class of renewable resource is called interactive resource, where the size of the resource stock (population) is determined jointly by the biological considerations and by actions taken by society.
- The stock of the renewable resource is generally affected by two factors i.e. biological and manmade factors.
- The biological growth curve takes the general logistic shape with at first successively large increments, then successively smaller one. The growth curve begins at the 'critical minimum level of population'.At low levels of the stock the fish multiply, but as they begin to compete for food their rate of growth slows down and eventually the stock converges on some maximum level. This is the economy's carrying capacity for a particular species in the absence of human interventions.
- Natural growth rate is known as stable equilibrium and minimum viable population is known as unstable equilibrium.

- With human intervention when catch (yield) level equals the growth of the stock, it is known as sustainable yield. Again, maximum of the sustainable yield is maximum sustainable yield.
- The economically optimum or efficient sustainable yield is less than the biologically maximum sustainable yield. This is because biologists are concerned only in stock and yield of the resource. But the economists are concerned with the marginal cost of harvesting or catching also.
- Allocation to be efficient has to equate marginal costs of harvest with marginal benefit i.e. the maximum net benefit.
- The maximum sustainable yield would be efficient, if the marginal cost of additional effort were zero. Hence economically efficient sustainable is not maximum sustainable yield and efficient sustainable yield is less than the maximum sustainable yield.

9.9 FURTHER READING

(1) Bhattacharya, R. N. (2001). *Environmental Economics: An Indian Perspective*. New Delhi: Oxford University Press

(2) Burhagohain and Das, Environmental Economics, EBH Publishers

(3) Hanley, Shrogram and White, Introduction to Environmental Economics, OUP

(4) Purkayastha, G. (2006). *Environmental Economics: Theory, Problems and Solutions*. New Delhi: Kalyani Publishers

9.10 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1: All means of satisfying human needs at a given point of time and place are called resources.

Ans to Q No 2: The natural resources are those resources which occur naturally. They cannot be produced.

Ans to Q No 3: Renewable resources are those which have regenerative capacity within an economically reliable time horizon. They are capable of self reproduction and interactive in nature.

Ans to Q No 4: The renewable resources are regenerated within an economically reliable time period.They are interactive in nature. Hence their size is determined jointly by the biological factors and human activities. If because of any forces the growth of the renewable resource is drawn down below the critical minimum level or more harvest is made by the human activities, then there is the chance of exhaustion of the renewable resource.

Ans to Q No 5: The size of the resource stock (population) of renewable resource is determined jointly by the biological considerations and by actions taken by society. Because of this reason renewable resource are known as interactive in nature.

Ans to Q No 6: False.

Ans to Q No 7: The biological growth curve follows the cumulative growth function by assuming the size of the renewable resource stock as a function of time. This cumulative curve takes the general logistic shape with at first successively large increments, then successively smaller one. After that it will reach some maximum level of population which is also the carrying capacity of the habitat.

Ans to Q No 8: The carrying capacity of an eco system is the maximum population of a particular species that the eco system can sustain indefinitely by providing them all the basic needs for subsistence. It is the upper limit of the population of that species which can live in that eco system as comfortably.

Ans to Q No 9: Critical minimum level of population is the minimum level of population below which the stock of the population will decline and will extinct in one day.

Ans to Q No 10: The growth of a resource stock is a function of the size of the stock itself in the absence of any change in the ecological characteristics of the ecosystem. This is known as density dependent growth.

Ans to Q No 11: (a) True (b) False

Ans to Q No 12: Sustainable yield is the size of the catch or yield or harvest level of a renewable resource which is equal to the growth of the resource stock.

Ans to Q No 13: The maximum of the sustainable yield is the maximum sustainable yield.

Ans to Q No 14: Allocation to be efficient has to equate marginal costs of harvest with marginal benefit i.e. the maximum net benefit.

9.11 MODEL QUESTIONS

Short Questions (Answer each question in about 150 words)

Q 1: Discuss the classification of the natural resources.

Q 2: Outline the differences between renewable resources and nonrenewable resources.

Q 3: Is maximum sustainable yield efficient? Justify your view.

Q 4: How can the optimum rate of harvest be determined for a renewable resource?

Essay type Questions (Answer each question in about 350 - 500 words)

Q 1: Describe the biological growth of a renewable resource.

Q 2: 'Economically optimum sustainable yield is less than biologically maximum sustainable yield'. Explain.

Q 3: Explain the concept of sustainable yield with suitable diagram.

Q 4: How can the effort-yield curve be derived from the growth curve? Explain.

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UNIT 10: SUSTAINABLE DEVELOPMENT - I

UNIT STRUCTURE

10.1 Learning Objectives

10.2 Introduction

10.3 History of Sustainable Development

10.4 Weak and Strong Sustainability

10.5 Indicators of Sustainable Development

- 10.5.1 Pressure Indicator
- 10.5.2 State Indicator
- 10.5.3 Response Indicator

10.6 Measurement of Sustainable Development

10.7 Let Us Sum Up

10.8 Further Reading

10.9 Answers to Check Your Progress

10.10 Model Questions

10.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- define sustainable development
- explain strong and weak sustainability
- explore the indicators of sustainable development.

10.2 INTRODUCTION

Sustainable development is an organizing principle for human wealth on a finite planet. Sustainable development ties together concern for the carrying capacity of natural system with the social and economic challenges faced by humanity. It is a larger issue encompassing a balanced approach towards economic, ecological and social development. The term sustainable development began to gain with acceptance in the late 1980s after its appearance in Our Common Future also known as the Brundtland Report. According to Brundtland Commission (1987) sustainable

development is that which meets the needs of the present without compromising the ability of future generation to meet their own needs.

The concept of sustainable development aims at maximizing the net benefits of economic activities, subject to maintaining the stock of productive assets over time and providing a social safety net to meet the basic needs of the poor. Sustainable development attempts to accelerate development in an environmentally responsible manner keeping in mind the inter-generational and intra generational equity requirements. It is a process in which development can be sustained for generations. It affords to the future generation the same, if not more, capacity to prosper as the present generation have.

The basic rule behind the sustainable development strategy is that the total amount of capital that is passed on to the next generation should not be less that the capital the current generation inherited. The three important components or aims of sustainable development include: (a) uplifting the standard of living of the mass people by adopting a reliable growth path (i.e. economic sustainability), (b) equitable and just distribution of resources so that mass people have access to the basic needs of life (i.e., social sustainability) and (c) environmental resources need to be deployed in such a fashion so that the inputs providing and waste assimilating capacity of our planet earth remain intact through generations (i.e., ecological sustainability).

This is the first unit on sustainable development. In this unit, a brief history of the concept of sustainable development has been discussed. In addition to that, the concepts of weak and strong sustainability, its indicators and measurements have been discussed.

In the next unit, we shall discuss some of the issues relating to sustainable development from the Indian perspectives. In this context, some of policy provisions like the Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, and Forest Conservation Act shall be discussed.

10.3 HISTORY OF SUSTAINABLE DEVELOPMENT

The world commission on Environment and Development' draw the world's attention to the accelerating deterioration of the human environment and natural resources and the consequences of that deterioration for economic and social development. The commission called attention for two important aspects: first, the wellbeing of the environment, of economies and of people is inextricably linked and second, sustainable development involves co-operation on a global scale.

The earlier concept of sustainable development emphasized the need for economic development to be compatible with constraint set by the natural environment. It is affected by the economic, ecological, social and political factors simultaneously. Sustainable development is about integration developing in a way that benefits the widest possible range of sectors, across borders and even between generations. The classical development approach generally relies on the principle of efficiency. In the neo classical approach efficiency is the guiding principle for production and consumption decision. But apart from efficiency some other important attributes such as equity, proper valuation of resources, resilience of ecology, etc. are incorporated in sustainable development.

Thomas Robert Malthus and Justers Von Liebig were the earlier economists related to the issue of sustainable development. Earlier in 20th century social scientists like Thorstein Veblen and A. C. Pigou draw attention to external costs of economic activities. United Nations published report on 'Man and his Environment' in 1969. This report focused on activities to avoid environmental degradation. The first use of the term sustainable in modern sense was by the Club of Rome in 1972 in its epoch-making report on the 'Limits to Growth'. The first 'UN and UNEP World Conference on Human Environment' was held in Stockholm in 1972. It had the slogan of 'only one earth' i.e. Our Common Future. The then Indian Prime Minister Indira Gandhi emphasised that the removal of poverty is an integral part of the goal of an environmental strategy for the world. In 1975 UNESCO Conference on Education about the Environment was made for setting up a global

environmental education framework. International Congress of the Human Environment, Kyoto emphasised on the same issue like Stockholm (1972). There were various other programmes related to sustainable development in the later years. They can be mentioned as 'The First World Climate Conference' in Geneva (1979) for the creation of the climate change research and programme monitoring, the first 'UN Conference on Least Developed Countries', Paris (1981) for helping the underdeveloped countries, 'Establishment of United Nations World Commission on Environment and Development' (1984)for the cooperation between developed and developing countries and the adoption of global development plans on environmental conservation, 'Montreal Protocol' (1987) was for the protection of the ozone layer, 'The Second World Climate Conference', (1990) Geneva, also gave stressed on the climate change, 'United Nations Conference on Environment and Development' (1992) i.e. the Earth Summit or Rio Conference declared the Agenda 21 Action Plan, The Kyoto Protocol (1997) was signed between countries to reduce CO2 and other greenhouse gas emissions, with commencement in 2005. UN published Millennium Development Goals (MDGs) in the year 2000. 'The World Summit on Sustainable Development, Johannesburg (2002), reaffirmed the previous obligations and set the guidelines for implementation of the concept in the future. 'The Third World Climate Conference' (2009), Geneva, was for further development of the global Climate Change Monitoring System with the aim of timely anticipation of possible disasters. 'UN Sustainable Development Summit'(2015), published 17 Millennium Development Goals which should be achieved by 2030 relating to sustainable development.

10.4 WEAK AND STRONG SUSTAINABILITY

Broadly, the concept of sustainable development has evolved along two different approaches i.e. the outcome approach which emphasizes flow variables and opportunity approach which emphasizes stock variables. Opportunity approach can further be classified as strong and weak sustainability. Economic sustainability defined in terms of strong and weak

emphasizes ecological sustainability of development encircling intra and intergenerational equity.

The concept of weak sustainability is based upon the work of Nobel Laureate Robert Solow and Hartwick. Weak sustainability has been defined using concepts like human capital and natural capital. Human or produced capital incorporates resource such as infrastructure, labour and knowledge. Natural capital covers the stock of environmental assets such as fossil fuels, biodiversity and other eco system service. The notion of weak sustainability states that human capital can be substituted by natural capital. Within weak sustainability the overall stock of man-made capital and natural capital remains constant over time and so here unconditional substitution between various kinds of capital is allowed.

Example: An example of weak sustainability may be mining coal and using it for production of electricity. The natural resource coal is replaced by manufactured good electricity. The electricity then can be used to improve quality of human life. Electricity can be used to produce many manufactured material in the industries or it can be used for the household purpose.

On the other hand strong sustainability assumes that human capital and natural capital are complementary, but not interchangeable. It accepts that there are certain functions that the environment performs that cannot be duplicated by human or man-made capital. For example some functions of the environment such as eco system, maintenance of the climate, ozone layer, bio diversity etc. cannot be replaced by the man-made capital. Strong sustainability aims for the maintenance of economic environment, and social capital through an efficient use of resources and by replacing non-renewable natural resources with renewable ones.



CHECK YOUR PROGRESS

Q 1: What is meant by sustainable development? (Answer in about 50 words)

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.....

Q 2: State whether the following statement is true or false (T/F).

Burndtland commission was held in 1987. (T/F)

Q 3: Define weak sustainability. (Answer in about 20 words)

.....

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Q 4: What is meant by strong sustainability? (Answer in about 20 words)

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10.5 INDICATORS OF SUSTAINABLE DEVELOPMENT

Indicators are used for the empirical specification of concepts that cannot be fully operationalised on the basis of generally accepted rules. As per Agenda 21, there are numerous indicators have been proposed to date to meet the criterion of policy relevance, analytical soundness and measurability which can be grouped variously. A first grouping draws from the Organization for Economic Co-operation and Development's (OECD's) Pressure-State-Response framework. Second grouping classification of indicators is according to main dimensions of sustainability as environmental, economic, social and integrated. Third is on the basis of spatial scale as global, national and local. Fourth is concerned with environmental medium like air, water, land etc. Finally indicators are grouped hierarchically as headline or core, local or basic, detailed or area specific. Most of the dimensions refer to a single dimension of sustainable development. These are State or Pressure indicator of OECD.

The pressure-state-response (PSR) framework follows as cause effect social response logic; it was followed by the OECD from earlier work by the Canadian government. Increasingly widely accepted and internationally adopted, it can be applied at a national level, at sectional level, at the levels of an industrial firm or at the community level. The PSR framework states that human activities exert pressures (such as pollution emissions or land use changes) on the environment which can induce changes in the state of the environment. Society then responds to changes in pressures or state either environmental and economic policies or

programs intended to prevent, reduce or mitigate pressures or environmental damage.



LET US KNOW

Agenda 21 is a non-binding action plan of the United Nations with regard to sustainable development. It is an outcome of Earth Summit. It is a comprehensive plan of action to be taken globally, nationally and locally by organizations of the United Nations System.

10.5.1 Pressure Indicator

Pressure indicator means human activities, process and patterns that impact on sustainable development. Pressure indicator measure policy effectiveness more directly i.e. whether emissions increases or decreases, whether forest depletion waxes or wanes and whether human exposure to hazardous condition grows or shrinks. It is a flow variable. They show development overtime of amounts of emissions, discharges, disposition, extractions and interventions originating from a set of economic activities. Environmental pressures relates to pressures from human activities extracted on the environment, including natural resources. Pressures cover underlying or indirect pressures which act as driving forces for environmental issues as well as proximate or direct pressures. Indicators of environmental pressures are closely related to production and consumption pattern, they often reflect emission or resource use intensities, along with related trends and changes over a given period. They can be used to show progress in meeting national objectives and international commitments.

10.5.2 State Indicator

State indicator indicates state of sustainable development. This indicator reflects the impact of the environmental pressure on the receptor on a predetermined region. It also includes imported

transboundary pressures. It shows the development overtime of stocks and the quality of environment. Environmental conditions relates to the quality of the environment and the related effects or impacts and the quality and quantity of the natural resources. They cover ecosystem and natural environment condition as well as quality of life and human health aspects. As such they reflect the ultimate objectives of environmental policies. Indicators of environmental conditions are designed to give an overview of the situation concerning the environment and development over time.

10.5.3 Response Indicator

Response indicator indicates policy options and other responses to the changes in state of sustainable development. It measures progress toward regulatory compliances or other governmental efforts, but do not directly tell what is happening to environment. Societal response shows the extent to which society responds to environmental concerns through environment, general, economic and sectoral policies and through changes in awareness and behaviour. They refer to individual and collective actions and reactions that are intended to mitigate, adapt to or to prevent human induced negative effects on environment. Again it wants to preserve and conserve natural resources and the environment.

Examples of the indicator can be cited as increasing pollution level (Pressure indicator) causes ozone layer depletion (State indicator). It leads to imposition of taxes on polluting industries (Response indicator). Again the rate of deforestation (Pressure indicator) leads to a change in the biomass (State indicator). Reforestation measures should be taken as a measure.



CHECK YOUR PROGRESS

Q 5: Define pressure indicator. (Answer in about 50 words)

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Q 6: What is response indicator? (Answer in about 30 words)

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10.6 MEASUREMENT OF SUSTAINABLE DEVELOPMENT

The United Nations Conference on Sustainable Development recommends on measuring sustainable development. It identified twenty themes of indicator covering environmental, social and economic aspects of sustainable development: subjective well-being, consumption and income, nutrition, health, housing, education, leisure, physical safety, trust, institutions, energy resources, mineral resources, land and ecosystems, water, air quality, climate, labour, physical capital, knowledge capital, and financial capital as a measure of sustainable development. Population has been added as a contextual indicator.

The concepts of economy and its sustainability have a long history. Measurement of the economy goes back many centuries, but the modern version has its origin in the period of the great depression in the 1920s and 1930s. “A System of National Accounts and Supporting Tables, Studies in Methods” was first published in 1953. In the 1950s and 1960s an influential environmental movement emerged in response to increasing concerns about the detrimental effects of economic production on the environment. This led to many initiatives to correct the concept of gross domestic product

and other macroeconomic aggregates to provide a better indicator for social and other welfare, or sustainable welfare.

The concept of sustainable development made an international breakthrough when the Report of the United Nations World Commission on Environment and Development (WCED) *Our Common Future* was published in 1987 (WCED, 1987). While the Brundtland report is usually credited with the conceptualisation of sustainable development, the United Nations conferences in Rio (1992) and Johannesburg (2002) both provided a major impetus to the measurement of sustainable development. The composite indicators developed in the 1990s by a number of economists built on the work started in the 1960s and 1970s. Another type of composite indicator also emerged during this period, the roots of which do not lie in the accounting framework of SNA. Examples of such indicators are Human Development Index (HDI), Ecological footprint (EF), Happy Planet Index (HPI), the Sustainable Society Index (SSI) and the Living Planet Index (LPI).



10.7 LET US SUM UP

- The term sustainable development began to gain with acceptance in the late 1980s after its appearance in Our Common Future also known as the Brundtland Report. According to Brundtland Commission (1987) sustainable development is that which meets the needs of the present without compromising the ability of future generation to meet their own needs.
- Sustainable development attempts to accelerate development in an environmentally responsible manner keeping in mind the inter-generational and intra generational equity requirements.
- The first use of the term sustainable in modern sense was by the Club of Rome in 1972 in its epoch-making report on the 'Limits to Growth'. The first 'UN and UNEP World Conference on Human Environment' was held in Stockholm in 1972. It had the slogan of 'only one earth' i.e. Our Common Future.

- 'UN Sustainable Development Summit' (2015), published 17 Millennium Development Goals which should be achieved by 2030 relating to sustainable development.
- The three important components or aims of sustainable development are, economic sustainability, social sustainability and ecological sustainability.
- The concept of weak sustainability is based upon the work of Nobel Laureate Robert Solow and Hartwick. The weak sustainability states that human capital or produced capital can be substituted by natural capital.
- The strong sustainability states that human capital and natural capital are complementary, but not interchangeable.
- The indicators of sustainable development can be stated as the Organization for Economic Co=operation and Development's (OECD's) Pressure-State-Response framework; secondly environmental, economic, social and integrated; thirdly on the basis of spatial scale as global, national and local and fourthly on the basis of environmental medium like air, water, land etc. Finally indicators are grouped hierarchically as headline or core, local or basic, detailed or area specific.
- The United Nations Conference on Sustainable Development recommends on measuring sustainable development identified twenty themes of indicator covering environmental, social and economic aspects of sustainable development: subjective well-being, consumption and income, nutrition, health, housing, education, leisure, physical safety, trust, institutions, energy resources, mineral resources, land and ecosystems, water, air quality, climate, labour, physical capital, knowledge capital, and financial capital as a measure of sustainable development.
- The concept of sustainable development made an international breakthrough when the Report of the United Nations World Commission on Environment and Development (WCED) *Our Common Future* was published in 1987.

- Examples of some composite indicators are Human Development Index (HDI), Ecological footprint (EF), Happy Planet Index (HPI), the Sustainable Society Index (SSI) and the Living Planet Index (LPI).



10.8 FURTHER READING

(1) Bhattacharya, R. N. (2001). *Environmental Economics: An Indian Perspective*. New Delhi: Oxford University Press

(2) Burhagohain and Das, Environmental Economics, EBH Publishers

(3) Hanley, Shrogram and White, Introduction to Environmental Economics, OUP

(4) Purkayastha, G. (2006). *Environmental Economics: Theory, Problems and Solutions*. New Delhi: Kalyani Publishers



10.9 ANSWRES TO CHECK YOUR PROGRESS

Ans to Q No 1: Sustainable development has been defined differently by different commissions. Yet the widely accepted definition is given by Burndtland Commission (1987). It stated that sustainable development is that which meets the needs of the present without compromising the ability of future generation to meet their own needs.

Ans to Q No 2: True

Ans to Q No 3: The weak sustainability states that human capital or produced capital can be substituted by natural capital.

Ans to Q No 4: The strong sustainability states that human capital and natural capital are complementary, but not interchangeable.

Ans to Q No 5: Pressure indicator refers to flow variable. They show development overtime of amounts of emissions, discharges, disposition, extractions and interventions originating from a set of economic activities. Environmental pressures relates to pressures from human activities extracted on the environment, including natural resources.

Ans to Q No 6: Response indicators show the extent to which society responds to environmental concerns through environment, general, economic and sectoral policies and through changes in awareness and behavior.

10.10 MODEL QUESTIONS

Short Questions (Answer each question in about 150 words)

Q 1: Write the aims of sustainable development in brief.

Q 2: Discuss the indicators of sustainable development.

Q 4: Discuss the strong and weak sustainability with suitable example.

Essay type Questions (Answer each question in about 300-500 words)

Q 1: Write in brief the history of sustainable development.

Q 2: What is PSR? Describe.

Q 3: Write a note on the measurement of sustainable development.

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UNIT 11: SUSTAINABLE DEVELOPMENT - II

UNIT STRUCTURE

11.1 Learning Objectives

11.2 Introduction

11.3 Environment Protection Act, 1986

- 11.3.1 The Act
- 11.3.2 Major Objectives of the Act

11.4 Air (Prevention and Control of Pollution) Act, 1981

11.5 Water (Prevention and Control of Pollution) Act, 1974

- 11.5.1 Water Pollution in India

11.6 Wild Life Protection Act, 1972

- 11.6.1 Objectives of the Act
- 11.6.2 Major Provisions under the Act

11.7 Forest Conservation Act, 1980

- 11.7.1 Background
- 11.7.2 Aims of the Act
- 11.7.3 Penalties

11.8 Let Us Sum Up

11.9 Further Reading

11.10 Answers to Check Your Progress

11.11 Model Questions

11.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- discuss the major issues discussed in the Environment Protection Act, 1986.
- describe the Air (Prevention and Control of Pollution) Act,
- know about the important provisions of the Water (Prevention and control of Pollution) Act,
- narrate the major issues tackled by the Wildlife Protection Act,
- acquire knowledge about the Forest Conservation Act,

11.2 INTRODUCTION

When we look around ourselves we find increasing news regarding the various environmental issues ranging from international issues to national environmental concerns. We see the global issues like the great pacific garbage patch, the protest by Greta Thunberg for environmental concerns and the return of 69 containers garbage by the Philippines government back to Canada. And internationally agencies are coming up with agreements and plans to tackle these issues be it the agreement between UN members to achieve 17 Sustainable Development Goals till 2030 or the recent agreement between G20 members regarding the reduction of marine plastic waste. These environmental issues have important economic implications. They impact not only the economic policies made by the government but also in turn affects the business organisation.

Similarly, recently in June 2019 the Government of India had asked states as well as National Highways Authority of India (NHAI) to avoid building highways through wildlife sanctuaries and national parks, unless absolutely unavoidable. It also suggested building a longer route just to ensure protection of ecologically sensitive areas and flora and fauna. According to the directive it had instructed NHAI "If it is absolutely unavoidable, all necessary clearances required under the Wildlife Protection Act 1972, Forest Conservation Act 1980 and Environment (Protection) Act 1986 should be obtained before any work is undertaken in such areas." In this unit, we shall discuss some of such vital issues relating to environmental protection with special reference to India.

11.3 ENVIRONMENT PROTECTION ACT, 1986

Since the 1960s, the concern for environment has grown. The increasing pollution, loss of vegetal power and biological diversity, excessive concentration of harmful chemicals in the ambient atmosphere and in food chains, growing risks of environmental accidents and threat to life support systems all led to the decrease in the environmental quality. It was during this time that the world community's resolve to protect and enhance the

environment quality found expression in the decisions taken at the United Nations Conference on the Human Environment held in Stockholm June, 1972. India being a member nation also participated and supported concerns for environment. Although a lot of measures were taken by the Indian government both before and after the conference, it was the Bhopal Gas Tragedy in 1984 that laid the foundation for an ACT that will provide a strong basis for environmental protection and become the precedence for other acts. It also acted as a measure to implement the agreements of the Stockholm Conference and in 1986 the Environment (Protection) Act was passed. The Environment (Protection) Act, 1986 is the most comprehensive act on the Indian statute book relating to environment protection. It is a general legislation for the protection of environment and it was enacted under Article 253 of the Constitution.

LET US KNOW



The Government of Bihar recently banned felling of trees, citing increasing pollution as well as a fatal heatwave. In Bihar, more than 90 people died due the severe heat wave. A probe into the increasing temperature revealed that according to official data, in the busy Bailey Road in Patna alone, more than 2200 trees have been chopped down in the past two-and-a-half years. An order was passed under the Forest Conservation Act by DK Shukla, principal chief conservator of forests stating that "All permissions granted to cut trees for development works, have become null and void," he said. The order, put forward by Deepak Kumar (principal secretary, Department of environment, forest and climate change) in May 2019, cited increasing pollution in Patna, Gaya, Bhagalpur, Muzaffarpur and other cities in the state.

11.3.1 The Act

The Constitution of India clearly states that it is the duty of the state to 'protect and improve the environment and to safeguard the forests and wildlife of the country'. The Department of Environment was established in India in 1980.This later became the Ministry of Environment and Forests in 1985. Environment

Protection Act, 1986 is an Act of the Parliament of India. The purpose of the Act is to implement the decisions of the United Nations Conference on the Human Environment. They relate to the protection and improvement of the human environment and the prevention of hazards to human beings, other living creatures, plants and property. The Act is an "umbrella" legislation designed to provide a framework for coordination of the activities of various central and state authorities established under previous laws, such as the Water Act and the Air Act. It also gives the government the power to give direction to closure, prohibition or regulation of industrial activities and the pollution created by them. The act has provisions for penalties for violation of the provisions of the act and rules, orders and directions. It also gives detail if the offence is done by a company or government department. It says for such offence the in-charge and head of department respectively would be liable for punishment.

11.3.2 Major Objectives of the Act

- To implement the decisions made at the U.N. Conference on the Human Environment held at Stockholm in June, 1972.
- To co-ordinate activities of the various regulatory agencies under the existing laws and creation of an authority or authorities for environment protection.
- To provide for deterrent punishment to those who endanger human environment, safety and health.
- To ensure sustainable development is also one of the goals of the EPA, 1986. If the act is not armed with the powers to ensure sustainable development, it will become a barren shell.
- To enact general law on environmental protection which could cover uncovered gaps in the areas of major environmental hazards as the existing laws generally focused on specific types of pollution or on specific categories of hazardous substances and some major areas of environmental were not covered.

- In short, the EPA, 1986 aims at protecting and improving the environment and prevention of hazards to human beings, other living creatures, plant and property.



CHECK YOUR PROGRESS

Choose the correct option.

Q 1: The world as World Environmental day is celebrated on:

(a) December 1 (b) June 5 (c) November 14 (d) August 15

Q 2: When was the Environment Protection Act introduced in India?

(a) 1972 (b) 1977 (c) 1986 (d) 1992

11.4 AIR (PREVENTION AND CONTROL OF POLLUTION) ACT, 1981

Air (Prevention and Control of Pollution) Act, 1981 is also a comprehensive legislation with more than fifty sections. It makes provisions, inter-alia, for Central and State Boards, to declare pollution control areas, puts restrictions on certain industrial units, has authority of the Boards to limit emission of air pollutants, power of entry, inspection, taking samples and analysis, penalties, offences by companies and Government and cognizance of offences etc.



LET US KNOW

In 2016, a World Health Organisation (WHO) study found that fourteen of the twenty world's most polluted cities belonged to India. Kanpur, in Uttar Pradesh, emerged as the city with the highest PM 2.5 level, standing at 173 (17 times higher than the limit set for safety). It is estimated that in 2016, over 9 lakh deaths were caused due to air pollution in India. Some other cities with high PM 2.5 levels include Faridabad, Varanasi, Gaya, Patna, Delhi, Lucknow and Agra.

The Act specifically empowers State Governments to designate air pollution areas and to prescribe the type of fuel to be used in these designated areas. According to this Act, no person can operate certain types of industries including the asbestos, cement, fertilizer and petroleum industries without consent of the State Board.

The Board can build its consent upon the fulfillment of certain conditions. The Air Act apparently adopts an industry wide "best available technology" requirement. The Government passed this Act in 1981 to clean up our air by controlling pollution. It states that sources of air pollution such as industry, vehicles, power plants, etc., are not permitted to release particulate matter, lead, carbon monoxide, sulfur dioxide, nitrogen oxide, volatile organic compounds (VOCs) or other toxic substances beyond a prescribed level.

To ensure this, Pollution Control Boards (PCBs) have been set up by Government to measure pollution levels in the atmosphere and at certain sources by testing the air. This is measured in parts per million or in milligrams or micrograms per cubic meter.

LET US KNOW



The report by the environment organisation Centre for Science and Environment (CSE) revealed that outdoor and household air pollution together are causing deadly diseases. “Air pollution is now the third highest cause of death among all health risks ranking just above smoking in India. This is a combined effect of outdoor particulate matter (PM) 2.5, ozone and household air pollution.”

“Due to this combined exposure, South Asians, including Indians, are dying early — their life expectancy has reduced by over 2.6 years. This is much higher than the global tally of reduced life expectancy by an average of 20 months. While globally a child born today will die 20 months sooner on an average than would be expected without air pollution in India they would die 2.6 years earlier,” the report released by the CSE said.

Objectives of the Act: The main objectives of the Act are as follows:

- To provide for the prevention, control and abatement of air pollution.
- To provide for the establishment of central and State Boards with a view to implement the Act.
- To confer on the Boards the powers to implement the provisions of the Act and assign to the

Penalties under the Act: The persons managing industry are to be penalised if they produce emissions of air pollutants in excess of the standards laid down by the State Board. The Board also makes applications to the court for restraining persons causing air pollution.

Whoever contravenes any of the provision of the Act or any order or direction issued is punishable with imprisonment for a term which may extend to three months or with a fine of Rs. 10,000 or with both, and in case of continuing offence with an additional fine which may extend to Rs 5,000 for every day during which such violation continues after conviction for the first contravention.

For example, recently in 2019, the National Green Tribunal (NGT) directed the Gujarat government to deposit 75 crore rupees in an escrow account following media reports on the high level of air pollution in Ahmedabad. It observed that a Pirana landfill site in the city is a major source of air pollution that affects public health. It also directed the construction of a biodiversity park in the area after the waste is removed. It also noted that industries are using furnace oil, and directed the State pollution control board to ensure that it is not used by industries.



CHECK YOUR PROGRESS

Q 3: The Air (Prevention and Control of Pollution) Act was enacted in the year:

(a) 1981 (b) 1996 (c) 2000 (d) 1974

11.5 WATER (PREVENTION AND CONTROL OF POLLUTION) ACT, 1974

In June 2018, a Composite Water Management Index report was published by the NITI Aayog which stated that "more than 600 million people in India face high to extreme water crisis in the country". It further added that about three-fourth of the households in the country do not have drinking water on their premises. Looking at the comprehensive view various reports have quoted that nearly 70 percent of water in India is contaminated. On the global scenario India is placed 120th amongst 122 countries in the water quality index.

After the Stockholm conference on Human Environment on June, 1972, it was considered appropriate to have uniform law all over the country for broad Environment problems endangering the health and safety of our people as well as of our flora and fauna. The Water (Prevention & Control of Pollution) Act, 1974 is the first enactment by the Parliament in this direction. This is also the first specific and comprehensive legislation institutionalising simultaneously the regulatory agencies for controlling water pollution. The Pollution Control Board at the Centre and in the State came into being under this Act.

11.5.1 Water Pollution in India

Rapid industrialisation in the country poses problems of environmental pollution and consequently have adverse health effects. This growth however cannot be stunted or dwarfed. A large quantity of water, used for domestic and industrial applications, requires certain specifications. The process industry, i.e., the chemical and allied industry, requires a large amount of water for their condensers and coolers. The Engineering industry also requires a considerable amount of water for different applications including the generation of steam. In power houses too, water is used for generation of high pressure steam. Besides, water is also used for recreation purposes.

The bulk of the water is drawn from natural stream, e.g., rivers, lakes, etc. These water reserves get contaminated due to the effluents received from industry. Sometimes its pH level is changed due to the acidic or alkaline nature of effluents. Many of the effluents, thus joining the river, are biologically degraded by the flora and fauna present in the river, but, then, the total pollution load should be only such that the undesirable organic load thus received, is fully degraded biologically, i.e., the total pollution load is within the assimilation capacity of the river.



LET US KNOW

A major chunk of India is on the brink of an extreme water crisis. The Composite Water Management Index report published by Niti Aayog in June 2018 reveals that around 600 million Indians are reeling under water shortage. Nearly 75 per cent households do not have access to drinking water on their premises.

To top it all, around 70 per cent of the fresh water available in the country is contaminated, making India rank among the lowest vis-à-vis water quality index.

However, when the pollution load exceeds the assimilation capacity, the additional pollution load reduces the microbial activity and, thus, adversely affects the health of the rivers, flora and fauna. This process ultimately leads to a further reduction in the assimilation capacity and, eventually, a situation arises when the river cannot receive any more pollution load.

This problem is equally important in both developing and developed nations. Water pollution has already reached serious levels at Kanpur, Varanasi, Delhi, Lucknow, Calcutta, etc.

It deals with different sources of water pollution and their abatement. Foreign materials, either from natural or other sources, contaminate water supplies or may be harmful to life because of their toxicity and the reduction of the normal oxygen level of water.



CHECK YOUR PROGRESS

Q 4: The Water (Prevention and Control of Pollution) Act was enacted in the year:

(a) 1986 (b) 1974 (c) 1994 (d) 1975

11.6 WILD LIFE PROTECTION ACT, 1972

The Wildlife Act was passed in 1972 to protect the wildlife and their habitats. The habitat destruction due to agriculture, industries, urbanisation and other human activities had led to the erosion of the country's wildlife.

11.6.1 Objectives of the Act

- Prohibition of hunting.
- Protection and management of wildlife habitats.
- Establishment of protected areas.
- Regulation and control of trade in parts and products derived from wildlife.
- Management of zoos.

11.6.2 Major Provisions under the Act

The major activities and provisions in the act can be summed up as follows:

- It defines the wildlife related terminology.
- Enactment of an All India Wildlife Protection Act (1972).
- It provides for the appointment of wildlife advisory Board, Wildlife warden, their powers, duties etc.
- Becoming a party to the Convention of International Trade in Endangered Species of Fauna and Flora (CITES, 1976).
- Launching a "national component of UNESCO's 'Man and Biosphere Programme' (1971).

- Under the Act, comprehensive listing of endangered wildlife species was done for the first time and prohibition of hunting of the endangered species was mentioned.
- Protection to some endangered plants.
- The Act provides for setting up of National Parks, Wildlife Sanctuaries etc.
- The Act provides for the constitution of Central Zoo Authority.
- There is provision for trade and commerce in some wildlife species with license for sale, possession, transfer etc.
- The act imposes a ban on the trade or commerce in scheduled animals.
- It provides for legal powers to officers and punishment to offenders.
- It provides for captive breeding programme for endangered species.
- If someone is caught in the process of trade of animal trophies and other articles derived from wild animals they will be subjected to three years of imprisonment and/or a fine of Rs. 25,000/-

Several Conservation Projects for individual endangered species like Lion (1972), Tiger (1973), Crocodile (1974) and Brown antlered Deer (1981) were stated under this Act. The Act is adopted by all states in India except J & K, which has its own Act.

Some of the major drawbacks of the Act include mild penalty to offenders, illegal wildlife trade in J & K, personal ownership certificate for animal articles like tiger and leopard skins, no coverage of foreign endangered wildlife, pitiable condition of wildlife in mobile zoos and little emphasis on protection of plant genetic resources.



CHECK YOUR PROGRESS

Q 5: The Wildlife (Protection) Act was enacted in the year:

(a) 1986 (b) 1974 (c) 1994 (d) 1972

11.7 FOREST CONSERVATION ACT, 1980

Forests are considered as the lungs of the environment as they perform a very important function of cleaning the environment and providing oxygen. The Forest Conservation Act of 1980 was enacted to control deforestation; it ensured that forestlands could not be de-reserved without prior approval of the Central Government. This was created as some states had begun to de-reserve the Reserved Forests for non-forest use.

These states had regularized encroachments and resettled 'project affected people' from development projects such as dams in these de-reserved areas. The need for a new legislation became urgent. The Act made it possible to retain a greater control over the frightening level of deforestation in the country and specified penalties for offenders. It also values meeting the needs of local people for food, fuel wood, fodder and Non-Timber Forest Produces (NTFPs). It gives priority to maintaining environmental stability and ecological balances. It expressly states that the network of Protected Areas should be strengthened and extended.

11.7.1 Background

The Indian Forest Act of 1927 consolidated all the previous laws regarding forests that were passed before the 1920s. The Act gave the Government and Forest Department the power to create Reserved Forests, and the right to use Reserved Forests for Government use alone. The preamble to the Indian Forest Act, 1927 (16 of 1927) states that the Act seeks to consolidate the law relating to forests, the transit of forest produce and the duty that can be levied on timber and other forest produce.

It also created Protected Forests, in which the use of resources by local people was controlled. Some forests were to be controlled by the village community, and these were called village Forests. The Act remained in force till the 1980s when it was realized that protecting forests for timber production alone was not acceptable. The other values of protecting the services that forests

provide and its valuable assets such as biodiversity began to overshadow the importance of their revenue earnings from timber.



LET US KNOW

In June 2019 the Supreme Court of India had halted the construction of road works that passes through a corridor between the Rajaji and Corbett Tiger Reserves. "There appears to be numerous violations of the Forest Conservation Act," it said. A Vacation Bench of Justices Deepak Gupta and Surya Kant issued notice to the Uttarakhand government, asking it to reply, within three weeks, to a report filed by the court-appointed Central Empowered Committee (CEC). The CEC sought an immediate halt to the construction of roads, bridges and culverts in the Rajaji Tiger Reserve between Laldhang and Chillarkhal as it would "adversely impact the habitat and wildlife of the ecologically sensitive area".

This led to the Forest Conservation Act of 1980 and its amendment in 1988. India's first Forest Policy was enunciated in 1952. Between 1952 and 1988, the extent of deforestation was so great that it became essential to formulate a new policy on forests and their utilisation.

The earlier forest policies had focused only on revenue generation. In the 1980's it became clear that forests must be protected for their other functions such as the maintenance of soil and water regimes centered on ecological concerns. It also provided for the use of goods and services of the forest for its local inhabitants.

The new policy framework made conversion of forests into other uses much less possible. Conservation of the forests as a natural heritage finds a place in the new policy, which includes the preservation of its biological diversity and genetic resources.

11.7.2 Aims of the Act

- Ø It was adopted to protect and conserve forests. The act extends to the whole of India except the state of Jammu and Kashmir.
- Ø It restricts the powers of the state in respect of de-reservation of forests and use of forest land for non-forest purposes.
- Ø The forest are the resource of nation. It is vital for the government to establish proper coordination between forest department and the local communities.
- Ø People participation, PPP (Public Private Partnership), Joint forest management are some of the methods that can be implemented in various eco-fragile areas.
- Ø Financing nature is often a challenge for developing country.
- Ø A promising approach 'debt for nature swaps' is being adopted at global level.
- Ø In this, conservation organisation buy debt obligation at a discount on the secondary market and then offer to cancel a debt if the debtor country promises to protect or restore an area of biological importance.
- Ø It should be taken care that while continuous logging, protection of most valuable forests including stream side buffer strip and prime wildlife habitat should also be done.
- Ø There are some alternative for clear cutting of forest for timer, log etc. like shelter wood harvesting, in which mature trees are remove in a series of two or more cut, strip cutting, in which all trees in a narrow corridor are harvested and selective cutting.

11.7.3 Penalties

- Ø **Penalties for offences in Reserved Forests:**
  - m No person is allowed to make clearing or set fire to a reserved forest.
  - m Cattle are not permitted to trespass into the reserved forest, cutting, collecting of timber, bark or leaves, quarrying or

collecting any forest products is punishable with imprisonment for a term of six months or with a fine which may extend to Rs. 500 or both.

- **Penalties for offences in protected Forests:**
  - A person who commits any of the following offences like cutting of trees, stripping the bark or leaves of trees, set fire to such forests or permits cattle to damage any tree, shall be punishable with imprisonment for a term which may be extended to six months or with a fine which can be extended to Rs. 500 or both.
  - Any forest officer even without an order from the magistrate or a warrant can arrest any person against whom a reasonable suspicion exists.



CHECK YOUR PROGRESS

Q 6: The Forest (Conservation) Act was enacted in the year:

(a) 1986 (b) 1974 (c) 1980 (d) 1972

Q 7: The Forest (Conservation) Act extends to the whole of India except:

(a) Uttar Pradesh (b) Karnataka (c) Jammu and Kashmir (d) Haryana



11.8 LET US SUM UP

- Management of environment means the proper utilisation, conservation preservation, control and recycling of the resources for maintaining a balanced ecosystems. The main focus of environment management is, thus, to avoid the overuse, misuse and abuse of the natural resources.
- The effective environmental management is the optimum allocation of finite resources among the various possible uses and it has to be based on scientific and technological approach which takes full note of socioeconomic parameters and compulsions.

- Environmental management is an interdisciplinary approach to resource conservation and it acts as a regulatory force on human wantonness in resource wasting.
- In India the Twelfth Five Year Plan has emphasized the need for sound environmental management which includes environmental planning, protection, monitoring, assessment, research, education, and conservation as major guiding factors for national development.
- Environmental pollution is a world-wide phenomenon; therefore, there is a need to have coordinated administrative structure from international level to national levels so that the environmental problems may be tackled in a coordinated and cooperative way.

11.9 FURTHER READING

(1) Bhattacharya, R. N. (2013). *Environmental Economics.* New Delhi: Oxford University Press.

(2) Burhagohain and Das. (n.d.) *Environmental Economics.* Guwahati: EBH Publishers

(3) Purakayastha, G. (2006). *Environmental Economics: Theory, Problems and Solutions.* New Delhi: Kalyani Publishers.

11.10 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1: (b)

Ans to Q No 2: (c)

Ans to Q No 3: (a)

Ans to Q No 4: (b)

Ans to Q No 5: (d)

Ans to Q No 6: (c)

Ans to Q No 7: (c)

11.11 MODEL QUESTIONS

Answer the following question in about 300 words each.

Q 1: What are the main provisions of the Forest (Conservation) Act, 1980?

Q 2: What are the salient features of Forest (Conservation) Act, 1980?

Q 3: What are the areas to which provisions of the Forest (Conservation) Act, 1980 extends?

Q 4: What is the broad definition of 'non-forest purpose' for the purpose of the Forest (Conservation) Act, 1980?

Q 5: Has the Forest (Conservation) Act, 1980 achieved the purpose for which it was enacted? Evaluate.

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UNIT 12: GREEN ACCOUNTING

UNIT STRUCTURE

12.1 Learning Objectives

12.2 Introduction

12.3 Green Accounting

- 12.3.1 Objectives of Green Accounting
- 12.3.2 Identifying and Estimating Environmental Costs
- 12.3.3 Elements of Green Accounting
- 12.3.4 Types of Green Accounting
- 12.3.5 Importance and Scope
- 12.3.6 Green Accounting: Indian Perspective

12.4 Alternative Indicators of Sustainability

12.5 Let Us Sum Up

12.6 Further Readings

12.7 Answers to Check Your Progress

12.8 Model Questions

12.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- put forward meaning of the concept of green accounting
- discuss and comprehend the need and importance of green accounting in economic development of the country
- appreciate and evaluate the impact of corporate decisions on environmental economics
- understand and examine other alternative indicators for measuring sustainability

12.2 INTRODUCTION

As studied in the previous unit 10 and 11 related to Sustainable Development- Part I and Part II, an elaboration was provided to understand the concept, need, importance, policies and regulations to promote

sustainability of the environmental resources to support the existence of humankind. Efforts are being made to plan, implement and upgrade skills and technology to create equilibrium between the needs of human race and its growing impact on the environmental resources.

It is well-evident that the 21st century has marked an ambitious era of development and growth in technology by experimenting and exploiting resources at its disposal. As per the United Nations World Population Prospects 2017, it is reported that there is rapid rise in global human population at 83 million annually or 1.1% per annum resulting in swelling of the population size of 7.616 billion in 2018 from 1 million in 1800. The tremendous increase in population has exerted enormous pressure on the environment by rapid urbanisation, industrialisation, technological development, infra-structural development, weapons for wartime, etc. These human actions have already damaged the environment ecology beyond reparability. Deforestation, soil erosion, drying of water reservoirs, frequent occurrence of massive tsunamis, landslides, drought, floods and drastic change in weather conditions across the globe are the reasons of concern and attention among the governments, corporate and people of the nation.

The importance of the environment for the survival of the humankind cannot be undermined. In order to evaluate and measure the human action and its impact on the environment ecology, Prof. Peter Wood had introduced the term and concept of "Environmental Accounting" in 1980 as a new stream of accounting which shall aim to provide information backed by facts and figures for the environment and its well-being as a result of growing businesses and industries in the country. It propagated the understanding of corporate profit/loss and revenue/expenses along with its cost/benefit on the environment as a result of corporate operations and use of resources. The concept emphasised three factors which included - Planet, People and Profitability. "Environment Accounting" is also known as "Green Accounting", "Resource Accounting", "Sustainable Accounting" or "Integrated Accounting".

12.3 GREEN ACCOUNTING

The role of environmental resources as a source of supply, waste absorber and the equaliser in maintaining livable habitat, though fundamental, has been completely ignored in our traditional development models. But any conventional economic accounting system that lacks the disclosure of environmental cost/benefit does not represent the true economic system of the country and universe as a whole. The reasons for the ignorance of accounting the natural capital can be attributed to two factors -

- Firstly, the human activities with the use of natural resources at the local levels were considered reversible and were assumed to have no likely effect on the environment so as to endanger the contribution of environment to the economy and human welfare.
- Secondly, due to lack of systematic structure and quantitative methodology to account the environmental contribution to economy and human welfare, it was difficult, time-consuming and ambiguous to collect wide data and information without proper methodology and direction.

Green accounting has been developed as a new system of sustainable accounting that provides the calculation of national income after accounting the economic damage and diminution of a nation's natural resource base. Green Accounting attempts to measure the sustainable levels of income that can be achieved without depleting the natural assets stock of a nation.

Green Accounting considers natural resources as the bundle or stock of natural capital and their use by humans. Thus, in principle, these natural resources shall have an economic value which shall be accounted in the similar manner as the value of other types of capital (land, labor, capital and entrepreneurship) that are used to produce goods and services. According to green accounting, while calculating the GDP of any nation it will be incomplete, inaccurate and misleading if it excludes the accounting of its natural capital which has been deployed as a useful resource or as a waste depository for production of goods and services in a year. We know

that while computing Net Domestic Product (NDP), depreciation is deducted from Gross Domestic Product (GDP) as an allowance for the consumption of man-made capital.

NDP = GDP - depreciation

However, this method of NDP computation ignores three important aspects -

- Non-accounting of depletion in natural resources resulting from use of farmland, stock, minerals, fishes, etc.,
- Effect of pollution on environmental degradation, and
- Defensive or remedial expenditures incurred to encounter the external effects of the environmental deterioration and degradation.

To overcome these drawbacks of conventional method of national income computation, the Statistical Division of United Nations has formulated the System of Environmental Economic Accounting (SEEA) which aims to focus on:

- Maintaining records of depletion of scarce natural capital,
- Computing the cost of environmental degradation, restoration and prevention.

Under the SEEA, the conventional NDP is replaced with computation of Green NDP or Environmental Domestic Product (EDP). The EDP takes account of the economic cost of degrading natural capital (natural resources) required to produce goods and services, directly or indirectly, in a particular year.

Conversion of NDP into EDP: Under macroeconomics, Net Domestic Product (NDP) is defined as,:

NDP = Net exports (X - M) + Final Consumption (C) + Net capital accumulation (I)

To calculate EDP, the net capital accumulation needs to be replaced with net capital accumulation of produced and non-produced economic assets after deducting net accumulation of non-produced natural assets. Thus, EDP can be stated as,

EDP = Net exports (X - M) + Final Consumption (C) + Net capital accumulation of produced economic assets (NAp.ec) + ((Net capital

accumulation of non-produced economic assets (NAnp.ec) - Net capital accumulation of non-produced natural assets (NAnp.n)).

12.3.1 Objectives of Green Accounting

The green accounting concept has been devised to provide information which will be material in establishing the relationship between environmental resources and its impact on human activities. It establishes the cost-benefit relationship between environment and organisations, corporate and countries. The accounting details the categorisation and segregation of various environmental costs pertaining to human activities as a result of use and intervention in the natural resources. These accounting records create the link between man-made capital and environmental capital through monetary valuation. As elaborated in the System of Environmental Economic Accounting (SEEA), developed by the Statistical Division of United Nations, the objectives of green accounting can be elaborated as follows:

- **Segregation and Elaboration of all Environment related Flows and Stocks of Traditional Accounts:** The segregation of all flows and stocks of assets related to environment permits the estimation of the total expenditure for the protection of the environment. A further objective of this segregation is to identify that part of the gross domestic product that reflects the costs necessary to compensate for the negative impacts of economic growth, that is, the defensive expenditures.
- **Linkage of Physical Resource Accounts with Monetary Environmental Accounts:** Physical resource accounts cover the total stock or reserves of natural resources and changes therein, even if those resources are not affected by the economic system. Thus natural resource accounts provide the physical counterpart of the monetary stock and flow accounts of SEEA.

- **Assessment of Environmental Costs and Benefits:**
  - The use (depletion) of natural resources in production and final demand;
  - The changes in environmental quality, resulting from pollution and other impacts of production, consumption and natural events, on the one hand, and environmental protection, on the other.
- **Accounting for the Maintenance of Tangible Wealth:** The SEEA extends the concept of capital to cover not only human-made but also natural capital. Capital formation is correspondingly changed into a broader concept of capital accumulation allowing for the use or consumption and discovery of environmental assets.
- **Elaboration and Measurement of Indicators of Environmentally Adjusted Product and Income:** The consideration of the costs of depletion of natural resources and changes in environmental quality permits the calculation of modified macro-economic aggregates, notably an environmentally adjusted net domestic product (EDP).

12.3.2 Identifying and Estimating Environmental Costs

It is not easy to identify and estimate the environmental costs. However, certain relative measures such as replacement and/or restoration cost can be computed to provide cost data. While calculating replacement and/or cost of natural capital few questions can be answered to gain the monetary value attached towards the replacement of natural capital. For example, the questions may include:

- In case of the damage or elimination of any species in the particular area, how much would be the cost for restoring it?
- How much would it cost to local authorities to eliminate or treat dirtier water clean-up as a result of degraded ecosystem function due to increase in water pollution?

- What shall be cost of additional flood control and safety cost as a result of ecosystem degraded functioning?
- These questions would serve the basis for computing environmental cost only when information related to ecosystem is available and hold true in the eyes of law. The construction of highways and business corridors has brought drastic ecological problems which are yet unaccounted for. The wildfires due to electric malfunctioning are resulting in damage to wild lands, property, resources and species worth millions of dollars. These unaccounted environmental costs are to be addressed by strong government policies and awareness about them to be spread among the individuals, organisations, corporate and governments.

12.3.3 Elements of Green Accounting

Environment or Green Accounting guidelines issued by Ministry of Environment, Japan 2005 indicates the purpose of green accounting to attain two types of benefits that includes, firstly, the benefit of environmental conservation, and secondly, economic benefit to be achieved by incurring cost on environmental conversation activities. Based on these guidelines, the elements of the green accounting can be classified as - (a) structural elements and (b) basic elements.

- *Structural elements:* Structural elements of green accounting can be classified as follows:
  - *Environmental conversation cost:* Investments and expense related to the prevention, reduction, and/or avoidance of environmental impact, removal of such impact, restoration following the occurrence of a disaster, and other activities are measured in 'monetary value'. Investment amounts are expenditures allocated during a target period for the purpose of environmental conservation. The benefits from these investments are seen over several periods and are recorded

as expense during the depreciation period (the amount of depreciable assets recorded during the period under financial accounting standards). Expense amounts refer to the expenses or losses recorded under financial accounting standards resulting from the consumption of goods or services for the purpose of environmental conservation.

- *Environmental conversation benefits:* The benefits obtained from the prevention, reduction, and/or avoidance of environmental impact, removal of such impact, restoration following the occurrence of a disaster, and other activities are measured in 'physical units'.
- *Economic benefits associated with the environmental conservation activities:* Benefits to a company's profit as a result of carrying forward with environmental conservation activities are measured in monetary value.

Ø Basic elements: Basic elements of green accounting aim to ensure the conformity of the goals of environmental accounting with the organisational managerial policies and decision-making related to environmental conservation. The basic elements comprise of identification of the following:

- *Target period:* It states that the information related to the company's financial accounting, environmental activities and its accounting should all be coordinated to match the company's fiscal year.
- *Aggregation Scope:* The scope of the environmental reports maybe either company-wide or corporate group-wise. In principle, under the company-wide reports, information pertaining to financial accounting, environmental conservation activities, and environmental accounting should be coordinated to use identical reporting units for the entire company. However, in case of corporate group-wise, the corporate group comprises of subsidiaries and affiliates of the company and therefore, the scope of reports should

include their activities to provide a consolidated understanding of the corporate actions on the environment and establish a correlation between the economic activities and environmental data.

- *Calculation of standards for environmental conservation costs:* The objective standards have to be identified depending upon the business type to categorise any cost as environmental conservation cost in monetary terms.
- *Calculation of standards for environmental conservation benefits:* The benefits obtained from the prevention, reduction, and/or avoidance of environmental impact, removal of such impact, restoration following the occurrence of a disaster, and other activities are measured in 'physical units'. There are no established valuation methods, yet integrating various environmental impacts into a single indicator as monetary value by valuating the economic benefits of environmental conservation activities can act as the standard for such benefits from the business activities. Environmental conservation benefits are divided into 4 categories in relation to its business operations. i) Environmental conservation benefit associated with the inputs of resources into business operations, ii) Environmental conservation benefit associated with environmental impact and waste emissions from business operations, iii) Environmental conservation benefit associated with the goods and services produced by business operations, iv) Environmental conservation benefit associated with transports and other operations.
- *Calculation of standards for economics benefits associated with the environmental conservation activities:* The economic benefits are the contribution to the profits of the company or organisation as a result of environment conservation activities undertaken, as measure in monetary terms. These

economic benefits can be categorised as A) actual benefits (benefits calculated based on confirmed data available), B) estimated benefits (benefits calculated based on certain assumed data).

12.3.4 Types of Green Accounting

Green Accounting has been designed to consider key environmental factors to be incorporated in the business plan so as to provide accurate and efficient economic position of the organisation and country, as a whole. Green accounting revolves around 3 important aspects viz., planet, people and profitability. It aims to include environmental costs into the financial strategy of any corporate, organisation and country and examine the social, economic and environmental impact of business operations and the cost to conserve environment to form an important part of economic budgets for the business and country. As broadly identified by Environment Protect Agency (EPA) of United States, the green accounting covers three areas of accounting, as below-

- *National income accounting* is a macro-economic measure. Gross Domestic Product (GDP) is a measure of the flow of goods and services through the economy. It is often cited as a key measure of our society's economic well-being. The term environmental accounting may refer to this national economic context that can use physical or monetary units to refer to the consumption of the nation's natural resources, both renewable and nonrenewable. In this context, environmental accounting has been termed "natural resources accounting."
- *Financial accounting* enables companies to prepare financial reports for use by stakeholders. Publicly held corporations report information on their financial condition and performance through quarterly and annual reports, governed by rules set by the Securities and Exchange regulatory authorities of the countries with input from industry's self-regulatory body. Generally

Accepted Accounting Principles (GAAP) is the basis for this reporting. Environmental accounting in this context refers to the estimation and public reporting of environmental liabilities and financially material environmental costs.

- *Management accounting* is the process of identifying, collecting, and analysing information principally for internal purposes. A key purpose of management accounting is to support a business's forward-looking management decisions. Management accounting can involve data on costs, production levels, inventory and backlog and other vital aspects of a business. The information collected under a business's management accounting system is used to plan, evaluate, and control in a variety of ways. Similarly, environmental management accounting refers to the use of data about environmental costs and performance in business decisions and operations.

12.3.5 Importance and Scope

The environmental changes and economic activities are interrelated, thus a change in environment has negative impact on economy, and similarly a change in economy has a direct impact on business and its operations. These grossed up changes have a long-term impact on the society, which makes it important and mandatory for corporate to be transparent and governments to be stringent towards corporate disclosures and regulatory compliance for environmental issues.

Under the traditional accounting parameters the facts and figures ignore to account the expenditures on damage control, quantum of deterioration or damage caused, and the cause and effect relationship between business activities and its related impact on environment. Thus green accounting acts as a measure to procure information to assess, both qualitative and quantitative, impacts on environment resulting from the business activities in any economy.

In order to broaden the scope of green accounting nationally and internationally, efforts have been made to unify the code and standards for the disclosure of the environment protection activities of the corporate across the global through various Environmental Financial Accounting and Reporting standards that have been set–up under the International Accounting Standard (IAS) issued by International Accounting Standards Board (IASB). These include –

- IAS 1 on Disclosure of accounting policies
- IAS 16 on Property, Plant and Equipment
- IAS 36 on Impairment of Assets
- IAS 37 on Provisions, Contingent liabilities and Contingent assets
- IAS 38 on Intangible assets

Other than these standards the International Organization of Standards (ISO) has designed the framework on 'Environmental Management System' under the ISO 14001 certification which provides voluntary certification to the interested organisations that wish to operate on plan-do-check-act (PDCA) concept on continuous improvement.

ISO 14001 provides standards for specific requirements for effective environmental management system thus helping in reducing the efforts of the organisation to establish its own environment performance requirements or standards.

12.3.6 Green Accounting: Indian Perspective

In India, it is necessary to avail environmental clearance from all the competent Government authorities. Union Ministry of Environment and Forest (MoEF) coordinates with the states and other ministries on the issues related to environment protection and pollution control mechanism. It has issued several legal and regulatory compliances towards environment protection for the individuals, organisations, corporate and governments to follow and abide by. The few prominent Acts include:

- Indian Penal Code
- Indian Port Act, 1908.
- The Factories Act, 1948.
- Merchant of shipping Act, 1958.
- Water (Prevention and Control of Pollution) Act, 1974.
- Water (Prevention and Control of Pollution) Cess Act, 1977.
- The Air (Prevention and Control of Pollution) Act, 1981.
- Forest (Conservation) Act, 1980. e) The Environment (Protection) Act, 1986.
- Indian Fisheries Act, 1987.
- Hazardous Waste (Management & Handling) Rules, 1989.
- Public Liability Insurance Act, 1991.
- Motor Vehicle Act, 1991.
- The National Environment Tribunal Act, 1995.

The Central Pollution Control Board (CPCB) has been set up to handle the violation of standards by corporate or industries in case of contamination of water bodies or air pollution. Any person undertaking any industrial operations or processes is required to submit environment statement to the CPCB. The MoEF has made it mandatory for all companies to disclose briefly about the activities undertake or proposed to be undertaken for adoption of clean technologies in prevention of pollution, waste recycling, management and its utilisation, pollution control measures, investment quantum on environment protection activities and the impact of these measures on environment conservation and waste reduction, to form part of the Board of Directors reports.

Under the National Voluntary Guidelines on Social, Environment and Economic Responsibilities of Business, the Securities Exchange Board of India (SEBI) has made it mandatory for all listed companies to report Environmental, Social and Governance (ESG) initiative undertaken by them.

To make companies socially responsible for their activities, the GOI under the Companies Act 2013 propagates mandatory acts of Corporate Social Responsibilities (CSR). Under this Act CSR is mandatory for all companies under the following 3 categories:

- Companies having net worth of INR 500 crore,
- Companies having turnover of INR 1000 crore, or
- Companies having net profit of INR 5 crore

The companies under the above category must spend at least 2 % of its average net profits of last 3 years on its CSR activities and mention the details of all these activities in the Board of Directors reports, annually.



CHECK YOUR PROGRESS

Q 1: State whether the following statements are True (T) or False (F):

(a) GDP is the true measure of the economic progress of the country. (T/F)

(b) NDP = GDP – Depreciation. (T/F)

(c) Environmental costs include both private and societal costs. (T/F)

(d) Private costs are borne by society. (T/F)

(e) Environmental conservation benefits are measured in monetary value. (T/F)

(f) Under Companies Act 2013, all company under the specified category has to spend 2% of the average profits of last years for the CSR initiatives. (T/F)

Q 2: Examine the factors leading to ignorance of accounting natural capital. (Answer in about 30 words)

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Q 3: How can NDP be converted into EDP? (Answer in about 30 words)

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Q 4: State the mandatory requirements of CSR under the Companies Act 2013. (Answer in about 30 words)

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12.4 ALTERNATIVE INDICATORS OF SUSTAINABILITY

Several efforts have been made in the past to develop various qualitative and quantitative measures to indicate corporate development and sustainability. The sustainability development indicates the need of economic growth with environmental conservation/protection and social equity. The measures shall indicate the technical and social activities for fulfilling the needs of the current generations and also ensure that the needs of the future generations are not compromised.

Other than the measures like Environmentally- Adjusted Net Domestic Product (EDP) and System of Environmental and Economic Accounting (SEEA) discussed in the previous section of the chapter, there are other qualitative indicators used to assess sustainability which are discussed as follows:

- **Life cycle Assessment**: Life cycle assessment deals with recording the environmental impacts of a product from the use of raw material through its disposal at the end of its useful life. It is an important tool for corporate/industries to administer and develop a blue-print of activities affecting environment and decide on actions to minimise harm and also to take advantages of the eco-friendly product, process or service.
- **Ecological Footprint**: The ecological footprint is a measure of quantum of human demand on the earth ecosystem. It indicates the amount of

biologically available productive land and sea area which shall be needed to regenerate the resources the human population consumes and to absorb and provide harmless the corresponding waste, under the given technology and resource management practice.

- **Environmental Performance Index (EPI)**: The method offers quantifying and numerically benchmarks for the environmental performance of a country's policy. The index has its origin from the Pilot Environmental Performance Index published in 2002 by U.N. Millennium Development Goals.
- **Adjusted Net Savings (ANS)**: Under the national accounting methods, in addition to GDP, calculations are made for savings and investment rates. Net domestic saving is estimated after making adjustments of borrowings and fixed capital depreciation from Gross domestic savings. On lines of measuring EDP, the World Bank has developed the method of Adjusted Net Savings (ANS) also called as 'Genuine Savings'. The ANS analysis is mostly appropriate for developing countries which indicate that – what may appear to be a development "success story" can conceal serious natural capital depletion and in some cases even a negative adjusted net saving rate. ANS is normally calculated as a percentage of national income, although it could also be expressed in monetary units.
- **Genuine Progress Indicator**: EDP, ANS, GDP, etc., are indicators that ignore social welfare costs. In order to create measure for social welfare Index for Sustainable Economic Welfare (ISEW) also known as Genuine Progress Indicator has been developed. Economists Herman Daly and John Cobb, Jr. had first described the ISEW in their 1989 book *For the Common Good*. The non-profit organisation Redefining Progress (based in Oakland, California) developed the GPI in 1995 as essentially a second-generation version of the ISEW.GPI is measured in monetary terms. ISEW is used in many European countries, U.S. and Chile, whereas GPI is widely used in U.S. Both these indicators apply five categorisations of costs to compute the index that includes - A. Consumption Base, B. Additions for services not

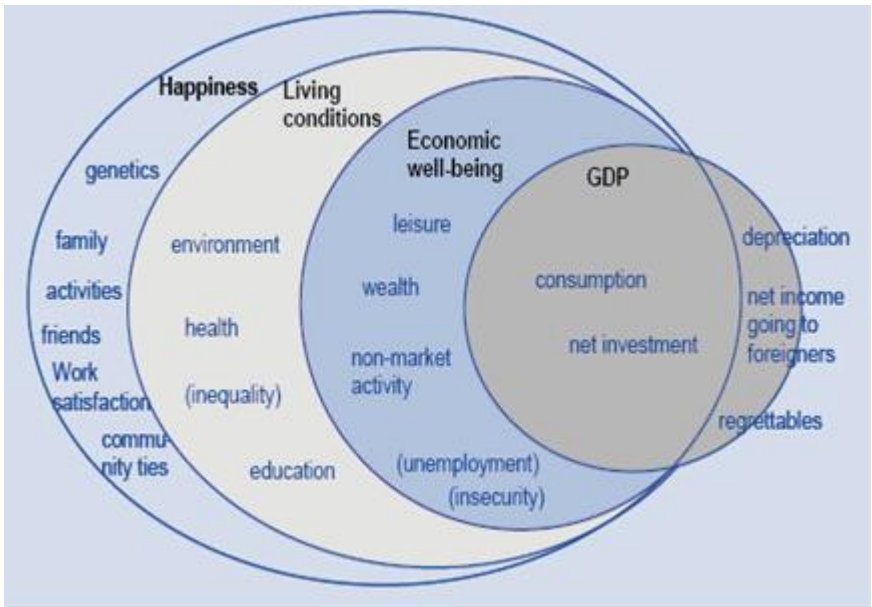
counted as consumption, C. Subtractions for Implicit overestimates of welfare, D. Subtractions for depletion of natural resource base, and E. Adjustments for capital accumulation and flow.

- **Human Development Index (HDI)**: One of most referred and recommended index to measure quality-of-life is United Nations – Human Development Index (HDI). HDI is calculated on yearly basis, based on three components life-expectancy, income and education. It ranks the nation on the basis of their policies activities and recommendations in the 3 components.
- **Better Life Index(BLI)**: As inspired by HDI, Organization for Economic Cooperation and Development (OECD) has developed a comprehensive index to capture data on well-being in different nations by the Better Life Index (BLI). BLI considers 11 dimensions of well-being that includes – i) Income, wealth and inequality, ii) Jobs and earnings, iii) Housing conditions, iv) Health status, v) work and Life balance, vi) Education and skills, vii) Social connections, viii) Civic engagement and governance, ix) Environmental quality, x) Personal security, and xi) Subjective well-being. The results for each dimension are standardised across countries resulting in a score from 0-10.The BLI has been measured for the 34 OECD nations, with plans to expand it to Brazil, China, India, Indonesia, Russia, and South Africa.
- **Gross National Happiness Index (GNHI)**: The index was developed by King of Bhutan, King H. M. Jigme Singye Wangchuk in 1972 with the focus on 4 policy objectives including – equitable economic development, environmental preservation, cultural resilience and good governance. The index was further elaborated by Centre for Bhutan Studies (CBS) and operationalised the index in 2011 to add 9 dimensions including - i) Psychological well-being, ii) Standard of living, iii) Corporate governance, iv) Health, v) Education, vi) Community vitality, vii) Cultural diversity and resilience, viii) Time use, and ix) Ecological diversity and resilience.

Figure 12.1 indicates a board view of the various elements considered to evaluate happiness and well-being indices. As discussed

these indicators are designed to provide some guidance on the issues of sustainability.

Figure12.1: Elements of Happiness and Wellbeing



Source: **Deutsche Bank 2006**

However, all the above mentioned indicators are an option to address the deficiencies in the conventional methods of computing economic performance of the countries around the world. But the success of these indicators depends upon the data collected and its interpretation of results to access environmentally sustenance of the society.



CHECK YOUR PROGRESS

Q 5: Expand the following:

(a) EPI : ……

(b) HDI : ……

(c) ANS : ……

(d) BLI : ……

(e) GPI : ……

(f) ISEW : ……

(g) GNHI : ……

Q 6: Fill in the blanks:

(a) Adjusted net savings index is also known as _____ .

(b) The three components of HDI includes ————,————— ——————————— and ————————————.

(c) BLI is based on ——————— dimensions of well-being.

(d) GNHI focuses on 4 policy objectives viz., ---————, ——— ————————, ————————— and ————————.



12.3 LET US SUM UP

- Green Accounting has been gaining popularity and demanding further propagation to become the integral part of the economic activities of the business and act as a check for the business operations and its impact on the environment.
- The human activities and have to a large extend damaged the environment ecology which has resulted in an adverse effect on the economic status of countries, whether developed, developing or under-developed.
- Efforts to account the human activities causing depletion, damage and deterioration to the natural resources have been initiated through the concept of environmental accounting or green accounting.
- These accounting records aimed to create awareness among individuals, organisations, corporate and governments of the nation of the growing importance to conserve natural resources and to implement financial strategies to incorporate the environmental conservation costs that shall be dedicated towards environment protection and conservation.
- Various legal, regulatory and accounting standards have been set-up world-wide to bring countries together to make them responsible for natural resource depletion and persuade them to indulge in economic activities to protect natural resource.
- Countries are working diligently to continuously evolve more uniform measures to apply for collecting environmental data, its interpretation standards and implementation strategies.

- Various reporting norms and indicators are applied by countries to suggest environmental sustainability at economic and social well-being levels.



12.4 FURTHER READING

(1) Bhattacharya, R. N. (2013). *Environmental Economics.* New Delhi: Oxford University Press.

(2) Burhagohain and Das. (n.d.) *Environmental Economics.* Guwahati: EBH Publishers

(3) Purakayastha, G. (2006). *Environmental Economics: Theory, Problems and Solutions.* New Delhi: Kalyani Publishers.



12.5 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1: (a) False (b) True (c) True (d) False (e) False (f) True

Ans to Q No 2: The reasons of the ignorance of accounting the natural capital can be attributed to two factors:

- Firstly, the human activities with the use of natural resources at the local levels were considered reversible and were assumed to have no likely effect on the environment so as to endanger the contribution of environment to the economy and human welfare.
- Secondly, due to lack of systematic structure and quantitative methodology to account the environmental contribution to economy and human welfare, it was difficult, time-consuming and ambiguous to collect wide data and information without proper methodology and direction.

Ans to Q N 3: Conversion of NDP into EDP:

Under macro-economics, Net Domestic Product (NDP) is defined as,

NDP = Net exports (X - M) + Final Consumption (C) + Net capital accumulation (I)

To calculate EDP, the net capital accumulation needs to be replaced with net capital accumulation of produced and non-produced

economic assets after deducting net accumulation of non-produced natural assets. Thus, EDP can be stated as,

EDP = Net exports (X - M) + Final Consumption (C) + Net capital accumulation of produced economic assets (NAp.ec) + ((Net capital accumulation of non-produced economic assets (NAnp.ec) - Net capital accumulation of non-produced natural assets (NAnp.n))

Ans to Q No 4:

Under the Companies Act 2013, CSR is mandatory for all companies under the following 3 categories:

(a) Companies having net worth of INR 500 crore,

(b) Companies having turnover of INR 1000 crore, or

(c) Companies having net profit of INR 5 crore

The companies under the above category must spend at least 2 % of its average net profits of last 3 years on its CSR activities and mention the details of all these activities in the Board of Directors reports, annually.

Ans to Q No 5:

(a) EPI = Environmental Performance Index

(b) HDI = Human Development Index

(c) ANS= Adjusted Net savings

(d) BLI = Better Life Index

(e) GPI= Genuine Performance Index

(f) ISEW= Index for Sustainable Economic Welfare

(g) GNHI = Gross National Happiness Index

Ans to Q No 6:

(a) Genuine Savings.

(b) Expectancy, income and education.

(c) 11

(d) Equitable economic development, environmental preservation, cultural resilience and good governance.

12.6 MODEL QUESTIONS

Short Questions (Answer each question in about 150 words)

Q 1: Differentiate between internal and external functions of green accounting.

Q 2: Differentiate between private and societal costs of green accounting.

Q 3: Briefly describe the structural elements of green accounting.

Q 4: State the relationship between BLI and GNHI of sustainability measurement.

Essay-type Questions (Answer each question in about 300-500 words)

Q 1: State the meaning and objectives of green accounting.

Q 2: Briefly discuss the types of green accounting.

Q 3: Describe the basic elements of green accounting.

Q 4: Write short note on any 4 alternate indicators of sustainability.

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UNIT 13: GLOBAL ENVIRONMENTAL ISSUES

UNIT STRUCTURE

13.1 Learning Objectives

13.2 Introduction

13.3 Climate Change

- 13.3.1 Implications of Climate Change
- 13.3.2 Mitigation of Climate Change
- 13.3.3 Greenhouse Gas Concentrations and Stabilisation

13.4 Global Warming

- 13.4.1 Impacts of Enhanced Greenhouse Effect
- 13.4.2 Measures to Check Global Warming

13.5 Acid Rain

- 13.5.1 Effects of Acid Rain
- 13.5.2 Control of Acid Rain

13.6 Ozone Layer Depletion

- 13.6.1 Thinning of Ozone Layer
- 13.6.2 Effects of Ozone Layer Depletion

13.7 Environment and Human Health

13.8 Let Us Sum Up

13.9 Further Reading

13.10 Answers to Check Your Progress

13.11 Model Questions

13.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- derive knowledge about the complex global environmental issues
- discuss the concepts of about global warming, acid rain, ozone layer depletion etc.
- describe how human health is affected by environment.

13.2 INTRODUCTION

The world environment is a composite global resource, sustaining life for all living beings and hence it needs to be preserved. At the conceptual level, the awareness about the seriousness of actual and potential conflicts between economic growth and environment, has become very wide since 1970s. Environment, since then has emerged as a major subject of intensive interest and research worldwide. Environmental degradation is not just global warming, pollution, ozonisation etc. in some isolated fashion, but the continuously deteriorating state of the composite natural resource base over time. This unit deliberates on such certain burning issues.

13.3 CLIMATE CHANGE

Climate is the average weather of an area. It is the general weather conditions, seasonal variations and extremes of weather in a region. Such conditions which average over a long period- at least 30 years is called climate. The term 'climate change' may be defined as a change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.

Thus, it is obvious that climate change is truly a global problem. It has occupied the attention of international policy makers for about 15 years now. Our climate is dependent on various factors such as temperature, wind and rain, location on the globe and the rotational and revolutionary movement of the earth. This we share with all of mankind, and with all living beings. Human industrial activity, mainly the combustion of fossil fuels has resulted in large-scale production of certain gases such as carbon monoxide and carbon dioxide and oxides of nitrogen that have heat trapping properties. These form a shield in the upper atmosphere. The earth receives heat from the sun, absorbs part of it and reflects a part back to space. These gases effectively reduce the amount that would normally be reflected back. This is called the Greenhouse Effect. As a result, there is an increase in the

average global temperature. It is estimated that the global temperature has risen about 1.5 degrees Celsius in the last two hundred years.

Why should such a small change matter? The problem is that if unchecked this process can continue. While in the short run some countries like Canada may even gain from warming (since some ice bound land may now become cultivable) in the long run human and other life may become impossible. Please note that the tolerance of the human body to heat is very low. It is believed that life is almost impossible in temperatures above 55 degrees Celsius. Further, rainfall patterns can be chaotically altered. Warmer countries like India have more to worry about as these parts will become uninhabitable first. An international treaty signed at Kyoto, Japan in 1997 urges all nations to reduce greenhouse gases emissions to 1990 levels. Countries are in the process of ratifying the treaty.

13.3.1 Implications of Climate Change

The Intergovernmental Panel on Climate Change (IPCC) in 1990 and 1992 published best available evidence about past climate change, the greenhouse effect and recent changes in global temperature. Some of its observations include:

- It has been observed that earth's temperature has changed considerably during the geological times. It has experienced several glacial and inter-glacial periods. However, during the past 10,000 years of the current interglacial period the mean average temperature has fluctuated by 0.5-1°C over 100 to 200 year period.
- We have relatively a stable climate for thousands of years due to which we have practised agriculture and increased in population.
- Even small changes in climatic conditions may disturb agriculture that would lead to migration of animals including humans.
- Anthropogenic (man-made) activities are upsetting the delicate balance that has established between various components of

the environment. Greenhouse gases are increasing in the atmosphere resulting in increase in the average global temperature.

- Ø This may upset the hydrological cycle; result in floods and droughts in different regions of the world, cause sea level rise, changes in agriculture productivity, famines and death of humans as well as live stock.
- Ø The global change in temperature will not be uniform everywhere and will fluctuate in different regions. The places at higher latitudes will be warmed up more during late autumn and winter than the places in tropics. Poles may experience 2 to 3 times more warming than the global average, while warming in the tropics may be only 50 to 100% on an average.
- Ø The increased warming at poles will reduce the thermal gradient between the equator and high latitude regions decreasing the energy available to the heat engine that drives the global weather machine. This will disturb the global pattern of winds and ocean currents as well as the timing and distribution of rainfall.
- Ø Shifting of ocean currents may change the climate of Iceland and Britain and may result in cooling at a time when rest of the world warms.
- Ø Disturbed rainfall will result in some areas becoming wetter and the others drier. Although rainfall may increase, higher temperatures will result in more evapo-transpiration leading to annual water deficit in crop fields.

13.3.2 Mitigation of Climate Change

Climate change mitigation consists of actions to limit the magnitude or rate of long-term global warming and its related effects. Climate change mitigation generally involves reductions in human (anthropogenic) emissions of greenhouse gases (GHGs). Mitigation may also be achieved by increasing the capacity of carbon sinks, e.g., through reforestation. Mitigation

policies can substantially reduce the risks associated with human-induced global warming.

According to IPCC's 2014 Assessment Report, "Mitigation is a public good; climate change is a case of the 'tragedy of the commons'. Effective climate change mitigation will not be achieved if each agent (individual, institution or country) acts independently in its own selfish interest (see International cooperation and Emissions trading), suggesting the need for collective action. Some adaptation actions, on the other hand, have characteristics of a private good as benefits of actions may accrue more directly to the individuals, regions, or countries that undertake them, at least in the short term. Nevertheless, financing such adaptive activities remains an issue, particularly for poor individuals and countries."

Examples of mitigation include reducing energy demand by increasing energy efficiency, phasing out fossil fuels by switching to low-carbon energy sources, and removing carbon dioxide from earth's atmosphere, for example, through improved building insulation.

Most countries are parties to the United Nations Framework Convention on Climate Change (UNFCCC). The ultimate objective of the UNFCCC is to stabilize atmospheric concentrations of GHGs at a level that would prevent dangerous human interference of the climate system. Scientific analysis can provide information on the impacts of climate change, but deciding which impacts are dangerous requires value judgments.

In 2010, Parties to the UNFCCC agreed that future global warming should be limited to below 2.0 °C (3.6 °F) relative to the pre-industrial level. With the Paris Agreement of 2015 this was confirmed, but was revised with a new target laying down "parties will do the best" to achieve warming below 1.5 °C. The current trajectory of global greenhouse gas emissions does not appear to be consistent with limiting global warming to below 1.5 or 2 °C. Other mitigation policies have been proposed, some of which are more

stringent or modest than the 2 °C limit. In 2019, after 2 years of research, scientists from Australia, and Germany presented the "One Earth Climate Model" that shows how exactly we can stay below 1.5 degrees in price of 1.7 trillion dollars per year.

13.3.3 Greenhouse Gas Concentrations and Stabilisation

One of the issues often discussed in relation to climate change mitigation is the stabilization of greenhouse gas concentrations in the atmosphere. The United Nations Framework Convention on Climate Change (UNFCCC) has the ultimate objective of preventing "dangerous" anthropogenic (i.e., human) interference of the climate system. As is stated in Article 2 of the Convention, this requires that greenhouse gas (GHG) concentrations are stabilised in the atmosphere at a level where ecosystems can adapt naturally to climate change, food production is not threatened, and economic development can proceed in a sustainable fashion.

There are a number of anthropogenic greenhouse gases. We shall discuss this in the next section. Please note that there is a difference between stabilizing CO_2 emissions and stabilising atmospheric concentrations of CO_2. Stabilising emissions of CO_2 at current levels would not lead to a stabilisation in the atmospheric concentration of CO_2. In fact, stabilising emissions at current levels would result in the atmospheric concentration of CO_2 continuing to rise over the 21st century and beyond (see the graphs opposite).

The reason for this is that human activities are adding CO_2 to the atmosphere faster than natural processes can remove it (see carbon dioxide in Earth's atmosphere for a complete explanation). This is analogous to a flow of water into a bathtub. So long as the tap runs water (analogous to the emission of carbon dioxide) into the tub faster than water escapes through the plughole (analogous to the natural removal of carbon dioxide from the atmosphere) the level of water in the tub (analogous to the

concentration of carbon dioxide in the atmosphere) will continue to rise.

According to some studies, stabilising atmospheric CO_2 concentrations would require anthropogenic Stabilising the atmospheric concentration of the other greenhouse gasses humans emit also depends on how fast their emissions are added to the atmosphere, and how fast the GHGs are removed. Stabilisation for these gases is described in the later section on non-CO_2 GHGs.

In 2018 an international team of scientists published research saying that the current mitigation policy in Paris Agreement is insufficient to limit the temperature rise to 2 degrees. For preventing that, restoration of natural Carbon sinks, Carbon dioxide removal, changes in society and values will be necessary.

13.4 GLOBAL WARMING

Troposphere, the lowermost layer of the atmosphere, traps heat by a natural process due to the presence of certain gases. This effect is called *Greenhouse Effect* as it is similar to the warming effect observed in the horticultural greenhouse made of glass. The amount of heat trapped in the atmosphere depends mostly on the concentrations of “heat trapping” or “greenhouse” gases and the length of time they stay in the atmosphere. The major greenhouse gases are carbon dioxide, ozone, methane, nitrous oxide, chlorofluorocarbons (CFCs) and water vapours. The average global temperature is 15°C. In the absence of greenhouse gases this temperature would have been -18°C. Therefore, Green House Effect contributes a temperature rise to the tune of 33°C. Heat trapped by greenhouse gases in the atmosphere keeps the planet warm enough to allow us and other species to exist. The two predominant greenhouse gases are water vapours, which are controlled by hydrological cycle, and carbon dioxide, which is controlled mostly by the global carbon cycle. While the levels of water vapour in the troposphere have relatively remained constant, the levels of carbon dioxide have increased. Other gases whose levels have increased due to human activities are methane, nitrous oxide and chlorofluorocarbons. Deforestation

has further resulted in elevated levels of carbon dioxide due to non-removal of carbon dioxide by plants through the process of photosynthesis.

Warming or cooling by more than 2°C over the past few decades may prove to be disastrous for various ecosystems on the earth including humans, as it would alter the conditions faster than some species could adapt or migrate. Some areas will become inhabitable because of drought or floods following a rise in average sea level.

Greenhouse Gases: The phenomenon that worries the environmental scientists is that due to anthropogenic activities there is an increase in the concentration of the greenhouse gases in the air that absorb infra-red light containing heat and results in the re-radiation of even more of the outgoing thermal infra-red energy, thereby increasing the average surface temperature beyond 15°C. The phenomenon is referred to as the enhanced greenhouse effect to distinguish its effect from the one that has been operating naturally for millennia.

The different greenhouse gases present in the troposphere and resulting in an increase in the temperature of air and the earth are discussed here:

- **Carbon dioxide*:*** It contributes about 55% to global warming from greenhouse gas produced by human activity. Industrial countries account for about 76% of annual emissions. The main sources are fossil fuel burning (67%) and deforestation, other forms of land clearing and burn (33%). CO_2 stays in the atmosphere for about 500 years. CO_2 concentration in the atmosphere was 355 ppm in 1990 that is increasing rate of 1.5 ppm every year.
- **Chlorofluorocarbons (CFCs):** These are believed to be responsible for 24% of the human contribution to greenhouse gases. They also deplete ozone in the stratosphere. The main sources of CFCs include leaking air conditioners and refrigerators, evaporation of industrial solvents, production of plastic foams, aerosols propellants etc. CFCs take 10-15 years to reach the stratosphere and generally trap 1500 to 7000 times more heat per molecule than CO_2 while they are in the troposphere. This heating effect in the troposphere may be partially offset

by the cooling caused when CFCs deplete ozone during their 65 to 110 years stay in the stratosphere. Atmospheric concentration of CFC is 0.00225 ppm that is increasing at a rate of 0.5% annually.

- **Methane (CH_4):** It accounts for 18% of the increased greenhouse gases. Methane is produced when bacteria break down dead organic matter in moist places that lack oxygen such as swamps, natural wetlands, paddy fields, landfills and digestive tracts of cattle, sheep and termites. Production and use of oil and natural gas and incomplete burning of organic material are also significant sources of methane. Methane stays in the atmosphere for 7-10 years. Each methane molecule traps about 25 times as much heat as a CO_2 molecule. Atmospheric concentration of methane is 1.675 ppm and it is increasing at a rate of 1% annually.
- **Nitrous Oxide (N_2O):** It is responsible for 6% of the human input of greenhouse gases. Besides trapping heat in the troposphere it also depletes ozone in the stratosphere. It is released from nylon products, from burning of biomass and nitrogen rich fuels (especially coal) and from the breakdown of nitrogen fertilizers in soil, livestock wastes and nitrate contaminated ground water. Its life span in the troposphere is 140-190 years and it traps about 230 times as much heat per molecule as CO2 The atmospheric concentration of N_2O is 0.3 ppm and is increasing at a rate of 0.2% annually.

13.4.1 Impacts of Enhanced Greenhouse Effect

The enhanced greenhouse effect will not only cause global warming but will also affect various other climatic and natural processes.

- *Global temperature increase:* It is estimated that the earth's mean temperature will rise between 1.5 to 5.5^0 C by 2050 if input of greenhouse gases continues to rise at the present rate. Even at value, earth would be warmer than it has been for 10,000 years.
- *Rise in Sea Level:* With the increase in global temperature sea water will expand. Heating will melt the polar ice sheets and

glaciers resulting in further rise in sea level. Current models indicate that an increase in the average atmosphere temperature of 3^0C would raise the average global sea level by 0.2 – 1.5 meters over the next 50 -100 years.

One meter rise in sea level will inundate low lying areas like Shanghai, Cairo, Bangkok, Sydney, Hamburg and Venice as well as agricultural lowlands and deltas in Egypt, Bangladesh, India, and China and will affect rice productivity. This will also disturb many commercially important spawning grounds, and would probably increase the frequency of storm damage to lagoons, estuaries and coral reefs.

In India, the Lakshadweep Islands with a maximum height of 4 meters above the level may be vulnerable. Some of the most beautiful cities like Mumbai may be saved by heavy investment on embankment to prevent inundation.

- *Effects on Human Health.* The global warming will lead to changes in the rainfall pattern in many areas, thereby affecting the distribution of vector-borne diseases like malaria, filariasis, elephantiasis etc.

Areas which are presently free from diseases like malaria, schistosomiasis etc. may become the breeding grounds for the vectors of such diseases. The areas likely to be affected in this manner are Ethiopia, Kenya and Indonesia. Warmer temperature and more water stagnation would favour the breeding of mosquitoes, snails and some insects, which are the vectors of such diseases. Higher temperature and humidity will increase/aggravate respiratory and skin diseases.

- *Effects on Agriculture:* There are different views regarding the effect of global warming on agriculture. It may show positive or negative effects on various types of crops in different regions of the world. Tropical and subtropical regions will be more affected since average temperature in these regions is already on the higher side. Even a rise of 2°C may be quite harmful to crops.

Soil moisture will decrease and evapo-transpiration will increase, which may drastically affect wheat and maize production.

13.4.2 Measures to Check Global Warming

To slow down enhanced global warming the following steps will be important:

- Cut down the current rate of use of CFCs and fossil fuel.
- Use energy more efficiently.
- Shift to renewable nuclear energy.
- Trap and use methane as a fuel.
- Adopt sustainable agriculture.
- Stabilise population growth.
- Efficiently remove CO_2 from smoke stacks.
- Plant more trees.
- Remove atmospheric Co, by utilising photosynthetic algae.

13.5 ACID RAIN

Combustion of fossil fuels like coal and the exhaust of automobiles are major contributors to the generation of an air pollutant called sulphur dioxide. This gaseous compound reacts with water vapour to form dilute sulphuric acid. This acid then falls to earth in droplets known as acid rain. Where soils and water lack pH buffers that neutralize acids, the increase in the acidity can cause great harm to vegetation and fish. It may be noted that stack (chimney) heights are often raised by factories to reduce air pollution in the immediate vicinity. This does reduce direct air pollution but also increases the incidence of acid rain.

13.5.1 Effects of Acid Rain

Acid rain causes a number of harmful effects below pH 5.1. The effects are visible in the aquatic system even at pH less than 5.5.

- It causes deterioration of buildings especially made of marble eg. monuments like Taj Mahal. Crystals of calcium and magnesium sulphate are formed as a result of corrosion caused by acid rain.
- It damages stone statues. Priceless stone statues in Greece and Italy have been partially dissolved by acid rain.
- It damages metals and car finishes.
- Aquatic life especially fish are badly affected by lake acidification.
- Aquatic animals suffer from toxicity of metals such as aluminium, mercury, manganese, zinc and lead which leak from the surrounding rocks due to acid rain.
- It results in reproductive failure, and killing of fish.
- Many lakes of Sweden, Norway, and Canada have become fishless due to acid rain.
- It damages foliage and weakens trees.
- It makes trees more susceptible to stresses like cold temperature, drought, etc. Many insects and fungi are more tolerant to acidic conditions and hence they can attack the susceptible trees and cause diseases.

13.5.2 Control of Acid Rain

- Emission of SO_2 and NO_2 from industries and power plants should be reduced by using pollution control equipment.
- Liming of lakes and soils should be done to correct the adverse effects of acid rain.
- A coating of protective layer of inert polymer should be given in the interior of water pipes for drinking water.

13.6 OZONE LAYER DEPLETION

A layer of a mixture of oxygen O_2 and Ozone O_3, known as the ozone layer in the upper atmosphere is responsible for reflecting back most of the ultraviolet rays arriving from the sun. Without this layer life-forms on earth would be exposed to high levels of ultraviolet rays that cause cancer.

Certain chemicals produced in manufacturing such as chlorofluorocarbons (CFCs) used in aerosol propellants and emissions from high-flying jet aircraft break down the ozone. The thinning of the ozone layer was first noticed in 1974 when scientists noticed ozone depletion above the Antarctic. By 1991 this effect had enlarged to include southern Argentina. The Montreal and Kyoto protocols are expected to address this problem too.

13.6.1 Thinning of Ozone Layer

The Antarctic ozone hole was discovered by Dr Joe C. Farman and his leagues in the British Antarctic Survey who had been recording ozone levels over this region since 1957. During spring season of South Pole i.e. September to November each year ozone depletion is observed. Steep decline has been observed since mid-1970s with a record low concentration of 90 DU in early October of 1993.

Chlorofluorocarbons (CFC) are mainly responsible for ozone depletion in the stratosphere. CFCs are a group of synthetic chemicals first discovered by Thomas Midgley Jr. in 1930. CFC-11 and CFC-12 are the CFCs most commonly used. CFCs are used as coolants in refrigerators and air conditioners, as propellants, cleaning solvents, sterilant and in styrofoam etc. CFCs released in the troposphere reach the stratosphere and remain there for 65-110 years destroying $\hat{I}_3$, molecules. In 1974, Rowland and Molina warned that CFC are lowering the concentration of ozone in the stratosphere and predicted severe consequences. It was however, in 1985 that scientists for the first time discovered that 50% (98% in some areas) of upper stratospheric ozone over Antarctica was destroyed during the Antarctic spring and early summer (September-December). At Antarctic region the temperature during winter drops to -90°C. The winds blowing in a circular pattern over earth's poles create polar vortices. Water droplets in clouds when enter these vortices form ice crystals. CFCs get collected on the surfaces of these ice crystals and destroy ozone much faster. Similar

destruction of ozone over North Pole occurs during Arctic spring and early summer (February-June). The depletion is 10-25% and it is less than that observed at South Pole.

Nitrous oxide emitted by supersonic aircrafts, during combustion of fossil fuel and use of nitrogen fertilizers breaks ozone molecules. Chlorine liberated from chlorofluorocarbons also break ozone molecules. The chain reaction started in Antarctic spring i.e. August/September continues till nitrogen dioxide is liberated from nitric acid formed in the stratosphere by photolysis (breakdown by sunlight). Nitrogen dioxide combines with chlorine and stops further destruction of ozone.

13.6.2 Effects of Ozone Layer Depletion

- Ø Ozone depletion in the stratosphere will result in more UV radiation reaching the Earth especially UV-B (290-320 nm). The UV-B radiations affect DNA and the photosynthetic chemicals. Any change in DNA can result in mutation and cancer. Cases of skin cancer (basal and squamous cell carcinoma) which do not cause death but cause disfigurement will increase.
- Ø Easy absorption of UV rays by the lens and cornea of eye will result in increase in incidents of cataract.
- Ø Melanin producing cells of the epidermis (important for human immune system) will be destroyed by UV-rays resulting in immuno-suppression. Fair people (can't produce enough melanin) will be at a greater risk of UV exposure
- Ø Phytoplanktons are sensitive to UV exposure. Ozone depletion will result in decrease in their population thereby affecting the population of zooplankton, fish, marine animals, in fact the whole aquatic food chain.
- Ø Yield of vital crops like corn, rice, soybean, cotton, bean, pea, sorghum and wheat will decrease.

- Degradation of paints, plastics and other polymer material will result in economic loss due to effects of UV radiation resulting from ozone depletion.

13.7 ENVIRONMENT AND HUMAN HEALTH

In general terms a physically fit person not suffering from any disease is called a healthy person. However, there are many other dimensions associated with the state of being healthy. According to World Health Organisation (WHO) health is "*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*". Human health is influenced by many factors like nutritional, biological, chemical or psychological. These factors may cause harmful changes in the body's conditions called disease.

- **Infectious organisms:** This includes:
  - Disease causing organisms pose greater environmental threats to health, more severely in the developing countries especially the tropical ones. High temperature and moisture along with malnutrition help many diseases to spread in these countries. Microbes especially bacteria can cause food poisoning by producing toxins in the contaminated food. Some moulds grow on food and produce poisonous toxins.
  - Infectious organisms can also cause respiratory diseases (pneumonia, tuberculosis, influenza etc.) and gastrointestinal diseases (diarrhoea, dysentery, cholera etc.)
  - There are various types of parasites that cause diseases like malaria, schistosomiasis, filariasis etc. Most of these infections take place when the environmental conditions are unclean and unhygienic.
- **Chemicals:** A large number of chemicals are introduced in the environment by anthropogenic activities. Industrial effluents containing various chemicals are of major concern. Chemicals can be divided into two categories i.e hazardous and toxic chemicals. Hazardous are the dangerous chemicals like explosives, inflammable chemicals etc. Toxic chemicals (toxins) are poisonous chemicals which kill cells and can

cause death. Many other chemicals can cause cancer (carcinogenic), affect genetic material (DNA) in cells (mutagenic) or cause abnormalities during embryonic growth and development (teratogenic), while there are others that affect nervous system (meurotoxins) and the reproductive system. Some of the pesticides and other industrial pollutants may act as hormone analogs in humans other species. These environmental hormones affect reproduction, development and cause various types of ailments including tumors.

Many chemicals like DDT and other chlorinated pesticides bio accumulate in food-chain and show deleterious effects at the top of the food chain. Many chemical substances present in wastewaters like heavy metals (mercury, cadmium, lead etc.) fluoride and nitrate can affect human health. Metals can contaminate food while cooking in various types of utensils including alloys like steel. Containers for canned food, especially which are acidic in nature, contaminate the food with lead. Lead also comes in water from the water-pipes where it is added for plumbing purposes. Various alcoholic beverages contain lead while tobacco contains cadmium that goes in the body and affects human health.

Various chemicals, gases and particulates laden with chemicals spewed into the environment from various industries cause air pollution and affect human health.

- *Noise:* Although human ear is capable of tolerating a range of sound levels, yet if sound levels beyond the permissible level exist for certain duration, it becomes painful and sometimes irreparable damage occurs. Besides hearing damage various types of physiological and psychological changes are induced by noise pollution.
- *Radiations:* Radiations are known to cause short-term and long term changes in various organs. Cosmic rays and ultra-violet rays cause harmful effects on human health which may include cancer.
- *Diet:* Diet has a very important role in maintaining health. Malnutrition makes humans prone to other diseases. There is a strong correlation between cardiovascular diseases and the amount of salt and fat in one's

diet. Food contamination can cause various ill effects. There had been cases of Dropsy in India, a disease which occurred due to contamination of mustard oil with the poisonous seeds of *Argemone mexicana*. Likewise various adulterated pulses, condiments, oils etc. sold in the market to earn profit affect human health.

- *Settlement:* Proper environment, availability of basic necessities of life like, water, sanitation etc. are essential for healthy living. Housing is very important from security point of view. Improper settlement and poor physical environment may cause various psychological problems which affect various vital physiological processes in the body.



CHECK YOUR PROGRESS

Q 1: Define the term climate.

Q 2: Mention the major 'greenhouse' gases.

Q 3: What is meant by Ozone Layer?



13.8 LET US SUM UP

- Climate change is truly a global problem and has occupied the attention of international policy planners for about 15 years now.
- Climate change mitigation consists of actions to limit the magnitude or rate of long-term global warming and its related effects. Climate change mitigation generally involves reductions in human (anthropogenic) emissions of greenhouse gases (GHGs).
- Troposphere, the lowermost layer of the atmosphere, traps heat by.a natural process due to the presence of certain gases. This effect is called Green House Effect as it is similar to the warming effect observed in the horticultural green house made of glass.
- Combustion of fossil fuels like coal and the exhaust of automobiles are major contributors to the generation of an air pollutant called sulphur dioxide. This gaseous compound reacts with water vapour to form dilute

sulphuric acid. This acid then falls to earth in droplets known as acid rain.

- A layer of a mixture of oxygen O_2 and Ozone O_3, known as the ozone layer in the upper atmosphere is responsible for reflecting back most of the ultraviolet rays arriving from the sun. Without this layer life-forms on earth would be exposed to high levels of ultraviolet rays that cause cancer.



13.9 FURTHER READING

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(3) Purkayastha, G. (2006). *Environmental Economics: Theory, Problems and Solutions*. New Delhi: Kalyani Publishers

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13.10 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1: Average weather of an area;

Ans to Q No 2: Carbon dioxide, ozone, methane, nitrous oxide, chlorofluorocarbons (CFCs) and water vapours.

Ans to Q No 3: A layer of a mixture of oxygen O_2 and Ozone O_3, known as the ozone layer in the upper atmosphere is responsible for reflecting back most of the ultraviolet rays arriving from the sun.



13.11 MODEL QUESTIONS

Q 1: Write down the implication of climate change. Also discuss the different ways of mitigation of climate change.

Q 2: Explain global warming. Mention some solutions for checking global warming.

Q 3: What is meant by Acid rain? Discuss its effects on human health.

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UNIT 14: DOMESTIC ENVIRONMENTAL POLICY

UNIT STRUCTURE

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14.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- discuss some of the major constitutional provisions of India for protection and preservation of environment
- describe the mechanism of Environment Impact Management.

14.2 INTRODUCTION

Existing legal institutions for environmental management in India are the result of a spate of environmental laws enacted by the Indian Parliament in the aftermath of the UN Conference on the Human Environment in Stockholm in 1972.

It was believed by the policy-makers that there is no trade-off between development and environment but in fact the relationship between them is complementary to the governmental effort for the overall strategy of economic development.

In this unit, the evolution of India's environmental legislations is discussed. The environment impact management is also an important issue. It is dealt with in the latter part of the unit.

14.3 EVOLUTION OF ENVIRONMENTAL POLICY IN INDIA

Since about the late 1980s, the Supreme Court of India has been pro-actively engaged in India's environmental issues. Whereas in most countries, it is the executive and the legislative branches of the government that plan, implement and address environmental issues; the Indian experience is different. The Supreme Court of India has been engaged in interpreting and introducing new changes in the environmental jurisprudence directly. The Court has laid down new principles to protect the environment, re-interpreted environmental laws, created new institutions and structures, and conferred additional powers on the existing ones through a series of directions and judgments.

The Court's directions on environmental issues go beyond the general questions of law, as is usually expected from the highest Court of a democratic country. The Supreme Court of India, in its order, includes executive actions and technical details of environmental actions to be implemented. Indeed, some critics of India's Supreme Court describe the Court as the *Lords of Green Bench* or *Garbage Supervisor*. Supporters of India's Supreme Court term these orders and the Indian bench as pioneering, both in terms of laying down new principles of law, and in delivering environmental justice.

The reasons for the increasing interjection of India's Supreme Court in governance arenas are, experts claim, complex. A key factor has been the failure of government agencies and the state owned enterprises in discharging their Constitutional and Statutory duties. This has prompted

civil society groups to file public interest complaints with the Courts, particularly the Supreme Court, for suitable remedies.

Public interest litigation and judicial activism on environmental issues extends beyond India's Supreme Court. It includes the High Courts of individual states.

14.4 ENVIRONMENTAL LEGISLATIONS IN INDIA

India is the first country in the world to have made provisions for protection and conservation of environment in its constitution. On 5th June, 1972, environment was first discussed as an item of international agenda in the U.N. Conference on Human Environment in Stockholm and thereafter 5th June is celebrated all over the world as World Environment Day. Soon after the Stockholm Conference our country took substantive legislative steps for environmental protection. The Wildlife (Protection) Act was passed in 1972, followed by the Water (Prevention and Control of Pollution) Act 1974, the Forest (Conservation) Act, 1980, Air (Prevention and Control of Pollution) Act, 1981and subsequently the Environment (Protection) Act, 1986.

The provisions for environmental protection in the constitution were made within four years of Stockholm Conference, in 1976, through the 42nd amendment as follows:

Article 48-A of the constitution provides: *"The state shall endeavour to protect and improve the environment and to safeguard forests and wildlife of the country."*

Article 51A (g*)* provides: *"It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures."*

Thus, our constitution includes environmental protection and conservation as one of our fundamental duties.

14.4.1 Wildlife (Protection) Act, 1972

The act, a landmark in the history of wildlife legislation in our country, came into existence in 1972. Wildlife was transferred from

State to Concurrent list in 1976, thus giving power to the Central Govt. to enact the legislation.

The Indian Board of Wildlife (IBWL) was created in 1952 in our country, which after the enactment of the Wildlife (Protection) Act actively took up the task of setting up wildlife National Parks and sanctuaries. We have already discussed the major activities and provisions in the act in Unit 11 (Section 11.6).

14.4.2 Forest (Conservation) Act, 1980

This act deals with the conservation of forests and related aspects. Except J & K, the act is adopted all over India. The Act covers under it all types of forests including reserved forests, protected forests or any forested land irrespective of its ownership The salient features of the Act are as follows:

- The State Govt. has been empowered under this Act to use the forests only for forestry purposes. If at all it wants to use it in any other way, it has to take prior approval of central Government, after which it can pass orders for declaring some part of reserve forest for non-forest purposes (e.g mining) or for clearing some naturally growing trees and replacing them by economically important trees (reforestation).
- It makes provision for conservation of all types of forests and for this purpose there is an Advisory committee which recommends funding for it to the Central Government.
- Any illegal non-forest activity within a forest area can be immediately stopped under this Act.

  Non-forest activities include clearing of forest land for cultivation of any type of plants/crops or any other purpose (except re-afforestation). However, some construction work in the forest for wildlife on forest management is exempted from non-forest activity (e.g. fencing making water-holes, trench, pipelines, check posts, wireless communication etc.)

1992 Amendment in the Forest Act: Some of the amendments are:

- In 1992, some amendment was made in the Act which made provisions for allowing some non-forest activities in forests without cutting trees or limited cutting with prior approval of Central Govt. These activities are setting of transmission lines seismic surveys, exploration, drilling and hydroelectric projects. The last activity involves large scale destruction of forest, for which prior approval of the Centre is necessary.
- Wildlife sanctuaries, National Parks etc. are totally prohibited for any exploration or survey under this Act without prior approval of Central Govt. even if no tree-felling is involved.
- Cultivation of tea, coffee, spices, rubber and plants which are cash-crops, are included under non-forestry activity and not allowed in reserve forests.
- Even cultivation of fruit-bearing trees, oil-yielding plants or plants of medicinal value in forest area need to be first approved by the Central Govt. This is because newly introduced species in the forest area may cause an imbalance in the ecology of the forest. If the species to be planted is a native species, then no prior clearance is required.
- Tusser cultivation (a type of silk-yielding insect) in forest areas by the tribals as a means of their livelihood is treated as a forestry activity as long as it does not involve some specific host tree like Asan or Arjun. This is done in order to discourage monoculture practices in the forests which are otherwise rich in biodiversity.
- Plantation of mulberry for rearing silkworm is considered a non-forest activity. The reason is same as described above.
- Mining is a non-forestry activity and prior approval of Central Govt. is mandatory. The Supreme Court in a case T.N Godavarman Thirumulkpad vs. Union of India (1997) directed

all on-going mining activity to be ceased immediately in any forest area of India if it had not got prior approval of Central government.

- Ø Removal of stones, bajri, boulder etc from river-beds located within the forest area fall under non-forest activity.
- Ø Any proposal sent to central govt. for non-forest activity must have a cost-benefit analysis and Environmental Impact statement (EIS) of the proposed activity with reference to its ecological and socio-economic impacts.

Thus, it has been seen the Forests (Conservation) Act has made ample provisions for conservation and protection of forests and prevents deforestation.

14.4.3 Water (Prevention and Control of Pollution) Act, 1974

This Act provides for maintaining and restoring the wholesomeness of water by preventing and controlling its pollution. Pollution is defined as such contamination of water, or such alteration of the physical, chemical or biological properties of water, or such discharge as is likely to cause a nuisance or render the water harmful or injurious to public health and safety or harmful for any other use or to aquatic plants and other organisms or animal life. The definition of water pollution has thus encompassed the entire probable agents in water that may cause any harm or have a potential to harm any kind of life in any way.

The salient features and provisions of the Act are summed up as follows:

- Ø It provides for maintenance and restoration of quality of all types of surface and ground water.
- Ø It provides for the establishment of Central and State Boards for pollution control.
- Ø It confers them with powers and functions to control pollution. The Central and State Pollution Control Boards are widely represented and are given comprehensive powers to advise,

coordinate and provide technical assistance for prevention and control of pollution of water.

- The Act has provisions for funds, budgets, accounts and audit of the Central and State Pollution Control Boards.
- The Act makes provisions for various penalties for the defaulters and procedure for the same.

The main regulatory bodies are the Pollution Control Boards, which have been, conferred the following duties and powers:

Central Pollution Control Board (CPCB):

- It advises the central govt. in matters related to prevention and control of water pollution.
- Coordinates the activities of State Pollution Control Boards and provides them technical assistance and guidance.
- Organises training programs for prevention and control of pollution.
- Organises comprehensive programs on pollution related issues through mass media.
- Collects, compiles and publishes technical and statistical data related to pollution.
- Prepares manuals for treatment and disposal of sewage and trade effluents.
- Lays down standards for water quality parameters.
- Plans nation-wide programs for prevention, control or abatement of pollution.
- Establishes and recognises laboratories for analysis of water sewage or trade effluent sample.

State Pollution Control Boards: The State Pollution Control Boards also have similar functions to be executed at state level and are governed by the directions of CPCB.

- The Board advises the State Governments with respect to the location of any industry that might pollute a stream or a well.

- It lays down standards for effluents and is empowered to take samples from any stream, well or trade effluent or sewage passing through an industry.
- The State Board is empowered to take legal samples of trade effluent in accordance with the procedure laid down in the Act. The sample taken in the presence of the occupier or his agent is divided into two parts, sealed, signed by both parties and sent for analysis to some recognized lab. If the samples do not conform to the prescribed water quality standards (crossing maximum permissible limits), then 'consent' is refused to the unit.
- Every industry has to obtain consent from the Board (granted for a fixed duration) by applying on a prescribed Proforma providing all technical details, along with a prescribed fee following which analysis of the effluent is carried out.
- The Board suggests efficient methods for utilisation, treatment and disposal of trade effluents.

The Act has made detailed provisions regarding the power of the Boards to obtain information, take trade samples, restrict new outlets restrict expansion, enter and inspect the units and sanction or refuse consent to the industry after effluent analysis.

While development is necessary, it is all the more important to prevent pollution, which can jeopardise the lives of the people. Installation and proper functioning of effluent treatment plants (ETP) in all polluting industries is a must for checking pollution of water and land. Despite certain weaknesses in the Act, the Water Act has ample provisions for preventing and controlling water pollution through legal measures.



CHECK YOUR PROGRESS

Q 1: When is World Environment Day celebrated?

Q 2: Which Amendment of the Constitution of India makes the provision for Environmental Protection?

14.4.4 The Air (Prevention and Control of Pollution) Act, 1981

Salient features of the Act are as follows:

- The Act provides for prevention, control and abatement of air pollution. (ii) In the Act, *air pollution has been defined as the presence of any solid, liquid or gaseous substance (including noise) in the atmosphere in such concentration as may be or tend to be harmful to human beings or any other living creatures or plants or property or environment.*
- Noise pollution has been inserted as pollution in the Act in 1987.
- Pollution control boards at the central or state level have the regulatory authority to implement the Air Act. Just parallel to the functions related to Water (Prevention and Control of Pollution) Act the boards perform similar functions related to improvement of air quality. The boards have to check whether or not the industry strictly follows the norms or standards laid down by the Board under section 17, regarding the discharge of emission of any air pollutant. Based upon analysis report consent is granted or refused to the industry.
- Just like the Water Act, the Air Act has provisions for define constitution, powers and function of Pollution Control Boards, funds, accounts, audit, penalties and procedures.
- Section 20 of the Act has provision for ensuring emission standards from automobiles. Based upon it, the state govt. is empowered to issue instructions to the authority in charge of registration of motor vehicles (under Motor Vehicles Act, 1939) that is bound to comply with such instructions.
- As per Section 19, in consultation with the State Pollution Control Board, the state government may declare an area within the state as “air pollution control area” and can prohibit the use of any fuel other than approved fuel in the area causing air pollution.

No person shall, without prior consent of State Board operate or establish any industrial unit in the "air pollution control area."

The Water and Air Acts have also made special provisions for appeals. Under Section 28 of Water Act and Section 31 of Air Act, a provision for appeals has been made. An Appellate Authority consisting of a single person or three persons appointed by the Head of the State, Governor is constituted to hear such appeals as filed by some aggrieved party (industry) due to some order made by the State Board within 30 days of passing the order.

The Appellate Authority after giving the appellant and the State Board an opportunity of being heard disposes off the appeal as expeditiously as possible.

14.4.5 The Environment (Protection) Act, 1986

The Act came into force on Nov. 19, 1986, the birth anniversary of our Late Prime Minister Indira Gandhi, who was a pioneer of environmental protection issues in our country. The Act extends to whole of India.



LET US KNOW

Some terms related to environment have been described as follows in the Act:

Environment includes water, air and land and the inter-relationships that exist among and between them and human beings, all other living organisms and property.

Environmental pollution means the presence of any solid liquid or gaseous substance present in such concentration, as may be, or tend to be, injurious to environment.

Hazardous Substance means any substance or preparation which by its physio-chemical properties or handling is liable to cause harm to human beings, other living organisms, property or environment.

The Act has given powers to the Central Government to take measures to protect and improve environment while the state governments coordinate the actions. The most important functions of Central Govt. under this Act include setting up of:

- The standards of quality of air, water or soil for various areas and purposes.
- The maximum permissible limits of concentration of various environmental pollutants (including noise) for different areas.
- The procedures and safeguards for the handling of hazardous substances.
- The prohibition and restrictions on the handling of hazardous substances in different areas.
- The prohibition and restriction on the location of industries and to carry on process and operations in different areas.
- The procedures and safeguards for the prevention of accidents which may cause environmental pollution and providing for remedial measures for such accidents.

The power of entry and inspection, power to take sample etc. under this Act lies with the Central Government or any officer empowered by it.

For the purpose of protecting and improving the quality of the environment and preventing and abating pollution, standards have been specified under Schedule I-IV of Environment (Protection) Rules, 1986 for emission of gaseous pollutants and discharge of effluents/waste water from industries. These standards vary from industry to industry and also vary with the medium into which the effluent in discharged or the area of emission. For instance, the maximum permissible limits of B.O.D. (Biochemical Oxygen Demand) of the waste water is 30 ppm if it is discharged into inland waters, 350 ppm if discharged into a public sewer and 100 ppm, if discharged onto land or coastal region. Likewise, emission standards vary in residential, sensitive and industrial area. Naturally the standards for sensitive areas like hospitals are more stringent. It is

the duty of the Pollution Control Board to check whether the industries are following the prescribed norms or not.

Under the Environmental (Protection) Rules, 1986 the State Pollution Control Boards have to follow the guidelines provided under Schedule VI, some of which are as follows:

- They have to advise the Industries for treating the waste water and gases with the best available technology to achieve the prescribed standards.
- The industries have to be encouraged for recycling and reusing the wastes.
- They have to encourage the industries for recovery of biogas energy and reusable materials.
- While permitting the discharge of effluents and emissions into the environment, the State Boards have to take into account the assimilative capacity of the receiving water body.
- The Central and State Boards have to emphasize on the implementation of clean technologies by the industries in order to increase fuel efficiency and reduce the generation of environmental pollutants.

Under the Environment (Protection) Rules, 1986, an amendment was made in 1994 for Environmental Impact Assessment (EIA) of Various Development Projects. There are 29 types of projects listed under Schedule I of the rule which require clearance from the Central Government before establishing.

Others require clearance from the State Pollution Control Board when the proposed project or expansion activity is going to cause pollution load exceeding the existing levels. The project proponent has to provide ELA report, risk analysis report, NOC from State Pollution Control Board, Commitment regarding availability of water and electricity, Summary of project report/feasibility report, filled in a questionnaire for environmental appraisal of the project and comprehensive rehabilitation plan, if more than 1000 people are likely to be displaced due to the project.

Under the Environment (Protection) Act, 1986 the Central Government also made the Hazardous Wastes (Management and Handling) Rules, 1989. Under these rules, it is the responsibility of the occupier to take all practical steps to ensure that such wastes are properly handed and disposed of without any adverse effects. There are 18 hazardous waste categories recognized under this rule and there are guidelines for their proper handling, storage, treatment, transport and disposal which should be strictly followed by the owner.

The Environment (Protection) Act, 1986 has also made provision for environmental Audit as a means of checking whether or not a company is complying with the environmental laws and regulation. Thus, ample provisions have been made in our country through law improving the quality of our environment.

14.5 ENVIRONMENTAL IMPACT MANAGEMENT

Environmental Impact Management (EIM) (also called as Environmental Impact Assessment (EIA) is defined as an activity designed to identify the impact on the bio geophysical environment, on man and well-being of legislative proposals, projects, policies, operational procedures and to interpret and communicate information.

The environmental impact assessment in India was started in 1976-77, when the Planning Commis-sion asked the Department of Science and Tech-nology to examine the river valley projects from environmental angle. This was subsequently ex-tended to cover those projects, which required ap-proval of the Public Investment Board.

Then the Govt. of India enacted the Environment (Protec-tion) Act on 23rd May 1986 to achieve the objec-tive the decision that were taken is to make envi-ronmental impact assessment statutory. After fol-lowing the legal procedure, a notification was is-sued on 27th Jan 94. 10thApril, 1997 and 27th Jan 2000 making environmental impact as-sessment statutory for 30 development projects (Schedule I), the mandatory EIA clearance proce-dure started.

EIA is a systematic process of identifying future consequences of a current or proposed action.

14.5.1 Objectives of EIM

The objectives of EIA are

- to identify, predict and evaluate the economic, environmental and social impact of development activities
- to provide information on the environmental consequences for decision making and
- to promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures.

EIA is widely accepted as a tool to ensure sustained development with minimum environmental degradation.

14.5.2 The EIM Cycle and Procedures

The EIA process in India is made up of the fol-lowing phases:

- Screening.
- Scoping and consideration of alternatives.
- Baseline data collection.
- Impact prediction.
- Assessment of alternatives, delineation of mitigation measures and environmental im-pact statement.
- Public hearing.
- Environment Management Plan.
- Decision making.
- Monitoring the clearance conditions.

Now, let us briefly discuss each of the processes.

- *Screening:* Screening is done to see whether a project requires environmental clearance as per the statutory noti-fications. The screening Criteria are based upon the factors like (a) Scales of investment, (b) type of development and (c) (iii) location of development.

A Project requires statutory environmental clearance only if the provisions of EIA notifica-tion and/or one or more statutory notification is mentioned.

- *Scoping: Scoping is a process of detailing the terms of ref-erence of EIA. It has to be done by the consult-ant in consultation with the project proponent and guidance, if need be, from Impact Assessment Agency. The Ministry of Environment and Forests has published guidelines for different sectors, which outline the significant issues to be ad-dressed in the EIA studies Quantifiable impacts are to be assessed on the basis of magnitude, prevalence, frequency and duration and non-quantifiable impacts (such as aesthetic or recre-ational value), significance is commonly deter-mined through the socio-economic criteria.*

After the areas, where the project could have sig-nificant impact, are identified, the baseline status of these should be monitored and then the likely changes in these on account of the construction and operation of the proposed project should be predicted. Recent years, scoping was determined by "Term of reference" clearance by MOEF.

- *Baseline Data:* Baseline data describes the existing environmen-tal status of the identified study area. The site-specific primary data should be monitored for the identified parameters and supplemented by sec-ondary data if available.
- *Impact Prediction:* Impact prediction is a way of 'mapping' the en-vironmental consequences of the significant as-pects of the project and its alternatives. Envi-ronmental impact can never be predicted with absolute certainty and this is all the more reason to consider all possible factors and take all pos-sible precautions for reducing the degree of un-certainty.

The Following Impacts of the Project should be assessed:

- *Air:* Changes in ambient levels and ground level con-centrations due to total emissions from point, line and

area sources effects on soils, materials, veg-etation, and human health.

- **m** *Noise:* Changes in ambient levels due to noise generated from equipment and movement of vehicles effect fauna and human health.
- **m** *Water:* Changes in water are evaluated particularly with respect to: (a) Availability to competing users, (b) Changes in quality, (c) Sediment transport, (d) Ingress of saline water
- **m** *Land:* Changes in land are evaluated particularly with respect to: (a) changes in land use and drainage pattern, (b) changes in land quality including, (c) effects of waste disposal and (d) changes in shoreline/river-bank and their sta-bility-
- **m** *Biological:* Changes in biological elements are evaluated particularly with respect to: (a) deforestation/tree-cutting and shrinkage of animal habitat, (b) impact on fauna and flora (including aquatic species if any) due to contaminants/ pollut-ants, (c) impact on rare and endangered species, en-demic species, and migratory path/route of animals and (d) impact on breeding and nesting grounds
- **m** *Socio-Economic:* Changes in socio-economic conditions are evaluated particularly with respect to: (a) impact on the local community including de-mographic changes, (b) impact on economic status, (c) impact on human health and (d) impact of increased traffic.

- **Ø** *Assessment of Alternatives, Delineation of Mitigation Measure and Environmental Impact Statement:* For every project, possible alternatives should be identified and environmental attributes compared. Alternatives should cover both project location and process technologies. Alternatives mould considers 'no project' option also. Alternatives should then be ranked for selection of the best environmental option for optimum economic benefits to the com-munity at large.

Once alternatives have been reviewed, a miti-gation plan should be drawn up for the selected option and is supplemented with an Environmen-tal Management Plan (EMP) to guide the propo-nent towards environmental improvements. The EMP is a crucial input to monitoring the clear-ance conditions and therefore details of monitor-ing should be included in the EMP.

An EIA report should provide clear informa-tion to the decision-maker on the different envi-ronmental scenarios without the project, with the project and with project alternatives. Uncertain-ties should be clearly reflected in the EIA report.

- *Public Hearing:* Law requires that the public must be informed and consulted on a proposed development after the completion of EIA report. Any one likely to be affected by the proposed project is entitled to have access to the Executive Summary of the EIA.

  Here, the affected persons may include (a) bona fide local residents, (b) local associations,(c) environmental groups: active in the area, and (d) any other person located at the project site/ sites of displacement

  They are to be given an opportunity to make oral/written suggestions to the State Pollution Control Board as per Schedule IV of Annex I.
- *Environment Management Plan:* It is related to the plan prepared for the management of the environmental impact.
- *Decision Making:* Decision making process involve consultation be-tween the project proponent (assisted by a con-sultant) and the impact assessment authority (as-sisted by an expert group if necessary). The deci-sion on environmental clearance is arrived at through a number of steps including evaluation of EIA and EMP.
- *Monitoring the Clearance Conditions:* Monitoring should be done during both construc-tion and operation phases of a project. This is not only to ensure that the commitments made are compiled

with but also to observe where the pre-dictions made in the EIA reports were correct or not.

Where the impacts exceed the predicted lev-els, corrective action should be taken. Monitoring will enable the regulatory agency to review the validity of predictions and the conditions of imple-mentation of the Environmental Management Plan (EMP).



CHECK YOUR PROGRESS

Q 3: Name India's First Wildlife Legislation?

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Q 4: When was Environment Impact Assessment started in India?

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14.6 LET US SUM UP

- Since about the late 1980s, the Supreme Court of India has been pro-actively engaged in India's environmental issues.
- India is the first country in the world to have made provisions for protection and conservation of environment in its constitution. On 5th June, 1972, environment was first discussed as an item of international agenda in the U.N. Conference on Human Environment in Stockholm and thereafter 5th June is celebrated all over the world as World Environment Day.
- The provisions for environmental protection in the constitution were made within four years of Stockholm Conference, in 1976.
- The Wildlife (Protection) Act, a landmark in the history of wildlife legislation in our country, came into existence in 1972. Wildlife was transferred from State to concurrent list in 1976, thus giving power to the Central Govt. to enact the legislation.
- Forest (Conservation) Act, 1980 deals with the conservation of forests and related aspects. Except J & K, the act is adopted all over India. The

Act covers under it all types of forests including reserved forests, protected forests or any forested land irrespective of its ownership.

- Water (Prevention and Control of Pollution) Act, 1974 provides for maintaining and restoring the wholesomeness of water by preventing and controlling its pollution.
- The Environment (Protection) Act, 1986 came into force on Nov. 19, 1986, the birth anniversary of our Late Prime Minister Indira Gandhi, who was a pioneer of environmental protection issues in our country. The Act extends to whole of India.
- Environmental Impact Assessment is defined as an activity designed to identify the impact on the bio geophysical environment, on man and well-being of legislative proposals, projects, policies, operational procedures and to interpret and communicate information.

14.7 FURTHER READING

(1) Bharucha, E. (2005). *Environmental Studies for Undergraduate Courses.* New Delhi: Universities Press

(2) Bhattacharya, R. N. (2001). *Environmental Economics: An Indian Perspective*. New Delhi: Oxford University Press

(3) Purkayastha, G. (2006). *Environmental Economics: Theory, Problems and Solutions*. New Delhi: Kalyani Publishers

(4) Singh, R. P. & Islam, Z. (2012). *Environmental Studies.* New Delhi: Concept Publishing Compay (P) Ltd

14.8 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q 1: 5th June

Ans to Q 2: 42nd Amendment

Ans to Q 3: Wildlife (Protection) Act, 1972

Ans to Q 4: 1976-77

14.9 MODEL QUESTIONS

Answer the following questions in about 300-500 words.

Q 1: What are the constitutional provision in India for protection and preservation of Environment?

Q 2: Write about the Wildlife (Protection) Act, 1972 of India?

Q 3: What are the major issues of Environment Legislation?

Q 4: Explain Environment Impact Assessment with example?

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UNIT 15: COMMUNITY AND ENVIRONMENT

UNIT STRUCTURE

15.1 Learning Objectives

15.2 Introduction

15.3 Women and Environment

15.3.1 International Agreements

15.4 What is Environmental Movement?

15.5 Chipko Movement

15.6 Narmada Bachao Andolan

15.7 Let Us Sum Up

15.8 Further Reading

15.9 Answers to Check Your Progress

15.10 Model Questions

15.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- describe the inter-relationship between community and environment
- narrate the major environmental movements that took place in India
- explain the relationship between women and environment
- describe the consequences of the environmental movements in India.

15.2 INTRODUCTION

Community is important as it helps society to provide security, protection and cooperation. Communities are part of everyday life and have positive effects on its members. Community participation is important for environmental protection and sustainability too. Principle 10 of the Rio Declaration asserts that 'environmental issues are best handled with the participation of all concerned citizens'. This principle is seen in action around the world with the recognition that indigenous communities are more effective than the state at protecting their local environment. For environmental

protection and conservation various community movements took place around the world.

In this unit, we will be concentrating on the relationship between women and environment, concepts of environmental movements and some of the important environmental movements that took place in India.

15.3 WOMEN AND ENVIRONMENT

Women play a significant role in managing natural resources at family and community levels. Women are predominantly responsible for management and conservation of resources for their families around the world. Women are engaged most of the time collecting and storing water, finding sources of fuel, food, fodder etc. According to the World Bank in 1991, "Women play an essential role in the management of natural resources, including soil, water, forests and energy and often have a profound traditional and contemporary knowledge of the natural world around them". Despite of these responsibilities, women still have less access to land, water and other productive natural resources due to gender-discriminatory social and cultural norms. Biased inheritance laws and customs often prohibit or limit women's direct control over these natural resources. According to the Food and Agriculture Organization, women produce between 60 and 80 percent of food in developing countries, yet they officially own only 2 per cent of land.

Women and men use natural resources differently, therefore, environmental conditions have different impacts on them. Women are most affected by environmental degradation. Studies have shown that natural catastrophe disproportionately hit women, especially where gender inequality persist more. These inequalities not only increase the effects of environmental degradation on women, but also limit the equal participation, voice, and decision-making of women in environmental negotiations, policies, and projects.

To come up with meaningful solutions to above mentioned challenges, governments, national organisations and international institutions have now given more attention to use gender-responsive approaches

ensuring the reflection of both women's and men's voices in environmental policies and projects related to conservation of environment and natural resources. These include improvement of resource productivity, enhancement of ecosystem management, creation of more sustainable energy, water, and food systems. This concern has been brought into the mainstream through various international agreements.

15.3.1 International Agreements

The importance of the relationship between women and environment has been focused in various international agreements. The Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW, formed in 1979), addresses a host of environmental issues. Similarly, the Beijing Platform for Action, an outcome of the Fourth World Conference on Women (1995), includes an entire chapter on women and the environment. Major sustainable development treaties have acknowledged the specific need of women's participation and mainstreamed gender perspective. The 1992 United Nations Earth Summit (UNCED) produced two key conventions which acted as a guide for realisation of environmental actions from a gender perspective. One was on biological diversity and another one was on combating desertification.



LET US KNOW

The Rio Declaration on Environment and Development, often shortened to Rio Declaration, was a short document produced at the 1992 United Nations "Conference on Environment and Development" (UNCED), informally known as the Earth Summit. The Rio Declaration consisted of 27 principles intended to guide countries in future sustainable development. It was signed by over 170 countries. It consists of 27 principles.

In 2001, the United Nations Framework Convention on Climate Change (UNFCCC) enhanced the participation of women at all levels of decision-making process related to climate change. Attention to gender perspectives and recognition of the relevance of gender equality and women's empowerment in climate change discussions have grown since the adoption of the Cancun Agreements which called for gender-sensitive adaptation actions. The UNFCCC was adopted at the Rio Earth Summit in 1992, with the ultimate aim to prevent dangerous human interference with the climate system.

The UN Women and Global Environment Facility (GEF) are trying to reduce the gender gaps in areas such as control over natural resources, access to benefits and services, and participation and decision-making. These actions will not only contribute to greater gender equality, but also unlock women's potential as key factor of change.

In these international agreements, women's equal participants in all decisions related to their environment, has come up as the pivotal aspect which need to be incorporated in all future actions. Demonstrating great capacity as educators, experts, leaders and innovators, women and women's movements have made great strides in preserving and protecting the resources around them. Women took the lead in the grass-roots Chipko Movement of India in the 1970s, where activists stopped the felling of trees by physically surrounding and hugging the trees. They also protected water sources from corporate control. Women around the world continue the fight against climate change, making sustainable consumption choices, improving access to and control over resources. They are also in the process of conservation of natural resources.

From the high level to the grassroots, the 1992 UN Earth Summit or India's Chipko Movement all highlighted the role of women's voices and perspectives in sustainable development.

15.4 WHAT IS ENVIRONMENTAL MOVEMENT?

Environmental movement is a social movement that involves an array of individuals, groups and coalitions that perceive a common interest in environmental protection and act to bring about changes in environmental policies and practices.

The origin of the environmental movement lay in the response to increasing levels of smoke pollution in the atmosphere during the Industrial Revolution. The emergence of great factories and the concomitant immense growth in coal consumption gave rise to an unprecedented level of air pollution in industrial centers; after 1900 the large volume of industrial chemical discharges added to the growing load of untreated human waste. The environmental movement began to take shape in North America when John Muir, one of the earliest environmentalists, convinced the U.S. congress to create the Yosemite National Park to preserve the beautiful valley. Many other conservation efforts began to take place across the continent with people trying to protect the dwindling American bison population. In 1916, then President of U.S., Woodrow Wilson founded the National Park Service, which deeply supported the growing environmental movement. The environmental movement only continued to grow in the 1950s, 60s, and 70s with many influential books being published. Among these the '*Silent Spring'* (1962) was one. *Silent Spring* was written by American biologist Rachel Carson. It was especially influential as it exposed the harmful and dangerous effects of the pesticide DDT. The book was so important for the environmental movement that it leads to the creation of the Environmental Protection Agency in 1970 and DDT was banned in 1972. The 1970s were greatly important for the green movement with many groups. The first Earth Day and the UN's first environmental conference also happened in the 70s. Into the 1980s, a growing awareness on global warming brought the environmental movement even more into the mainstream.

The origin of the environmental based movement in India can be traced back to the early twentieth century when people protested against

the commercialisation of forest resources during the British colonial period. In India, the first environmental movement was believed to be started by Bishnoi community. Bishnoi is a religious sect found in the Western Thar Desert and northern states of India. This religious sect was founded by Guru Maharaj Jambaji in 1485 AD in the Marwar (Jodhpur) desert region. Jambaji recognised the importance of trees and banned cutting down of trees. This community carries the ideology of Jambaji, therefore worship nature. The Bishnoi movement was led by Amrita Devi in 1731. The movement erupted as a protest against the native king Ajit Singh of Jodhpur who ordered to take away the trees from the forest region near the village of Khejarli, where Bishnoi villagers fostered an abundance of khejri (acacia) trees, for construction of a palace. Around 363 villagers sacrificed their lives to protect the forest by clinging to them. Later, the king apologised for the incident and declared the region as protected area.

However, it was from 1970, environmental movement started in large numbers in India. Some of the movements have widened their focus from basic survival needs to ecological concerns. In modern India, two prominent environmental movements are namely, Chipko Movement and the Narmada Bachao Andolan. A brief description of both is given below.



CHECK YOUR PROGRESS

1. Fill in the blanks

a) The Earth summit was held in ……

b) Rio Declaration consists of…… Principles.

2. When did CEDAW form?

3. Define Environmental Movement (in 50 words)

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15.5 CHIPKO MOVEMENT

Destruction of livelihood of poor through exploitation of natural resources by the rulers or the dominant class, faulty developmental policies of the government which threat the basic survival needs of the poor, damage to environment are some of the vital reasons of the emergence of environmental movements in India. Several forest based environmental movements have been recorded in the post-independent India. Chipko is one major movement among such protest movements. This movement is based upon the implications of state management of forest resource on the peoples' livelihood opportunities and the issue of exploitation of the local communities by dominant section of the society. Details of the Chipko movement will follow in the next section.

The Chipko movement originated in Uttarakhand region of India. It is a mountainous region with noticeably high mountains ranging from 1000 ft. to 25000 ft. above the mean sea level. Himalayas had rich forests, which had long been central to the livelihood strategies of the mountain people. Terrace agriculture and animal husbandry constituted the dominant economic activity of the people. The forests provided essential inputs like leaf manure for farming, grazing and fodder for cattle, and fuel and foodstuff for household consumption; thereby meeting the basic subsistence needs of the local public.

The Chipko movement began to protect the Himalayan forests from destruction. Many protests were organised against the colonial forest policy during the early decades of the twentieth century. The forest policy of both colonial and independent India was adverse to the livelihood opportunities of the people. Even with the collapse of the colonial structure the policy, the pattern of resource use by the state continued along the colonial lines. The design of the 1952 Forest Policy followed the outlines of the Forest Policy of 1894, thereby reinforcing the state's right to exclusive control over forest resources and their management. The Forest Department resorted to the monoculture plantation of Chir Pine at the cost of far more productive trees for local agro-forestry. The commercial exploitation of forest by outside

entrepreneurs with government approval resulted in indiscriminate felling of trees with devastating ecological consequences. The main demand of the local people in these protests was to entitle the benefits of the forests, especially the right to fodder, to local people.

Studies show that in early 1973, the forest department allotted ash trees to a private company. This incident provoked the Dasholi Gram Swarajya Sangha (DGSS) a local cooperative organisation to fight against this injustice through lying down in front of timber trucks and burning resin and timber depots as was done in the quit India movement. As leaders of the movement were the ardent follower of Gandhian thought of non-violence, they did not support of earlier act of protest. It is reported that the strategy of 'embracing' the trees in the forest to prevent tree from being felled by the contractors was thought of by Chandi Prasad Bhatt, one of the leaders, in a meeting in the Mandai on April 1st 1973. The name of the Movement, that is, 'Chipko' comes from the word 'embrace' in Hindi. With its success, the movement was spread to other neighboring areas and popularly known as Chipko movement.

The contribution of Sunderlal Bahuguna, another prominent leader of Chipko movement, is also significant. He brought the movement to prominence through a trans-Himalayan march of about 5000 km during 1981-83 to gather support from the villagers. The march ended with a meeting with then Prime Minister Indira Gandhi who later passed legislation to protect some areas of the Himalayan forest. Bahuguna coined the Chipko's slogan "Ecology is permanent economy." Chipko Movement is largely influenced by the above mentioned Bishnoi Movement.



CHECK YOUR PROGRESS

4. Fill in the blanks

a) The Chipko movement originated in the …… region.

b) The Chipko comes from the word '……' In Hindi.

5. How does the Chipko movement depict the Gandhian ideology of non-violence? (in 50 words)

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15.6 NARMADA BACHAO ANDOLAN

The Narmada Basin covers an area of approximately 94, 500 square kilometers between the Vindhya and the Satpura ranges in Central India. It is the site of the Narmada Valley Development Project (NVDP), an ambitious project that seeks to harness the river Narmada that flows through the three states of Madhya Pradesh, Maharastra and Gujarat, which envisages that thirty big dams; one hundred and thirty-five medium dams, and three thousand small dams will be constructed on the Narmada river and its forty-one tributaries. However, the Narmada basin has such characteristic that has led the people to oppose the project envisaged by the state. This is because between gorges flanked by densely forested basaltic hills, the 1312 kilometers long Narmada Valley contains large alluvial plains in Madhya Pradesh. To the West, the Narmada River meanders through Gujarat widening into a 25-kilometer long estuary as it flows into the Gulf of Cambay. More than 22 million people live in the valley and several tribal groups, particularly Bhils and Gonds occupy the forested uplands. The project is estimated to affect over 2.5 lakh of people. The Sardar Sarovar Project (SSP) and the Narmada Sagar Project (NSP) are the two biggest dams to be constructed in the Narmada River, and the SSP alone will submerge 245 villages: 19 in Gujarat, 33 in Maharastra, and 193 in Madhya Pradesh. Thus these two projects have remained controversial owing to their large-scale displacement and problems of humane rehabilitation. This has resulted in the emergence of a protest movement unique of its kind called the ‘Narmada Bachao Andolan’.

The movement has drawn upon a multiplicity of discourses for protests such as displacement risks and resettlement provisions; environmental impact and sustainability issues; financial implications of the project; forceful evictions and violations of civil liberties; issues pertaining to river valley planning and management; implications of western growth model, and alternative development and appropriate 'technology, among many others. The movement uses various tools of protest such as Satyagraha (political action based on truth and non-violence as coined by Gandhi), Jal Samarpan (sacrificial drowning in the rivers), Rasta Roko (road blockade at strategic points), Gaon Bandhi (refusing the entry of government officials in to the villages), demonstrations and rallies, hunger strikes and blockade of projects.

The Narmada Bachao Andolan has successfully brought to public domain the hitherto closed and protected discourse on mega development projects, thereby opening new vistas for environmental movements. The protest also has pointed out the necessity to address the shortcomings in institutional frameworks governing big developmental projects.

In the environmental realm, the Narmada Bachao Andolan is involved in a struggle to protect local ecological resources like forests and rivers. In the economic realm, it articulates a conflict over access to productive natural resources like forests, land and water that are under threat of exploitation by the three riparian states and the transnational corporations. In the cultural front, it articulates to protect the identities and solidarities of the communities affected by the project which are grounded around issues of kinship, neighbourhood and the everyday social interactions. Hence, the movement involves interplay of various socio-political, economic and environmental variables at different levels. This movement provides a challenging and a unique opportunity for a social scientist to comprehend its dynamic and transformative character and its consequent implications to public policy and the society.



15.7 LET US SUM UP

- Communities can be involved in natural resources management to conserve and preserve the nature. Community afforestation should be encouraged through participation of the local people in the efficient management of forest.
- As women are mostly involved in the process of conservation of nature, women's participation in every stage of decision making process of resources conservation should be ensured.
- These movements allowed the village communities to utilise the forest produce and restore the use of traditional conservation methods widely.
- These movements successfully resisted deforestation.
- These movements forced government to rethink the priorities of the local people in the use of forest produce.



15.8 FURTHER READING

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(2) Naik, I.C. (2016). *Environmental Movements, State and Civil Society.* New Delhi: Rawat Publication.



15.9 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q no 1: a) 1992 b) 27

Ans to Q no 2: In 1979

Ans to Q no 3: Environmental movement is a type of "social movement that involves an array of individuals, groups and coalitions that perceive a common interest in environmental protection and act to bring about changes in environmental policies and practices.

Ans to Q no 4: a) Uttarakhand b) Embrace

Ans to Q no 5: The strategy of embracing trees is said to have been agreed to after a deliberation which had to decide a method of resisting the axe-men from the felling of trees in the forests keeping in consonance with the Gandhian ideology of non-violence as the entire programme

was being espoused by the Savodaya workers. Thus the name 'Chipko' was derived from the consensual strategy of clinging on to the trees as a non-violent direct action.

15.10 MODEL QUESTIONS

Short Questions (Answer each question in about 150 words)

Q 1: Describe the role and importance of women in conservation of natural resources.

Q 2: How do communities play an important role in preserving and conserving nature?

Q 3: What do you understand by the term environmental movement?

Q 4: Describe the overall consequences of the Chipko and the Narmada Bachao Movement in India.

Essay Type Question (Answer each question in about 300-500 words)

Q 1: Explain the Chipko Movement.

Q 2: Explain the Narmada Bachao Movement.

Q 3: Write a small history of environmental movements in the World and in India.



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Learner's Feedback on Course

Dear Learner,

Regarding the course as mentioned above, we would like to know your opinions and comments so as to improve the quality of self learning materials in future. Please respond to the following statements by ticking the number you feel most reflect your opinion. After completion of the additional comments, please detach the page and send/mail the same to us at the address given below.

The Director, Centre for Internal Quality Assurance, KKHandiqui State Open University
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(E-mail id: ciqa@kkhsou.in)

1. Approximately how many hours did you spend for studying the units in the course? | | | |
2. Please give your opinions (by √ mark) to the following items based on your reading of the block:

Sl. No.	Statements	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I.	The SLMs of the course fulfil the learning objectives set out in the beginning of each unit					
II.	The units of the SLM could satisfy my academic needs and expectations					
III.	The Unit writers have excellent knowledge about the course contents					
IV.	Language and contents of the units were presented at a level which I could readily understand					
V.	Ample opportunity for participation in the activities provided in the units					
VI.	Used enough Illustrations (Diagrams, tables etc.) for conceptual clarity					
VII.	Quality of content is engaging, relevant, and up-to-date					
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IX.	The Possible/model questions and the answers to check my progress have benefited me a lot					

Additional Comments: *(Please feel free to provide your open comments)*

1. Which aspects of the SLM, according to you, worked well?

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2. What sort of changes/improvements do you feel KKHSOU could implement to improve the overall quality of the SLM?

Thank you for taking the time to complete this form.

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