Module I

1

GROWTH AND ENVIRONMENT

Unit Structure

1.0 OBJECTIVES

The major objectives of the present unit are as follows:

- To understand the complexity of the interaction of economy and environment;
- To understand the arguments of Limits to Growth;
- To learn about the emergence of the idea of sustainable development.

1.1 INTRODUCTION

Economics growth and environment are so deeply connected to each other that goal of sustainable development tends to be incomplete if environment friendly approach of growth is not followed. The objective of this unit is to impart the knowledge about the importance of environments to the economy and to understand the relationship between environment and development. The rapid economic growth over the last decades coupled with population growth has put huge pressure on environment. As a result, there has been significant degradation of the environment throughout the world. Hence, the need for promoting sustainable development has assumed greater importance. The present unit discusses link between economic growth and environment, how economic activity depends upon and affects the natural environment. It considers the argument that the environment sets limits to economic growth and learn about the emergence of the idea of sustainable development.

1.2 ECONOMIC GROWTH AND ENVIRONMENT

The present unit is classified into following segments:

Environment and economy are closely interlinked. Environment provides raw materials and other resources to the economy. The economy transforms those raw materials derived from the nature into consumable goods. However, along with production of goods, the producers also generate wastes and pollutants which are ultimately disposed into the environment. The environment also acts as a sink of wastes pollutants. But it has a limited capacity of waste assimilation as there are some wastes or pollutants which cannot be degraded easily and that tends to affect economic growth in future.

Economic growth and Environment both are connected to each other and therefore influence each other. Natural resources are vital for securing economic growth and development, not only for present but for future generations too.

The environment plays an important role in supporting economic activity. It contributes:

- Directly, by providing resources and raw materials such as water, timber and minerals that are required as inputs for the production of goods and services;
- Indirectly, through services provided by ecosystems including carbon sequestration, water purification, managing flood risks, and nutrient cycling.

But economic growth has pressurized the environment at national and international level over the time. The relationship between ecology and the economy has become significant as humans gradually understand the impact of economic decisions are quite visible on the sustainability and quality of the planet.

The World Bank estimated that, under present productivity trends and given projected population, the output of developing countries would be about five times higher by the year 2030 than it is today. The output of industrial countries would rise more slowly, but it would still triple over the same period. If environmental pollution were to rise at the same pace, environmental adversities would occur. Millions of people would become sick or die from environmental causes, and the planet would be significantly and irreparably harmed.

The conflict between economic growth and the environment is a complex issue and sharper today than ever before. Indeed, the relationship between economic growth and the sustainability of ecosystems has been extensively discussed in the literature, but the results remain controversial.

While economic growth has produced many benefits – raising standards of living and improving quality of life across the world – it has also resulted

in the depletion of natural resources and the degradation of ecosystems. There has been much debate over whether or not it is possible to achieve economic growth without unsustainably degrading the environment, and a growing realisation that economic growth at the current rate of depletion and degradation of environmental assets cannot continue indefinitely.

Environment supports Economic growth:

Natural environment affects economic activities in number of ways. The OECD defines natural capital as "natural assets in their role of providing natural resource inputs and environmental services for economic production". This ranges from clean air and water, to the soils we use to grow crops and the minerals and ores we extract from the earth.

Natural capital contributes to economic output through two main channels:

- Directly as an input to the process of economic activity; and
- Indirectly through its effect on the productivity of the other factors of production.

➢ **Natural capital as a direct input to wealth creation:**

The natural environment provides the raw materials and resources for economic production of goods and services. These resources are classified into Non-renewable and renewable resources.

Non-renewable resources are those with a finite endowment, which can be depleted over time. Non-renewable resources like fossil fuels, minerals, metals, and basic aggregates are extracted from the natural environment to produce energy, machinery, consumer products, the built environment, and much else; in 2007, UK economic activity resulted in the extraction of over 450 million tonnes of fossil fuels and minerals within the UK.

Renewable resources are those which are capable of being replenished through natural processes or their own reproduction. However, these resources can be exhausted if they are consumed at a rate faster than the rate of replenishment. Renewable resource, such as forests and fisheries, contribute directly to economic activity and Country's GDP.

➢ **Natural capital as an indirect input to wealth creation:**

Apart from direct effects of environment, indirect inputs from the environment also affect the economic processes to a great extent. The indirect inputs provided by ecosystems facilitate the processes of production and act as a sink for the adverse environmental effects of economic activity. They include:

Global life support functions – Natural areas provide global life support functions, including climate regulation and regulation of the chemical composition of the atmosphere and oceans. While natural areas play a role in the maintenance of life-essential services, it is difficult to evaluate and demonstrate the contribution that particular habitat types or areas make.

However, one area where the contribution of particular habitats is being recognised and evaluated more explicitly is with regard to the ability of forests to act as a store for carbon.

Water regulation – Natural areas can buffer hydrological flows and dampen environmental fluctuations, provide flood and storm protection, and prevent run-off damage. Natural processes can also provide water quality benefits; for example, by preventing sediment run-off into rivers.

Pollution filtering – Natural resources play an important role in pollution control and detoxification, including the removal of nutrients and pollutants from water, filtering of dust from the air, and providing noise reduction.

Waste sink– This is the capacity of the environment to assimilate the waste products of production and consumption and convert them into harmless or ecologically useful products. The physical capacity of the land, water and the atmosphere to absorb wastes is determined by physical factors such as the climate, rainfall, wind patterns, and geographical location. The natural environment provides a repository for all non-recycled waste produced by economic activity. In the absorptive capacity of the atmosphere, the oceans, and the soil, the natural environment is able to assimilate some of that waste without diminishing the provision of its other services.

Soil retention and provision – The natural environment, such as many wetland habitats, provide benefits by preventing soil loss and by storing silt.

Nutrient cycling – Ecological processes provide benefits through the storage, processing, and acquisition of nutrients essential for plant growth.

Waste decomposition – Naturally occurring micro-organisms provide benefits through their ability to break down organic matter and speed up the process of waste decomposition.

Economic growth impacts environment:

Economic activities and economic growth have grater impact on environment across the world. Society has become very much aware of the environmental impact of agriculture/industry over the last few decades because of increasing negative consequences of certain economic practices. Examples of the negative consequences of agriculture include water pollution (both surface and groundwater), soil erosion and soil compaction, the loss of wetlands because of drainage, and the loss of biodiversity because of land clearance for more agriculture as well as the adoption of new technologies. Air pollution, water pollution, noise pollution are negative consequences of industrial growth which cannot be overlooked.

At the same time the demand for a clean and healthy natural environment provides opportunities for employment and wealth creation; for example,

organic agriculture and industries responsible for managing and protecting natural resources. Other industries aim to reduce the environmental impacts of economic activity; for example, through generating renewable energy, through waste management techniques, and through products and technologies that reduce air and noise pollution from production processes. Yet others aim to mitigate adverse environmental impacts and restore natural assets to their previous condition, such as water treatment services and land remediation.

Thus, the link between the economy and the environment are manifold: the environment provides resources to the economy, and acts as a sink for emissions and waste. Natural resources are essential inputs for production in many sectors, while production and consumption also lead to pollution and other pressures on the environment. Poor environmental quality in turn affects economic growth and wellbeing by lowering the quantity and quality of resources or due to health impacts, etc. In this context, environmental policies can curb the negative feedbacks from the economy on the environment (and vice-versa). But how effective they are and whether they generate a net benefit or a net cost to society is the subject of much debate and depends on the way they are designed and implemented.

1.3 ENVIRONMENT AS AN ECONOMIC AND SOCIAL GOOD/ASSET:

Environment is considered as Economic and social good as it plays an important role in economic growth and social well-being of a nation. The natural environment plays a key role in our economy, as a direct input into production and through the many services it provides. Environmental resources such as minerals and fossil fuels directly facilitate the production of goods and services. The environment provides other services that enable economic activity, such as sequestering carbon, filtering air and water pollution, protecting against flood risk, and soil formation. It is also vital for our wellbeing, providing us with recreational opportunities, improving our health, and much more.

Environmental resources, it may be materials, services or information all are valuable for society and economy. Food from plants and animals, wood for cooking, heating, and building, metals, coal, and oil are all environmental resources. Clean land, air, and water are environmental resources, as are the abilities of land, air, and water to absorb society's waste products. Heat from thesun, transportation and recreation in lakes, rivers, and oceans, a beautiful view, or the discovery of a new species are all environmental resources. The environment provides a vast array of materials and services that people use to live. Often these resources have competing uses and values. A piece of land, for instance, could be used as a farm, a park, a parking lot, or a housing development. It could be mined or used as a garbage dump. Some resources are renewable, or infinite, and some are non-renewable, or finite. Renewable resources like energy from the sun are plentiful and will be available for a long time. Finite resources, like oil and coal, are non-renewable because once they are extracted from

the earth and burned, they cannot be used again. These resources are in limited supply and need to be used carefully. Many resources are becoming more and more limited, especially as population and industrial growth place increasing pressure on the environment.

1.4 LIMITS TO GROWTH

There are several theories describing the relationship between economic growth and environmental quality. The Limits to growth theory are one of them. The limits to growth theory consider the possibility of breaching environmental thresholds before the economy reaches the EKC (Environmental Kuznets Curve) turning point.

The limits theory defines the economy-environment relationship in terms of environmental damage hitting a threshold beyond which production is so badly affected that the economy shrinks.

An important event in the emergence in the last decades of the perception that there is a sustainability problem and it was published in 1972 in a book, 'The Limits to Growth' (Meadows et al., 1972), which was widely understood to claim that environmental limits would cause the collapse of the world economic system in the middle of the twenty-first century.

The book was condemned by most economists, but influenced many other people.

The Limits to Growth reported the results of a study in which a computer model of the world system, World3, was used to simulate its future. World3 represented the world economy as a single economy, and included interconnections between that economy and its environment.

According to its creators, "World3 was built to investigate five major trends of global concern – accelerating industrialization, rapid population growth, widespread malnutrition, depletion of non-renewable resources, and a deteriorating environment. These trends are all interconnected in many ways, and their development is measured in decades or centuries, rather than in months or years. With the model we are seeking to understand the causes of these trends, their interrelationships, and their implications as much as one hundred years in the future."

It incorporated:

(a) a limit to the amount of land available for agriculture;

(b) a limit to the amount of agricultural output producible per unit of land in use;

(c) a limit to the amounts of non-renewable resources available for extraction;

(d) a limit to the ability of the environment to assimilate wastes arising in production and consumption, which limit falls as the level of pollution increases.

On the basis of a number of simulations usingWorld3, the conclusions reached by the modelling team were as follows:

1. If the present growth trends in world population, industrialization, pollution, food production and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next 100 years. The most probable result will be a sudden and uncontrollable decline in both population and industrial capacity.

2. It is possible to alter these trends and to establish a condition of ecological and economic stability that is sustainable far into the future. The state of global equilibrium could be designed so that the basic material needs of each person on earth are satisfied and each person has an equal opportunity to realize his or her individual human potential.

3. If the world's people decide to strive for this second outcome rather than the first, the sooner they begin working to attain it, the greater will be their chances of success.

What The Limits to Growth actually said was widely misrepresented. It was widely reported that it was an unconditional forecast of disaster sometime in the next century, consequent upon the world running out of non-renewable resources. It was widely reported that the World3 results said that there were limits to 'economic growth'. In fact, what they said, as the conclusions quoted above indicate, is that there were limits to the growth of material throughout for the world economic system.

A sequel (Meadows et al., 1992) to The Limits to Growth, written by the same team and entitled 'Beyond the Limits', was published in 1992 to coincide with the UNCED conference held in Rio de Janeiro. The publication of the sequel generated much less controversy than the original did.

As far as implication of limit theory is concerned, the available global data and scenario of past 30 years, indicate that the three conclusions drew in The Limits to Growth are still valid and need proper attention towards it.

1.5 SUSTAINABLE DEVELOPMENT

The question arises, will the world be able to sustain economic growth indefinitely without controlling the environment degradation? Are there trade-offs between the goals of achieving high and sustainable rates of economic growth and attaining high standards of environmental quality? Increased extraction of natural resources, accumulation of waste and concentration of pollutants will therefore overwhelm the carrying capacity of the biosphere and result in the

degradation of environmental quality and a decline in human welfare., despite rising incomes. Furthermore, it is argued that degradation of the resource base will eventually put economic activity itself at risk. To save the environment and even economic activity from itself, economic growth must cease and the world must make a transition to a steady-state economy.

Sustainable Development focuses on meeting the needs of the present without compromising the ability of future generations to meet their needs. The concept of sustainability is composed of three pillars: **Economic, Environmental, and Social**—also known informally as **Profits, Planet, and People**. Sustainability encourages businesses to frame decisions in terms of environmental, social, and human impact for the long-term, rather than on short-term gains such as next quarter's earnings report. It influences them to consider more factors than simply the immediate profit or loss involved. Increasingly, companies have issued sustainability goals such as commitment to zero-waste packaging by a certain year, or to reduce overall emissions by a certain percentage. These companies can achieve their sustainable needs by cutting emissions, lowering their energy usage, sourcing products from fair-trade organizations, and ensuring their physical waste is disposed of properly and with as small of a carbon footprint as possible. The push for sustainability is evident in areas such as energy generation where the focus has been on finding new deposits to outpace the drawdown on existing reserves. Some electricity companies, for example, now publicly state goals for energy generation from sustainable sources such as wind, hydropower, and solar.

The 2005 World Summit on Social Development identified sustainable development goals, such as **economic development, social development, and environmental protection**. This view has been expressed as an illustration using three overlapping ellipses indicating that the three pillars of sustainability are not mutually exclusive and can be mutually reinforcing. In fact, the three pillars are interdependent, and in the long run, none can exist without the others. The three pillars have served as a common ground for numerous sustainability standards and certification systems in recent years, in particular in the food industry. Some sustainability experts and practitioners have illustrated four pillars of sustainability or a quadruple bottom-line. One such pillar is future generations, which emphasizes the long-term thinking associated with sustainability. There is alsoan opinion that considers resource use and financial sustainability as two additional pillars of sustainability. Sustainable development consists of balancing local and global efforts to meet basic human needs without destroying or degrading the natural environment. The question then become show to represent the relationship between those needs and the environment A study from 2005 pointed out that environmental justice is as important as sustainable development. Ecological economist Herman Daly asked, "what use is a sawmill without a forest?" From this perspective, the economy is a subsystem of human society, which is itself a subsystem

of the biosphere, and an obtain in one sector is a loss from another. This perspective led to the nested circles' figure of 'economics' inside 'society' inside the 'environment'.

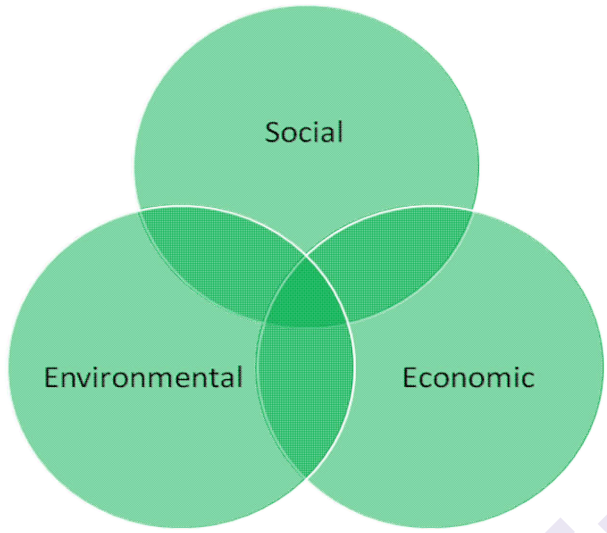


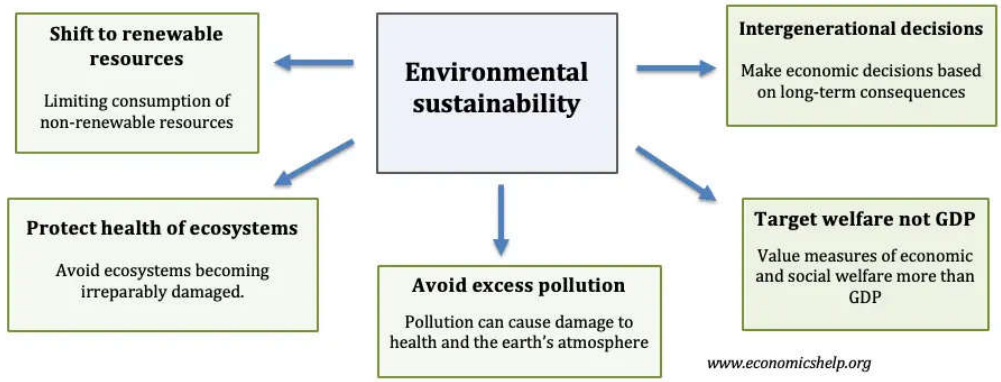
Figure 1.1 Sustainability

Some ecologists argue economic growth invariably leads to environmental damage. However, there are economists who argue that economic growth can be consistent with a stable environment and even improvement in the environmental impact. This will involve a shift from non-renewables to renewables resources. A recent report suggests that renewable energy is becoming cheaper than more damaging forms of energy production. Environmental policy which protects the environment, through regulations, government ownership and limits on external costs can enable economic growth to be based on protection of the environmental resource.

It is possible to replace cars running on petrol with cars running on electricity from renewable sources. This enables not only an increase in output, but also a reduction in the environmental impact. There are numerous possible technological developments which can enable greater efficiency, lower costs and less environmental damage.

Include quality of life and environmental indicators in economic statistics. Rather than targeting GDP, environmental economists argue we should target a wider range of living standards + environmental indicators. The following chart depict sustainable Economic development can be achieved without environmental damage.

Sustainable Economic Development without environmental damage



1.6 SUMMARY

Thus, this unit is devoted to the vital relation between economic growth and environment. It studies the impact of environment on growth and at the same time impact of growth on environment. The role of environment in economic growth and development is quite obvious because environment acts as a social good or asset. Limits to growth theory is an eye opener for present and future generation. If environment is not protected then it can limit the growth and collapse the economic system of the world in near future. Sustainability can be achieved through proper combination of three pillars: Economic, Social and Environment. Sustainable economic development is possible without environmental damage if proper policy is formed and implemented. The unit highlights the limit to growth and sustainability in precise manner to make the concepts understandable for our leaners.

1.7 QUESTIONS

Q1. Analyse the relationship between Economic growth and environment.

Q2. Explain the interrelation between Economic growth and environment.

Q3. Environment can impose limits to economic growth. Analyse it.

Q4. How does natural capital involve directly and indirectly in creating wealth in the economy?

Q5. Discuss the Limits to growth theory in brief.

Q6. Explain Sustainable Development and Sustainability.

Q7. Write a note on 'Environment as an Economic and Social good'.

Q8. Natural capital is direct and indirect input to wealth creation, explain.

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2

ENVIRONMENTAL CURVE, NATURAL RESOURCES AND GREEN ACCOUNTING

Unit Structure

2.0 OBJECTIVES

The major objectives of the present unit are as follows:

- To understand the nexus between environment and development through Kuznets Environment Curve;
- To learn about different types of Natural resources useful for economic growth and development;
- To understand the importance of Natural resource Management and Green Accounting Methodology;

2.1 INTRODUCTION

The relationship between the environment degradation and economic development is observed as inverted U shape curve, known as Environmental Kuznets Curve. The hypothesis populated that in the early phase of development, environmental degradation increases. But as the level of development reaches certain threshold the people become aware about the environment and invest more in environmental protection. This leads to decline in environmental degradation.The unit deals with allmajor areas of natural resource: exhaustible resources, renewable resources and Common Property resources. One of the most needed fields in Environmental Economics, Natural Resource Management is also highlighted in the present unit. Natural Resource Management refers to the sustainable utilization of major natural resources Green accounting or Environmental accounting is also analysed in this unit. Green NNP or environmentally adjusted NNP is considered the best measure of sustainable development.

2.2 ENVIRONMENTAL KUZNETS CURVE

Present unit is classified into following segments:

The nexus between environment and development is quite complex. The question of how are they related to each other is similar to the theory posed by Simon Kuznets in 1955, regarding the relation between level of income and inequality along with economic development. Kuznets hypothesized that there is an inverted U-shaped relationship between inequality and economic development.

The environment and development trade-off can also be explained in terms of Environment Kuznets curve.

Gene Grossman and Alan Krueger in their studies of the relationship between the environment degradation and economic development found a similar inverted U-shaped relationship. This inverted U-shaped relationship between the environmental degradation and economic development is known as Environmental Kuznets Curve (EKC). The EKC hypothesis expresses the most likely relationship between the environment and economic development. It states that the environmental degradation is low when the level of economic development is low. The environmental degradation increases with economic development in the early phase but it comes down at the later stage of development. That is, in the initial stage of development, environmental degradation increases but eventually declines at certain threshold level of income.

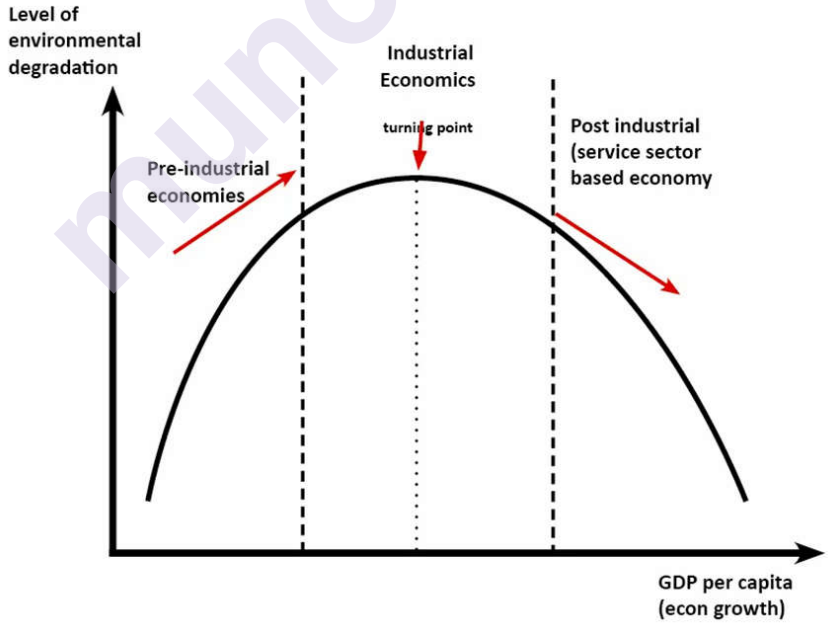

Figure 2.1 : The environmental Kuznets curve: A development-environment relationship

In the figure 2.1 the environmental Kuznets curve is inverted U-shaped. The level of environmental degradation is measured along the vertical axis and the level of GDP per capita (a measure of development) is measured

along the horizontal axis. The curve shows that as the level of income increases, the environmental degradation also increases but up to point. Then turning point reached where level of environmental degradation starts to decline as income increases.

The increase in environmental degradation in the initial phase can be attributed to the heavy emphasis on economic growth and capital formation to enhance production and consumption. It is due to heavy emphasis on industrial development and movement of the economy from the clean agrarian economy to polluting industrial economy. For the early phase of development, people tend to neglect environmental matters due to high level of poverty, lack of awareness, income inequality and lack of community level institutions etc. These result in increase in environmental degradation in the early phase of development.

The decline in environmental degradation after the certain threshold level of income is attributable to technological change and efficiency in use of energy and other resources. The technical innovation enables the economy to produce more level of output with the same resources. At the same time, it encourages the recycle of materials and reduces the pressure on the environment. Further, the institutions of natural resource not linked to environment, increase in education and awareness among the people about the ill effects of environmental degradation and better implementation of environmental regulations contribute to reduce environmental degradation. In fact the person with higher income has a tendencyto prefer better environmental quality and spend more to consume the environment. The economic structure also changes from polluting industrial to clean services economy.

Criticisms

The EKC relationship between the environmental degradation and the level of development has been criticized under the following grounds:

- The Environmental Kuznets curve has been found only for some air quality indicators especially local pollutants. There is no evidence of the EKC in case of global pollutant like carbon dioxide (CO2).
- The EKC hypothesis states that at certain threshold level of per capital income the turning point will occur and increase in income beyond that level heads decline in environmental degradation. However, it does not say the exact level of income at which the turning will occur. There is no agreement in literature on the income level at which the environmental degradation starts declining.
- The shape of the curve may be N-shaped instead of invented U-Shaped if the level of environmental degradation after declining for some time again starts increasing as nations incomes continue to increase. Arrow argues that the inverted U-shaped relationship would appear to be false, if pollution increases again at the end due to higher levels of income and mass consumption.
- Suri and Chapman argued that reduction in pollution may not be occurring. On a global scale because the wealthy nations have a

tendency of exporting the pollution intensive activities like, manufacturing of clothing, furniture etc. to poorer countries. Thus, the level of pollution may be declining in the developed countries but it is compensated by the increase in pollution in developing countries. So, the pollution level at the global scale may remain unchanged with economic development.

Thus, it can be concluded that the relationship between the environment and economic development is quite complex and unpredictable. The environmental Kuznets curve has tried to explain the possible relationship between the level of environmental degradation and economic development. The hypothesis populated that in the early phase of development, environmental degradation increases. But as the level of development reaches certain threshold the people become aware about theenvironment and invest more in environmental protection. This leads to decline in environmental degradation.

2.3 NATURAL RESOURCES: EXHAUSTIBLE, RENEWABLE, COMMON PROPERTY RESOURCES

The various types of natural resources are used in human life for maximum welfare. There are two types of resources used for the development of a country. These types are of renewable and exhaustible or non-renewable resources which are most important to any country's sustainable development.

2.3.1 What Are Exhaustible Resources?

Exhaustible resources are also known as Non-renewable resource. Such resources are natural substances which are not replenished with the speed at which they are consumed. It is a finite resource. Fossil fuels such as oil, natural gas, and coal are examples of Exhaustible resources. Humans constantly draw on the reserves of these substances while the formation of new supplies takes ages.

Exhaustible resources come from the Earth. Humans extract them in gas, liquid, or solid form and then convert them for their use, mainly related to energy. The reserves of these substances took billions of years to form, and it will take billions of years to replace the supplies used.

There are four major types of Exhaustible resources: Oil, Natural gas, Coal, and Nuclear energy. Oil, natural gas, and coal are collectively called fossil fuels. Fossil fuels were formed within the Earth from dead plants and animals over millions of years—hence the name “fossil” fuels. They are found in underground layers of rock and sediment. Pressure and heat worked together to transform the plant and animal remains into crude oil (also known as petroleum), coal, and natural gas.

All of these Exhaustible or Non-renewable resources have proved historically to be valuable energy sources that are inexpensive to extract.

Storage, conversion, and shipping are easy and cheap. Fuels created from non renewable resources are still the primary source of all the power generated in the world due to their affordability and high energy content.

Other Types of Exhaustible or Non-renewable Resources

Most nonrenewable resources are formed from organic carbon material which is heated and compressed over time, changing their form into crude oil or natural gas. However, the term non renewable resource also refers to minerals and metals from the earth, such as gold, silver, and iron. These are similarly formed by a long-term geological process. They are often costly to mine, as they are usually deep within the Earth's crust. But they are much more abundant than fossil fuels. Some types of groundwater are considered nonrenewable resources if the aquifer is unable to be replenished at the same rate at which it's drained.

The problem of pollution and environmental degradation arise due the maximum and continuous use of exhaustible or Non-renewable resources.

2.3.2 Understanding Renewable Resources

A renewable resource is one that can be used repeatedly and does not run out because it is naturally replaced. Examples of renewable resources include solar, wind, hydro, geothermal, and biomass energy. Their supply replenishes naturally or can be sustained. The sunlight used in solar energy and the wind used to power wind turbines replenish themselves. Timber reserves can be sustained through replanting.

Renewable resource is important for sustainable development and environment protection of a nation. There are main two types of renewable resources i.e. biotic and abiotic. Animals, fish, plants are the biotic renewable resources whereas air, water, wind energy and solar energy are the examples of abioticrenewable resources. These two types of renewable resources stock don't diminish completely. But it is highly impossible to introduce exclusion principle for renewable resources. Now-a-days we are using all these renewable natural resource son large scale. So, in future we may face the problem of sustainable development and environment protection. Biofuel is popular renewable source nowadays.

Biofuel, or energy made from renewable organic products, has gained prevalence in recent years as an alternative energy source to exhaustible resources such as coal, oil, and natural gas. Although prices are still higher for biofuel, some experts project that, due to increasing scarcity and the forces of supply and demand, the prices of fossil fuels will grow higher, making the price of biofuel more competitive.Types of biofuel include biodiesel, an alternative to oil, and green diesel, which is made from algae and other plants. Other renewable resources include oxygen and solar energy. Wind and water are also used to create renewable energy. For example, windmills harness the wind's natural power and turn it into energy.

2.3.3 Common Property Resources (CPR)

Common property resource means a good or service shared by a well-defined community. In other words, collectively consumed goods and services Goods and services that are consumed simultaneously by a group of consumers or by the community as a whole are called Common property resource. For example, public roads provided by the state or defence services provided by the state. It is not possible to exclude people from consumption of this good or it may not be desirable to exclude people from consumption of this this good. These collectively consumed gods are often public goods and merit goods.

But it is not mandatory that they be public goods or merit goods. Sometimes, private sector can also provide collectively consumed goods or services. But private sector will provide these only when it is possible to individually collect fees or price from the consumers of this good.

The community controls the use of such resource by individuals. However, enforcement is weak due to difficulties in monitoring. For example, water in a village pond, which is a common property resource, is used by the villagers only. The village as a community decides upon the manner and the purpose for which the pond water can be used, which results in a set of norms, evolved over time, and largely unwritten. In case of a breach of the norms, however, imposition of penalty is poorly enforced due to poor monitoring, subjectivity in the norms and ambiguities in property rights. The common property regime for managing natural resources is frequently misunderstood. It is often observed as a situation in which there is no management regime in place; as a situation of open access, which is free for all. Accordingly, resource degradation in the developing countries is incorrectly attributed to 'common property systems', whereas it actually originates in the dissolution of local, level institutional arrangements. Therefore, there is a need to properly understand the common property resources and its management systems as these have direct bearing on the sustainable development of natural resources.

We can list a large number of Common Property Resources, which can be brought under the broad headings like land resources, forest resources, water resources, and fishery resources. These resources are being degraded overtime due to overuse or lack of proper management.

Here we discuss briefly about these common property resources.

Land Resources

Common property land resource refers to lands identified with a specific type of property rights. The common lands covered in the National Sample Survey (NSS) enquiry are panchayat lands, government revenue lands, village common lands, village thrashing lands, unclassified forest lands, woodlands and wastelands, river banks, and lands belonging to other households used as commons.

Forest Resources

Another category of land for which common property rights may exist is land under forests. Unclassified forests, with very low productivity, are always open to use by local communities: Accordingly, both protected and unclassified forests are treated as forming a part of common property forest resources. It is, therefore, the subset of total forest area minus reserve forests to which common property rights are assumed to exist.

Water Resources

There are a variety of resources of water, which are in the public domain, and a significant part of these are included in the category of commons. Examples are flows of rivers, tanks and natural lakes, groundwater, wetland and mangrove areas, and such other water bodies. Man-made water resources such as dams and canals, tube wells, other wells, and supply of all types of potable water also fall in the category of CPRs depending upon their property rights. Unfortunately, even after many debates about property rights (such as traditional rights, community rights, and basic need human rights), water has not yet been declared as CPR in India, though references are made in the water policy document indirectly. By and large, water resources in India are in common property regimes only. Irrigation canals are managed jointly by the government and communities. Traditionally, tanks, village ponds, and lakes - all of which are treated as CPRs -are sources of water for drinking, livestock rearing, washing, fishing and bathing, and several sanitary-related activities.

Problems with Common Property Resources

Open Access

Basically, it is a situation where there are no enforceable property rights over the use of the resource. Here, a right of inclusion is granted to anyone who wants to use the resource. Examples of open access resources are fishing in the open sea, river, lake, or ponds, ill-managed village common grazing lands, buffer areas of forests, groundwater, etc. Open access results from the absence - or breakdown - of a management and authority system whose very purpose was to introduce and enforce a set of norms of behaviour among participants with respect to the natural resource.

Tragedy of Common

People have always a tendency to use (misuse) public property according to their whims and fancies. As the public property is not owned by any individual, no one can claim for an exclusive ownership. The net result being misuse of public properties. Perhaps this is the main reason for garbage appearing in the public road, discharging effluents into the river, public parks being misused, public buildings being disfigured etc.

Prof. Garrett Hardin examined the reasons why public properties are either being misutilised or over utilized by the people. The answer that he identified has been published in the article titled “The Tragedy of commons” (1968). He had studied the character of herdsmen in England. Hardin anxiously watched out the peculiar behavior of herdsmen that they

are always prepared to add additional cattle into the pasture land in England. The logic prevailed that the farmer who grazed the most cattle stood to benefit most from the commons. But the tragedy of this kind of action is that the land was overgrazed and destroyed. This came to be known as " Tragedy of Commons" . Though the tragedy of commons is an observation based on the real experience example, it finds its applicability in most of the situation in which the resources are owned by the public. There is a tendency to over exploit public resources resulting in total destruction or non-availability of further resources.

2.4 ACCOUNTING AND NATURAL RESOURCE MANAGEMENT, GREEN ACCOUNTING

2.4.1 Natural Resource Management (NRM):

Natural Resource Management refers to the sustainable utilization of major natural resources, such as land, water, air, minerals, forests, fisheries, and wild flora and fauna. Together, these resources provide the ecosystem services that provide better quality to human life. Natural resources provide fundamental life support, in the form of both consumptive and public-good services. Ecological processes maintain soil productivity, nutrient recycling, the cleansing of air and water, and climatic cycles. For successful Natural Resource Management, Natural resource accounting is essential tool. But Natural resource accounting is a discipline which is still in an experimental stage at the moment. This is an accounting with a particular focus on material and energy flow information and environmental cost information.

Natural resource accounting can be used for:

- Demonstration of accountability for the management and protection of natural resources; Identifying environmental problems such as resource depletion;
- Analysing government policy;
- Undertaking resource management and decision-making;
- Monitoring Sustainable Development;
- Drawing up (Macro-Economic) indicators for environmental performance or prosperity;
- Improving benchmark for measuring a country's National Product

Problems or constraints of Natural Resource Accounting

Natural resource accounting has been affected by not only practical problems it is also the subject of fierce debate about the most suitable methodologies.

One of the most contentious issues is, for example, whether or not natural resource accounting should lead to the generation of a figure for the 'green' national product, i.e. a totally new indicator, or whether the compilation of an account is in itself sufficient. If the answer is that one needs to have a

figure for a green national product, the next question arises is whether the figure calculated should be that for the net or the gross national product, and how it should be arrived at. The various organisations involved in the debate each take a different view about this.

A further complicating issue is how to assess thevalue of natural resources in monetary terms.

The cost of data collection is another potential problem affecting the compilation of natural resource accounts. This is of particular significance to those countries which have yet to begin collecting the relevant data. It is always advisable to perform a cost-benefit analysis of the situation before starting to collect new data. The chief factor determining the degree of benefit is the use that is made of the data. The high cost of obtaining new data has led some countries to decide in practice to work with estimates rather than actual figures.

This is one of the toughest nuts to crack, as it requires not only information on quantities, but also qualitative data on each particular resource, e.g. water. In addition, the way in which each resource is used(in the case of fresh water, for example, whether this is as drinking water, to fill natural lakes and rivers, as an aquatic habitat for fish or as cooling water for power stations) also affects the value assigned to it. Finally, account needs to betaken of the impact which a certain degree of pollution of the resource in question may have on public health. The difficulty of valuation is exacerbated by the absence in many cases of a market price for the resource (e.g. clean air).

The following diagram (Figure 3), which originates from the World Bank, shows how the valuation of natural resources and environmental degradation can result in the production of a natural resource account (otherwise known as an environmental account).

Figure 3: Relationship between conventional and environmental Account

	Conventional Accounting	Environmental Accounting
Goal	Profit maximization	Improve corporate Environmental performance
Data	Primarily quantitative	Qualitative Limited Quantitative
Internal Machanism	Management Accounting	Environmental management
External Machanism	Financial Reporting	Environmental reporting
Regulated	Yes- throught Accounting standards and corporate legislation	No. but Environmental legisiation and standards (e.g. ISO 14001, EMS, ect)
Auditing tool	Financial Auditing	Environmental Auditing

The table gives a clear indication of the steps which have to be taken, taking a conventional account as the starting point, in order to compile a natural resource account (i.e. an environmental account) in either physical terms (see column A)or monetary terms (see column C). The monetary version of the natural resource account can then be used to draw up an adjusted version of the national accounts (see bottom row).

2.4.2 Green Accounting

The Net National Product (NNP) is known as the best welfare measure under standard national income accounting. But the present system of national accounting i.e. NNP fails as a measure of sustainable development as it does not take into account the use an abuse of natural resources. While considering the allowances for consumption of capital in calculating NNP, it gives consideration only to depreciation of men-made capital and ignores depreciation of natural resources – non-renewable, renewable resources, pollution etc.

The present accounting system suffers from certain deficiencies. These are:

- The NNP takes note of only such production and consumption processes where there is market price.
- It does not impute the values of environmental goods and services used in production process and
- It also does not consider any allowance for depreciation/degradation or depletion of natural resources.

Therefore, the concept of green accounting of NNP arises from a concern that an economic indicator such as NNP doesn't reflect the depreciation and degradation of environment. This may lead to incorrect development divisibility. Green national income accounting takes into consideration the environmental and ecological loss arising out of the developmental effort while calculating the national income. Green national income is environmentally sustainable income of the economy.

The Green accounting of income is an attempt or method to correct the present measure of NNP for use and above of natural and ecological resources to arrive at sustainable income which can be a measure or indicator of sustainable development.

The improvement in the methods of accounting were debated in the 1992 United Nations conference on Environment and development (UNCED) held at Rio de Jenerio, which recommended all nations to develop a system of **Integrated Environmental and Economic Accounting (IEEA)-** which came to be known as Green Accounting.

A sustainable path has the characteristic that along it the overall productive capacity is not reduced, what we need to know is at each movement how much of this productive base we can use up. This is given by environmentally adjusted NNP. NNP is the total income earned by the economy less allowances for the depreciation of man-made capital.

ENP = GNP –Depreciation of man-made capital-depreciation of natural capital.

ENP is a good measure of sustainable development.

Environmentally adjusted NNP(ENP) is the annual pay-off from our total capital stock (Man-made and natural)

ENP will rise if the total capital rises or as technology improves. So, the indicator of sustainable development is whether the ENP is rising or falling. The development is sustainable if the ENP is rising and vice-versa.

In practice, it is difficult to develop an accounting for natural resources.

Parikh and Parikh (1997) elaborated on the system of Environment and Economic accounting as developed by the United Nations and provided a definition of Green NNP as –Green NNP = Value of consumption of natural goods and services + value of production of natural collected (such as fuelwood, biogas) + value of environmental amenities provided by environmental resources stocks (such as clean air, top soil) + value of leisure enjoyed (Say in enjoying aesthetic beauty of wildlife revenue) + value of net additions to production of capital + value of net addition to natural capital stock + value of addition to stocks of defensive capital (such) as water purifier).

Thus, NNP is the total income earned by the economy in any year, less an allowance for the depreciation of manmade capital.

Green NNP or environmentally adjusted NNP is a good measure of sustainable development.

Thus, Green NNP is the annual pay-off from our total capital stock (manmade + natural). ENP can rise over time if this total capital stock rises and /or as technology improves. According, Hartwick rule, the total stock of capital can be maintained by reinvesting hoteling rents (price-MC) from optimal non-renewable resources infraction planning new natural or manmade capita. So, the indictor of sustainability is non-declining ENP, or whether ENP is rising or falling. It ENP is falling, and then society's sustainable level of income is falling too. Development is unsustainable.

The best measure of sustainable development is Green Account.

2.5 SUMMARY

This unit discussed about the relationship between the environment and development in the light of Kuznets curve hypothesis which argued that there is an inverted U-shaped relationship between the two. It also analysed and discussedtypes and importance of Natural resources, problems of Common Property resources, Natural Resource Management and finally green accounting. Natural resource management is need of the hour and the unit tries to overview it. Natural Resource Management refers to the sustainable utilization of major natural resources, such as

land, water, air, minerals, forests, fisheries, and wild flora and fauna. Together, these resources provide the ecosystem services that provide better quality to human life. Green accounting is a good measure of sustainable development. The indicator of sustainable development is whether the ENP (Environmental National Product) is rising or falling. The development is sustainable if the ENP is rising and vice-versa.

2.6 QUESTIONS

Q1. Critically explain the Environmental Kuznets Curve.

Q2. Explain exhaustible and renewable natural resources.

Q3. Explain Common Property Resources. What are the main problems with Common Property Resources?

Q4. What is natural resource management? Outline the usefulness of natural resource accounting.

Q5.Discuss the Problems or constraints of Natural Resource Accounting.

Q6. Explain the concept of Green Accounting.

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Module II

3

MICRO FOUNDATIONS OF ENVIRONMENTAL ECONOMICS - I

Unit Structure

3.0 OBJECTIVES:

- To know the concept and types of Environmental Goods and Services
- To Learn about Externalities and Market Failure
- To understand Social Cost – Benefit Analysis

3.1 INTRODUCTION

Like any other discipline, environmental economics also has its own basic concepts, theories and analytical tools, which constitute its foundation. Most of its concepts and theories are drawn from microeconomics, welfare economics and macroeconomics. To appreciate the utility and relevance of environmental economics and to use it in practical life, it is necessary for us to clearly define and understand its basic concepts and theories.

We, as individuals interact with the environment every day in some way or the other. We inhale oxygen from the environment and release carbon dioxide into it, we eat food directly either obtained from the environment or produced using environmental resources, and we dispose wastes into the environment. In short, we depend on the environment for our survival, growth and development. Our attitude towards the environment and our decisions relating to consumption and provision of environmental goods and services affect the quality of the environment. Hence, it is necessary for us to understand the factors that affect individual behaviour and decisions as they relate to the environment to diagnose the root causes of environmental problems and identify appropriate remedial measures. Demand and supply are the two most important concepts in

microeconomics useful in understanding and explaining the behaviour of individuals. The theory of consumer behaviour attempts to explain why an individual demands more or less of a commodity and demands something and not the other. The theory of firm, or the theory of production explains why a producer produces more, or less of a commodity and why and how much he offers to sell in the market.

3.2 ENVIRONMENTAL GOODS AND SERVICES

Environmental goods and services (EGS) can directly improve the quality of life for citizens by providing a cleaner environment and better access to safe water, sanitation or clean energy. In addition, the use of environmental goods can reduce harmful side-effects of various activities that damage the environment and are hazardous to human health and can help make the use of energy significantly more efficient.

Environmental goods are **typically non-market goods**, including clean air, clean water, landscape, green transport infrastructure (footpaths, cycle ways, greenways, etc.), public parks, urban parks, rivers, mountains, forests, and beaches. Environmental goods are a sub-category of public goods.

Environments services refers to the qualitative functions of natural assets of land, water and air. The three basic types of environmental services are disposal services, which reflect the functions of the natural environment as an absorptive sink for residuals, productive services, which reflect economic functions, and consumer or consumptive services, which provide for the physiological and recreational needs of humans.

Environmental services include the provision of raw materials and energy used to produce goods and services, as well as the removal of waste from human activities, and their role in life support and landscape maintenance. The environmental services concepts captures the broad idea that the natural environment incorporates many uses or benefits that can be termed as services.

Environmental goods and services are products that are manufactured or services rendered for the main purpose of:

- preventing or minimising pollution, degradation or natural resources depletion;
- repairing damage to air, water, waste, noise, biodiversity and landscapes;
- reducing, eliminating, treating and managing pollution, degradation and natural resource depletion;
- carrying out other activities such as measurement and monitoring, control, research and development, education, training, information and communication related to environmental protection or resource management.

3.2.1 Types of Environmental Goods and Services

A. Pure Public / Collective Goods

Most natural resources and environmental amenities are public goods, ranging from environmental quality and watershed protection to ecological balance and biological diversity. Public goods range in geographical scope from local or regional to national or global. For example, biological diversity is an international public good since it is not possible (or desirable) to exclude other nations from benefiting from its conservation. Therefore, it is unreasonable to expect such goods to be provided in sufficient quantities by an individual country in a free market.

A public good is characterised by jointness in supply, in that to produce the good for one consumer it is necessary to produce it to all consumers. In many cases, no individuals can be excluded on enjoyment of a public good (for example, national defence) whether they pay for it or not.Since nobody can or should be excluded from the benefits of a public good, consumers would not voluntarily pay for it and hence, no firm would find it profitable to produce such a good, as it is not possible for it to cover its production cost through the market. Thus, the market mechanism would fail to supply a public good, although the good has very high utility and would contribute to social welfare. Thus, a free market will lead to underproduction of public goods. Environmental goods belong to the entire community and there are no individual rights of ownership. They are consumed simultaneously by a large number of people. Unlike the case of private goods, the consumption of public goods or use of IT services by one person does not diminish its quantity for availability to others. to sum up there are three main characteristics of public goods:

a. Non excludability

b. Non – rivalrous consumption

c. Indivisibility

Non- excludability means that nobody can be excluded from consuming a public good and no market can exist for it and therefore provision must be made by the government, financed by taxation, for example defence, roads, street lights, lighthouses, eradication of diseases, clean air and water and so on.

A rigorous definition of pure public/ collective good, or a pure non collective/ private good can be given as follows:

$X^1 = a_1X$

$X^2 = a_2X$

$X^n = a_nX$

Where X is the total quantity of the good X and X^1, X^2, ..., X^n are the quantities of the good consumed by persons 1,2, …n and a_1, a_2, …, a_n are the production of the good consumed by the persons 1,2, …, n. For a pure public good, $a_1 = a_2$, …, an=1, and for a pure private good $a_1 = a_2$, …, a_n=0, except for one person (a_i), whose proportion equals to 1, i.e., a_i=1.

Examples of environmental goods and services that are pure public/ collective goods include solar radiation, biodiversity, conservation, ozone layer and their sheds

B. Mixed Collective goods:

Some of the environmental goods and services are mixed collective goods. A mixed collective good is one which, like a pure collective good, is used in common bi a large number of individuals and from whose use free Riders cannot be easily excluded, and whose use like that of private good, is sub tractable, that is its use by one of the co- users to that extent. Thus, mixed collective goods have one characteristic each in common with pure collective goods and private, or non-collective goods. Examples of environmental goods and services that are mixed public/ collective goods include wildlife, marine fish, recreational services of lakes and several watershed services.

3.3 EXTERNALITIES AND MARKET FAILURE:

Market Failure arises when the outcome of an economic transaction is not completely efficient, meaning that all costs and benefits related to the transaction are not limited to the buyer and the seller in the transaction. Individual consumers will often purchase goods with an environmental component to make up for their inability to directly purchase environmental goods, thus revealing the value they hold for certain aspects of environmental quality. For example, someone may buy a cabin on a lake in order to enjoy not only the home itself but also the lake's pristine environment. If the individual could exclusively capture the environmental benefits that result from owning the cabin, the demand for cabins would reflect the full value of both the home and the environmental goods it provides, and the market for cabins would be efficient. Unfortunately, in the case of environmental goods, markets often fail to produce an efficient result, because it is rare that any one individual can incur the full benefit, as well as the cost, of a particular level of environmental quality. That is because environmental goods commonly suffer from the presence of externalities (that is, consequences that no one pays for) or a lack of property rights.

Externalities

Private markets offer an efficient way to put buyers and sellers together and determine what goods are produced, how they are produced, and who gets them. The principle that voluntary exchange benefits both buyers and sellers is a fundamental building block of the economic way of thinking.

But what happens when a voluntary exchange affects a third party who is neither the buyer nor the seller?

Consider, for example, a concert producer who wants to build an outdoor arena that will host country music concerts a half-mile from your neighborhood. You will be able to hear these outdoor concerts while sitting on your back porch—or perhaps even in your dining room. In this case, the sellers and buyers of concert tickets may both be quite satisfied with their voluntary exchange, but you have no voice in their market transaction.

The effect of a market exchange on a third party who is outside, or external, to the exchange is called an *externality*. Because externalities that occur in market transactions affect other parties beyond those involved, they are sometimes called *spillovers*.

There are two types of externalities: Negative and Positive.

Negative Externality exists when individuals bear a portion of the cost associated with a good's production without having any influence over the related production decisions. For example, parents may have to pay higher health-care costs related to pollution -induced asthma among their children because of increased industrial activity in their neighborhood. Producers do not consider those costs to others in their decisions. As a result, they produce more goods with negative externalities than is efficient, which leads to more environmental degradation than is socially desirable.

Positive Externalities also result in inefficient market outcomes. However, goods that suffer from positive externalities provide more value to individuals in society than is taken into account by those providing the goods. An example of a positive externality can be seen in the case of college roommates sharing an off-campus apartment. Though a clean kitchen may be valued by all the individuals living in the apartment, the person who decides to finally wash the dishes and scrub the kitchen floor is not fully compensated for providing value to all the roommates. Because of that, the decision to clean the kitchen undervalues the benefits of such an action and the kitchen will go uncleaned more often than is socially desirable. Such is the case with environmental quality. Because markets tend to undervalue goods with positive externalities, market outcomes provide a level of environmental quality that is lower than is socially desirable.

Key Points

- Economic production can cause environmental damage. This tradeoff arises for all countries, whether high-income or low-income, and whether their economies are market-oriented or command-oriented.

- An **externality**, sometimes called a **spillover**, occurs when an exchange between a buyer and seller has an impact on a third party who is not part of the exchange. Externalities can be positive or negative.

- **Market failure** is when the market does not allocate resources on its own efficiently in a way that balances social costs and benefits; externalities are one example of a market failure.

- **Social costs** are costs that include both the private costs incurred by firms and also **additional external costs** incurred by third parties outside the production process.

Pollution

From 1970 to 2012, the population of the United States increased by one-third and the size of the US economy more than doubled. Despite this growth, the United States, using a variety of anti-pollution policies, has made genuine progress against a number of pollutants.

According to the US Energy Information Administration, the emissions of certain key air pollutants declined substantially from 2007 to 2012; in fact, they dropped 730 million metric tons a year—a 12% reduction. This seems to indicate that progress has been made in the United States in reducing overall carbon dioxide emissions, which cause greenhouse gases.

Despite the gradual reduction in emissions from fossil fuels, many important environmental issues remain. Along with the still-high levels of air and water pollution, other issues include hazardous waste disposal, destruction of wetlands and other wildlife habitats, and the impact of pollution on human health.

Pollution as a negative externality

Pollution is a negative externality. Economists illustrate the *social costs* of production with a demand and supply diagram. The social costs include the private costs of production incurred by the company and the external costs of pollution that are passed on to society.

The diagram below shows the demand and supply for manufacturing refrigerators. The demand curve, \text{D}Dstart text, D, end text, shows the quantity demanded at each price. The supply curve, \text{Sprivate} Sprivatestart text, S, p, r, i, v, a, t, e, end text, shows the quantity of refrigerators supplied by all the firms at each price if they are taking only their private costs into account and they are allowed to emit pollution at zero cost. The market equilibrium, \text{E0}E0start text, E, 0, end text, where quantity supplied and quantity demanded are equal, is at a price of $650 and a quantity of 45,000. You can find this same information in the first three columns of the table below as well.

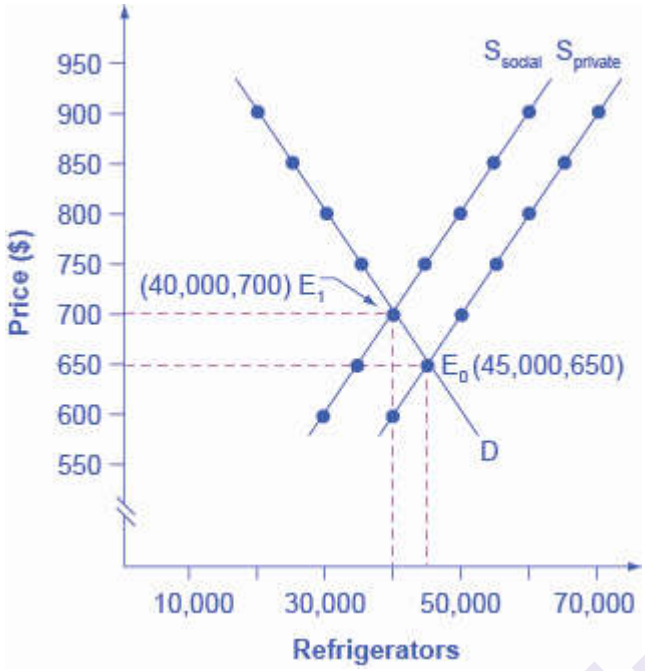

Figure 3.1

The graph shows how equilibrium changes based on whether a firm focuses on its own costs or social costs.

Image credit: *Figure 1* in "The Economics of Pollution" by Open Stax College, CC BY 4.0

Price	Quantity demanded	Quantity supplied before considering pollution cost	Quantity supplied after considering pollution cost
$600	50,000	40,000	30,000
$650	45,000	45,000	35,000
$700	40,000	50,000	40,000
$750	35,000	55,000	45,000
$800	30,000	60,000	50,000
$850	25,000	65,000	55,000
$900	20,000	70,000	60,000

A supply shift caused by pollution costs

The situation is not actually that simple, however. Pollution is created as a byproduct of the metals, plastics, chemicals, and energy that are used in manufacturing refrigerators. Let's say that, if these pollutants were emitted into the air and water, they would create costs of $100 per refrigerator produced. These costs might occur because of injuries to human health, impact on property values, destruction of wildlife habitat, reduction of recreation possibilities, or because of other negative impacts.

In a market with no anti-pollution restrictions, firms can dispose of certain wastes at no cost. Now imagine that firms that produce refrigerators must factor in these *external costs* of pollution—that is, the firms have to consider not only the costs of labor and materials needed to make a refrigerator but also the broader costs to society from pollution. If the firm is required to pay $100 for the additional external costs of pollution each time it produces a refrigerator, production becomes costlier and the entire supply curve shifts up by $100.

Notice the fourth column of the table above. Taking external costs of pollution into account, the firm will need to receive a price of $700 per refrigerator and produce a quantity of 40,000. Remember that supply curves are based on choices about production that firms make while looking at their marginal costs; demand curves are based on the benefits that individuals perceive while maximizing utility. If no externalities existed, private costs would be the same as the costs to society as a whole, and private benefits would be the same as the benefits to society as a whole. Thus, if no externalities existed, the interaction of demand and supply would coordinate social costs and benefits.

But the reality is that externalities *do* exist. Because of this, a supply curve showing private costs doesn't actually represent all social costs.

Because externalities represent a case where markets no longer consider all social costs but only some of them, economists commonly refer to externalities as an example of *market failure*. When there is market failure, the private market fails to achieve efficient output because either firms do not account for all costs incurred in the production of output and/or consumers do not account for all benefits obtained, in the case of a positive externality. In the case of pollution, at the market output, social costs of production exceed social benefits to consumers, and the market produces too much of the product.

There's a general concept here. If firms are required to pay the social costs of pollution, they create less pollution but produce less of the product and charge a higher price.

Corrective instruments

Once the market inefficiency relating to a particular environmental good is understood, policy makers can correct for the inefficiency by employing any number of instruments. Regardless of the instrument, the goal is to provide incentives to individual consumers and firms so that they will choose a more efficient level of emissions or environmental quality.

Command and Control

Command and control is a type of environmental regulation that allows policy makers to specifically regulate both the amount and the process by which a firm should maintain the quality of the environment. Often it takes the form of a reduction of emissions released by the firm during the production of its goods. This form of environmental regulation is very common and allows policy makers to regulate goods where a market-based approach is either not possible or not likely to be popular.

Summary

- Economic production can cause environmental damage. This tradeoff arises for all countries, whether high-income or low-income, and whether their economies are market-oriented or command-oriented.
- An *externality*, sometimes called a *spillover*, occurs when an exchange between a buyer and seller has an impact on a third party who is not part of the exchange. Externalities can be positive or negative.
- *Market failure* is when the market does not allocate resources on its own efficiently in a way that balances social costs and benefits; externalities are one example of a market failure.
- *Social costs* are costs that include both the private costs incurred by firms and also *additional external costs* incurred by third parties outside the production process.

3.4 SOCIAL COST-BENEFIT ANALYSIS

The notion that a zero pollution objective is not necessarily ideal policy is one of the more difficult concepts for environmental economists to convey. After all, if pollution is bad shouldn't we design policy to completely eliminate it? Many of us are drawn to the field based on a genuine concern for the environment and the belief that economics provides a powerful tool for helping solve environmental problems. Yet we are often in the position of recommending policies that appear on the surface to be anti-environmental. How can these observations be reconciled? The answer lies in understanding scarcity: we have unlimited wants, but live in a world with limited means. Economists in general study how people make decisions when faced with scarcity. Scarcity implies that resources devoted to one end are not available to meet another; hence there is an opportunity cost of any action. This includes environmental policy. For example, funds used by a municipality to retrofit its water treatment plant to remove trace amounts of arsenic (a carcinogen) cannot also be used to improve local primary education. Environmental economists are tasked with recommending policies that reflect scarcity of this type at the society level. For both individuals and societies scarcity necessitates trade-offs, and the reality of trade-offs can make the complete elimination of pollution undesirable. Once this is acknowledged the pertinent question becomes how much pollution should be eliminated.

How should we decide? Who gets to decide? To help provide answers economists use an analytical tool called cost-benefit analysis.

Cost-benefit analysis provides an organizational framework for identifying, quantifying, and comparing the costs and benefits (measured in dollars) of a proposed policy action. The final decision is informed (though not necessarily determined) by a comparison of the total costs and benefits. While this sounds logical enough, cost-benefit analysis has been cause for substantial debate when used in the environmental arena. The benefits of environmental regulations can include, for example, reduced human and wildlife mortality, improved water quality, species preservation, and better recreation opportunities. The costs are usually reflected in higher prices for consumer goods and/or higher taxes. The latter are market effects readily measured in dollars, while the former are nonmarket effects for which dollar values are not available. In addition to complicating the practice of cost- benefit analysis (monetary values for the nonmarket effects must be inferred rather than directly observed) this raises ethical issues. Should we assign monetary values to undisturbed natural places? To human lives saved? To the existence of blue whales and grey wolves? If we decide such things are too 'priceless' to assign monetary values we lose the ability to use cost-benefit analysis to inform the decision. What then is the alternative? How do we decide? Who gets to decide?

Environmental economists tend to favour cost-benefit analysis in the policy arena because of the discipline and transparency it provides in evaluating policy options. It is easy to evaluate absolutes. Most would agree that reducing nitrogen contamination of groundwater wells, limiting the occurrence of code red ozone alerts, and preserving habitat for grizzly bears are worthy goals. Determining the relative merits of any one of these compared to the others, or compared to non-environmental goals such as improving public education, is much more daunting. Because policy making is ultimately about evaluating the relative merits of different actions some mechanism is needed to rank the alternatives. Without the discipline of cost- benefit analysis it is not clear how the interests, claims, and opinions of parties affected by a proposed regulation can be examined and compared. Criterion such as 'moral' or 'fair' do not lend themselves well to comparison and are subject to wide ranging interpretation. Who gets to decide what is moral or fair? Cost-benefit analysis is far from perfect, but it demands a level of objectivity and specificity that are necessary components of good decision making.

Advantages of CBA

- A variety of different impacts can be measured in the same units
- Can be used as a device for determining where limited funding and resources should be directed.
- Takes into account both direction and intensity of preferences.

- Allows us to emphasize both the economic value of environmental protection as well as the opportunity cost of protecting the environment

Problems of CBA

- How to determine value for the environment? Is it immoral to place monetary values on things such as wildlife?
- It is very difficult to predict the effects of a single change on an entire ecosystem. An understanding of the ripple effects of a certain policy on the environment is often uncertain.
- Is it appropriate to discount future costs and benefits and if so, what should the discount rate be?
- Can the CBA be manipulated to reflect the interests of firms? CBA does not test sustainability.
- So does CBA, with discounted benefits and costs, give future generations the short shrift?

3.5 SUMMARY

- Environmental goods and services (EGS) can directly improve the quality of life for citizens by providing a cleaner environment and better access to safe water, sanitation or clean energy. In addition, the use of environmental goods can reduce harmful side-effects of various activities that damage the environment and are hazardous to human health and can help make the use of energy significantly more efficient.
- An **externality**, sometimes called a **spillover**, occurs when an exchange between a buyer and seller has an impact on a third party who is not part of the exchange. Externalities can be positive or negative.
- **Market failure** is when the market does not allocate resources on its own efficiently in a way that balances social costs and benefits; externalities are one example of a market failure.
- Cost-benefit analysis provides an organizational framework for identifying, quantifying, and comparing the costs and benefits (measured in dollars) of a proposed policy action. The final decision is informed (though not necessarily determined) by a comparison of the total costs and benefits

3.6 QUESTIONS

1. Explain in detail the concept & types of Environmental goods & Service.
2. Discuss the term market failure.
3. Write o note on external ties.
4. Explain the advantages & disadvantages of cost benefit analysis with references to Environment Policy.

3.7 REFERENCES:

1. Joseph J Seneca and M K Taussig: Environmental Economics.

2. P Abelson: Cost Benefit Analysis and Environmental Problems.

3. P Nikamp: Theory and Application of Environmental Economics, Vol. I

4. H Siebert: Economics of Environment: Theory and Policy.

5. D N Thompson: The Economics of Environmental Protection.

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4

MICRO FOUNDATIONS OF ENVIRONMENTAL ECONOMICS - II

Unit Structure

4.0 OBJECTIVES

- To know the Equi-Marginal Principle
- To understand the concept of Economic Efficiency
- To know learn the concept of Damage Cost and Abatement Cost
- To understand the Role of Institutions in Environmental Protection
- To know Coase Theorem

4.1 INTRODUCTION

Like any other discipline, environmental economics also has its own basic concepts, theories and analytical tools, which constitute its foundation. Most of its concepts and theories are drawn from microeconomics, welfare economics and macroeconomics. To appreciate the utility and relevance of environmental economics and to use it in practical life, it is necessary for us to clearly define and understand its basic concepts and theories.

4.2 THE EQUI-MARGINAL PRINCIPLE

A Model of a Single Polluting Firm

Consider a polluting firm that faces an increasing marginal pollution abatement cost curve. Left unregulated it will choose to abate zero units of carbon and avoid the abatement costs represented by the area underneath the marginal abatement cost curve: B + C + D. Suppose a benefit-cost

analysis has determined that optimal abatement occurs at the blue dot where the marginal benefit and marginal cost curves intersect. The resulting level of emissions is e*

(measured right to left along the horizontal axis).

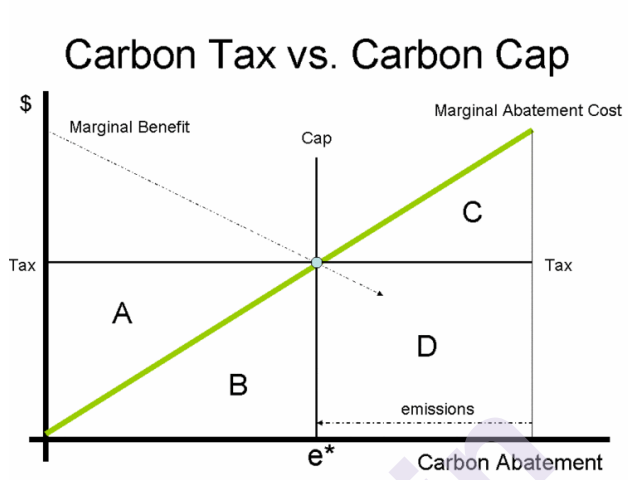


Fig. 4.1

Carbon Tax

One way to achieve this level of abatement is to set a tax where marginal benefit equals marginal abatement cost -- represented by the horizontal "tax" line. The polluting firm will notice that it is cheaper to abate carbon emissions as long as the marginal abatement cost is lower than the tax. Since the tax bill (A + B) is great than the marginal abatement cost bill (B) to the left of the vertical "cap" line the firm will choose to abate. To the right of the "cap" line the marginal abatement cost bill (C + D) is greater than the tax bill (D) so the firm will choose to pay the tax and continue to pollute.

Results:

- The efficient abatement level is achieved: e*
- The abatement cost to the pollution firm = B + D
- Government revenue = D

Carbon Cap

Another way to achieve this level of abatement is to set a cap where marginal benefit equals marginal abatement cost -- represented by the vertical "cap" line. The polluting firm must abate its carbon emissions to e*.

Results:

- The efficient abatement level is achieved: e*
- The abatement cost to the pollution firm = B

A Model with Two Polluting Firms

Now things get a bit more hairy. A two-panel diagram is needed to better understand the logic of trading The two-panel diagram illustrates the increasing marginal abatement costs of two firms. One has an old, dirty, plant with high abatement costs (in blue) that goes right to left with abatement. The other firm has a newer plant that has lower abatement costs (in green) that goes left to right with abatement. The width of the horizontal axis is the abatement that must be achieved to reduce overall emissions to the efficient level.

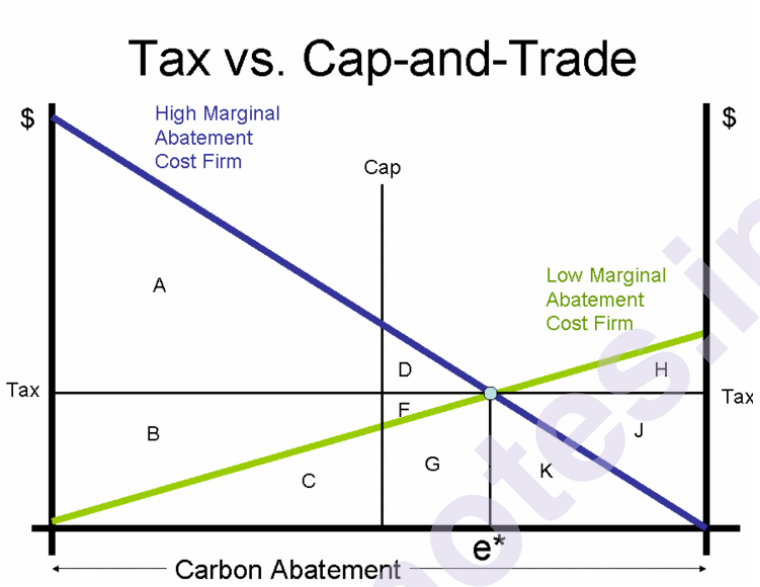


Fig. 4.2

The intersection of the two marginal abatement costs is where economic efficiency is achieved. This is known as the "equimarginal principle." The total costs of achieving the efficient abatement/emissions level is: C + G + K. The efficient emissions level, e*, shows that the low abatement cost firm should reduce more emissions than the high abatement cost firm.

Carbon Tax

One way to achieve this level of abatement is to set a tax where the marginal abatement costs are equal -- assuming that we have this information (we don't but we can iterate towards the intersection) -- represented by the horizontal "tax" line. As above, the polluting firms will notice that it is cheaper to abate carbon emissions as long as the marginal abatement cost is lower than the tax.

The high cost firm will abate to e* (right to left) and suffer abatement costs of K and pay a tax bill to the government equal to B + C + F + G. The low cost firm will abate to e* (left to right) and suffer abatement costs of C + G and pay a tax bill to the government equal to J + K.

Results:

- The efficient abatement level is achieved: e*
- The abatement cost to the polluting firms, C + G + K, is minimized
- Government revenue = B + C + F + G + J + K

Carbon Cap-and-Trade

Another way to achieve this level of abatement is to set a carbon cap by issuing carbon permits to polluting firms. Each permit gives the firm the right to emit one unit of carbon. If we don't have the political will to go ahead and give more permits to the high cost firm (in order to achieve efficiency) we can do it "fairly" by giving each firm the same amount of permits -- represented by the vertical "cap" line. The abatement cost to the low abatement cost firm is equal to area C. The abatement cost to the high abatement cost firm is D + F + G + K.

At some point the high cost firm might rather have a permit than pay those high costs. If it recognizes that its marginal abatement cost is higher than the marginal abatement cost of the low cost firm it could propose a trade. In effect, the blue line over area D, F and G is a demand curve for permits and the green line is a supply curve for permits. Anywhere in between the blue and green line is a permit price that is mutually agreeable between both firms. A competitive permit market will result in a permit price equivalent to the efficient carbon tax. Trading reduces overall abatement costs by area D + F.

Results:

- The efficient abatement level is achieved: e*
- The abatement cost to the polluting firms, C + G + K, is minimized

Conclusions

In terms of the market failure, the negative carbon externality, both a carbon tax and carbon cap-and-trade will achieve the same level of increased efficiency by achieving the optimal abatement level at the minimum cost. The only difference is the distributional implications. The cost to the firm is lower for carbon cap-and-trade. The government receives tax revenue with a carbon tax. Both policies are preferred over technological or output standards (i.e., command and control regulation).

4.3 ECONOMIC EFFICIENCY

Economic efficiency implies an economic state in which every resource is optimally allocated to serve each individual or entity in the best way while minimizing waste and inefficiency.

When an economy is economically efficient, any changes made to assist one entity would harm another.In terms of production, goods are produced at their lowest possible cost, as are the variable inputs of production.

Some terms that encompass phases of economic efficiency include allocative efficiency, productive efficiency, distributive efficiency, and Pareto efficiency. A state of economic efficiency is essentially theoretical; a limit that can be approached but never reached.

Instead, economists look at the amount of loss, referred to as waste, between pure efficiency and reality to see how efficiently an economy functions.

The principles of economic efficiency are based on the concept that resources are scarce. Therefore, there are not sufficient resources to ensure that all aspects of an economy function at their highest capacity at all times. Instead, scarce resources must be distributed to meet the needs of the economy in an ideal way while also limiting the amount of waste produced. The ideal state is related to the welfare of the population with peak efficiency also resulting in the highest level of welfare possible based on the resources available.

Productive firms seek to maximize their profits by bringing in the most revenue while minimizing costs. To do this, they choose the combination of inputs that minimize their costs while producing as much output as possible. By doing so, they operate efficiently; when all firms in the economy do so, it is known as productive efficiency.

Consumers, likewise, seek to maximize their well-being by consuming combinations of final consumer goods that produce the highest total satisfaction of their wants and needs at the lowest cost to them. The resulting consumer demand guides productive (through the laws of supply and demand) firms to produce the right quantities of consumer goods in the economy that will provide the highest consumer satisfaction relative to the costs of inputs. When economic resources are allocated across different firms and industries (each following the principle of productive efficiency) in a way that produces the right quantities of final consumer goods, this is called allocative efficiency.

Finally, because each individual values goods differently and according to the law of diminishing marginal utility, the distribution of final consumer goods in an economy are efficient or inefficient. Distributive efficiency is when the consumer goods in an economy are distributed so that each unit is consumed by the individual who values that unit most highly compared to all other individuals. Note that this type of efficiency assumes that the amount of value that individuals place on economic goods can be quantified and compared across individuals

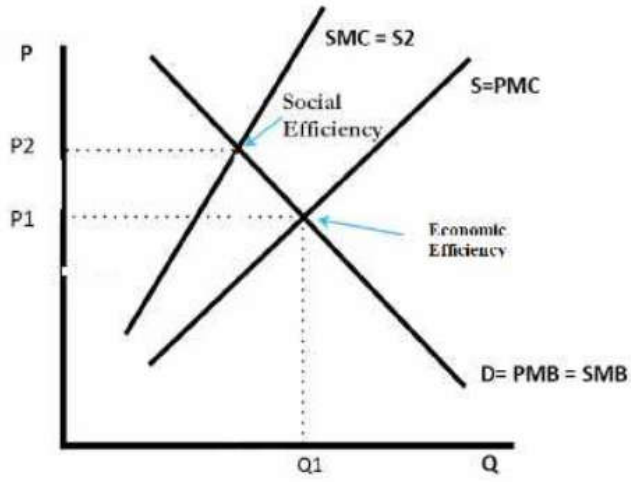


Fig. 4.3 Economic and Social efficiency

Intersection of S and D is a point of economic efficiency Fig 4.3 . To the right of the intersection output would be more than what is required for economic efficiency. There would be an excess demand or a deficient supply for the product. To the left of the intersection, the output would be less than what is economically efficient as there would be excess supply or deficit demand for the product.

4.4 DAMAGE COST & ABATEMENT COST

Pollution damage costs

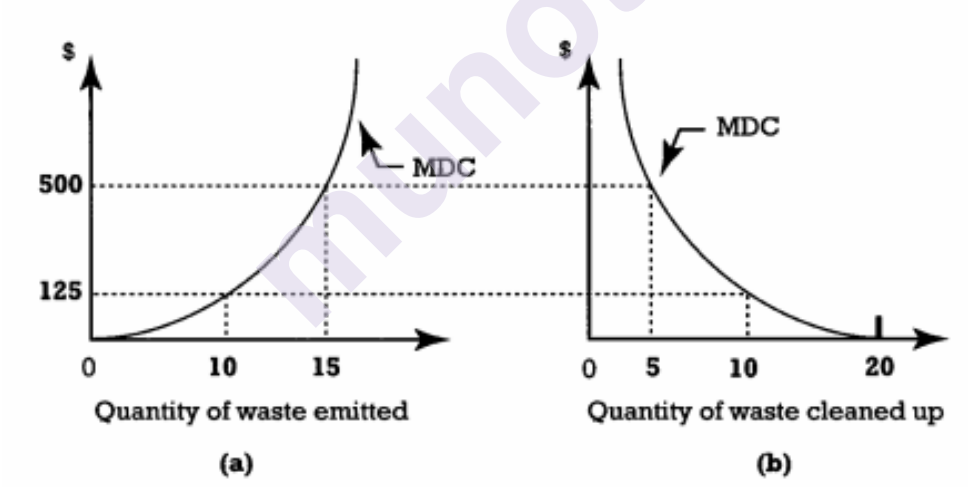
Even if it is technologically feasible to get rid of all pollutants from a given environmental medium, such an undertaking may be difficult to justify on the basis of cost considerations. However, when the volume of waste discharged exceeds the assimilative capacity of the environment, and is left untreated, it can contribute to a deterioration in environmental quality. The total monetary value of all the various damages resulting from the discharge of untreated waste into the environment is referred to as pollution damage cost.

Such damage to environmental quality may be manifested in a variety of ways, largely depending on the amount and the nature of the untreated waste. For example, when biodegradable pollutants, such as sewage, phosphate-containing detergents and feedlot waste are emitted into a lake, they can lead to the development of a process known as eutrophication. Over time, the outcome of this process is to cover a substantial portion of the lake with green substances composed mainly of algae and weeds. One immediate effect is the reduction of the scenic appeal of the lake. In addition, there is a negative impact on the population of aquatic organisms, because the ability of a body of water to support fish and other organisms depends on how much dissolved oxygen it contains. Thus, if biodegradable pollutants were discharged into a lake and left untreated, the damage to environmental quality would be identified in terms of

reduced scenic attraction and decreased population of certain aquatic organisms, such as fish. The monetary value of these adverse environmental effects constitutes pollution damage cost.

The identification and estimation of pollution damage costs are even more complicated in the case of persistent pollutants. Examples of such pollutants include toxic metals, such as lead and mercury, radioactive wastes, and inorganic compounds such as some pesticides and waste products produced by the petrochemical industry. What is particularly significant about these types of pollutants is not the mere fact that they are patently dangerous to living organisms and the ecosystem as a whole, but the fact that because of their very slow decomposition process they tend to persist in the environment for a very long period of time. In other words, their adverse environmental effects transcend present action. For example, radioactive elements leaking from nuclear power plants today will have detrimental effects over several generations. This makes the estimation of damage costs arising from persistent pollutants extremely difficult.

In general, then, pollution damage costs are identified in terms of the losses of or damage to plants and animals and their habitats; aesthetic impairments; rapid deterioration to physical infrastructures and assets; and various harmful effects on human health and mortality. In order to estimate damage costs, however, we need to go beyond the physical account of damage. More specifically, the damage identified in physical terms needs to be expressed in monetary terms as much as possible.



Figures 4.4a and 4.4b

As the above discussions indicate, the estimation of pollution damage costs is a formidable task and requires a good deal of imagination and creative approaches. Furthermore, other factors being equal, the more persistent the pollutants, the harder the task of evaluating damage costs. In fact, some aspects of pollution damage are simply beyond the realm of economic quantification. Regardless of these difficulties, pollution damage does occur. Hence, as a society striving for a better life, we need to develop a procedure that will provide us with a framework designed to enhance our understanding of pollution damage costs.

Conceptually, Figures 4.4a and 4.2b are two alternative representations of the general characteristics of the marginal pollution damage cost (MDC). As with the MCC curves, the only difference between these two figures is in the labeling of the x-axis. A basic assumption in the construction of these curves is that damage cost is an increasing function of pollution emissions. In other words, the damage caused by a unit of pollution increases progressively as the amount of pollution (untreated waste) emitted increases. As the numerical example in Figure 10.2a indicates, the marginal damage cost increases from $125 (the cost of the tenth unit of waste) to $500 (the cost of the fifteenth unit of waste) as the amount of waste emissions increases from 10 to 15 units. This is, of course, in accord with the ecological principle discussed in Chapters 4 and 5 of a cumulative (nonlinear) effect of pollution on the environment.

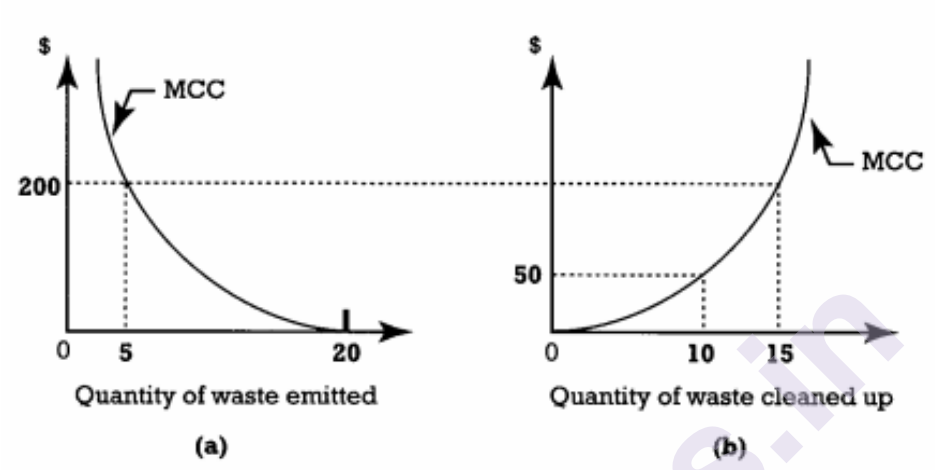
It is also important to note that these two alternative presentations offer different interpretations regarding the damage cost curve. In Figure 10.2a, as discussed above, the damage cost curve measures the social cost of the damage to the environment in monetary terms, resulting from each additional unit of waste emission. This cost increases as the volume of waste emitted increases. On the other hand, the damage cost curve represented by Figure 10.2b depicts the amount society is willing to pay to avoid damage (or cleanup) at the margin. In other words, it measures society's willingness to pay for improved environmental quality on an incremental basis, or the demand for environmental quality.

Pollution control (abatement) costs:

Pollution control (abatement) costs represent direct monetary expenditures by a society for the purpose of procuring resources to improve environmental quality or to control pollution. Expenditures on sewage treatment facilities, smokestacks, soundproof walls and catalytic converters on passenger cars are just a few examples of pollution control costs. These expenditures may be incurred exclusively by private individuals, such as expenditures on soundproof walls by residents living in close proximity to an airport. In contrast, sewage treatment facilities may be undertaken as a joint project by local and federal government agencies. In this case the expenditures are shared by two government bodies. In some situations, a project may be undertaken by a private firm with some subsidy from the public sector. Thus, as these examples illustrate, the bearers of the expenditures on pollution control projects may vary, and in some instances are difficult to trace. Despite this possible complication, the conventional wisdom is to view pollution control cost in its entirety. To this extent the specific source of the expenditure is irrelevant. What is relevant is that all components of the expenditures attributable to a specific project are fully accounted for, regardless of the source of the funds.

In general, we would expect the marginal pollution control cost to increase with increased environmental quality or cleanup activities. This is because incrementally higher levels of environmental quality require investments in technologies that are increasingly costly. For example, a certain level of

water quality could be achieved through a primary sewage treatment facility. Such a facility is designed to screen out the solid and visible material wastes, but nothing more. If a higher level of water quality is desired, an additional expenditure on secondary or tertiary treatment may be required. Such additional treatments would require implementation of new and costly technologies designed to apply either chemical and/or biological treatments to the water. Graphically, we can visualize the marginal control cost (MCC) as follows.



Figures 4.5a and 4.5b

Figures 4.5a and 4.5b are two alternative ways of representing the marginal pollution control cost in graph form. Before we proceed any further, it is very important to understand the exact reading of these two curves. First, as will be evident shortly, the two graphs convey the same concept, but have different labels on their x-axes. In Figure 4.5a, the x-axis represents units of untreated waste emitted into the environment, and in Figure 4.5b the same axis represents the units of treated waste or cleanup. Second, in Figure 4.5a, the marginal cost of the twentieth unit of waste is indicated to be zero. This number represents the benchmark or total number of units of waste that is being considered for treatment. Third, the curves in both figures measure marginal cost. For example, in Figure 4.5a, the cost is $200 when the unit of waste emitted is 5. What exactly does this cost measure? It measures the cost of cleaning up or controlling the fifteenth unit of waste. This is because given a benchmark of 20 units of waste, emission of only 5 units means a cleanup of 15 units (20–5). In fact, this result is easily confirmed by looking at Figure 4.5b since the marginal control cost of treating the fifteenth unit of waste is $200. This clearly shows that Figures 4.5a and 4.5b are two different ways of looking at the same thing. Finally, it is important to note that in both cases, the marginal pollution control cost increases at an increasing rate as a higher level of cleanup or environmental quality is desired. The numerical example in Figure 10.1b clearly illustrates this. The marginal cost to control (or treat) the tenth unit of waste is indicated to be $50. However, the marginal cost is increased to $200, a fourfold rise, to treat the fifteenth unit of waste.

At this stage it is important to specify certain important technological factors that determine the position of any marginal pollution control cost curve. More specifically, it is important to note that the marginal pollution control cost curves are constructed by holding constant such factors as the technology of pollution control, the possibility of input switching, residual recycling, production technology, etc. A change in any one of these predetermined factors will cause a shift in the entire marginal pollution control cost curve. For instance, a power company that uses coal as its primary source of input could reduce pollution (sulfur) emission by switching from coal with a high sulfur content to low-sulfur coal. In this particular case, the effect would be to shift the marginal pollution control cost downward. Similar results would occur if there were a significant improvement in pollution control technology, such as the development of a new and more efficient catalytic converter for automobiles.

Finally, since pollution control costs are explicit or out-of-pocket expenditures, it is assumed that no apparent market distortion occurs as a result of a third party effect—that is, an externality. In other words, for pollution control costs, there will be no difference between private and social costs. However, this is not to suggest that market distortion in the assessment of pollution control costs cannot exist as a result of either market imperfection (power) or government intervention.

As stated earlier, pollution control cost accounts for only one side of the total social costs of pollution. Let us now turn to a detailed examination of the second component of the total pollution disposal costs, namely pollution damage costs.

4.5 ROLE OF INSTITUTIONS IN ENVIRONMENTAL PROTECTION

The role of national government is critical for control of environmental pollution control,conservation and improvement of environment for promoting sustainable development. Toaddress the diverse environmental issues a number of environment related institutions andorganization have been setup at international, national level by United Nations, national governments and civil society. An environmental organization is an organization seeks toprotect, analyze or monitor the environment against misuse or degradation or lobby forthese goals. Environmental organization may be a government organization, a nongovernment organization, a charity or trust.

The Role of Government Organizations in Environmental Protection

1. Central Pollution Control Board

Established: It was established in 1974 under the Water **(Prevention and Control of Pollution) Act, 1974.**

Objective: To provide technical services to the Ministry of Environment and Forests under the provisions of the **Environment (Protection) Act, 1986.**

Key Functions:

- Advise the Central Government on any matter concerning prevention and control of water and **air pollution and improvement** of the quality of air.
- Plan and cause to be executed a nation-wide programme for the prevention, control or abatement of **water and air pollution**
- Coordinate the activities of the **State Board and resolve disputes** among them
- Provide technical assistance and guidance to the **State Boards**, carry out and sponsor **investigation** and **research** relating to problems of water and air pollution, and for their prevention, control or abatement
- **Plan** and **organise** training of persons engaged in the programme on the prevention, control or abatement of water and air pollution
- Organise through mass media, a **comprehensive mass awareness programme** on the prevention, control or abatement of water and air pollution
- Collect, compile and publish technical and **statistical data** relating to water and air pollution and the measures devised for their effective prevention, control or abatement;

National Biodiversity Authority

Established When: It is a statutory **autonomous body** under the **Ministry of Environment and Forests,** Government of India established in 2003, after India signed Convention on Biological Diversity (CBD) in 1992

Headquarter: Chennai

The objective of the body: Implementation of **Biological Diversity Act, 2002**

Key Functions:

It acts as a **facilitating, regulating and advisory** body to the Government of India "on issues of conservation, sustainable use of biological **resources and fair and equitable** sharing of benefits arising out of the use of biological resources."

Additionally, it advises State Governments in identifying the areas of **biodiversity importance** (biodiversity hotspots) as heritage sites.

Animal Welfare Board of India

Established When: It was established in 1962 under Section 4 of The Prevention of Cruelty to Animals Act,1960.

Headquarter: Chennai

Objective: To advise Government on Animal Welfare Laws and promotes animal welfare in the country.

Key Functions:

- **Recognition of Animal Welfare Organisations**: The Board oversees **Animal Welfare Organisations (AWOs)** by granting recognition to them if they meet its guidelines. The organisation must submit paperwork; agree to nominate a representative of the Animal Welfare Board of India on its Executive Committee, and to submit to regular inspections. After meeting the requirements and inspection, the organisation is considered for grant of recognition.
- The **AWBI** also appoints key people to the positions of (Hon) Animal Welfare Officers, who serve as the key point of contact between the people, the government and law enforcement agencies.
- **Financial assistance**: The Board provides financial assistance to recognised Animal Welfare Organisations (AWOs), who submit **applications to the Board**. Categories of grants include Regular Grant, Cattle Rescue Grant, Provision of Shelter House for looking after the **Animals, Animal Birth Control (ABC) Programme, Provision of Ambulance for the animals in distress and Natural Calamity grant.**

Forest Survey of India

Established When: It is a government organization in India under the **Union Ministry of Environment, Forest and Climate Change** for conducting forest surveys and studies. The organization came into being in, 1981.

Headquarter: Dehradun, Uttarakhand

Objective

The objective of the organization is monitoring **periodically** the changing situation of **land and forest resources** and present the data for **national planning**; **conservation** and **management** of **environmental preservation** and **implementation** of social forestry projects.

Key Functions

- The Functions of the Forest Survey of India are:
- To prepare State of **Forest Report biennially**, providing an assessment of the latest forest cover in the country and monitoring changes in these.

- To conduct an inventory in **forest and non-forest** areas and develop a database on forest tree resources.
- To prepare thematic maps on **1:50,000 scale, using aerial photographs**.
- To function as a **nodal agency for collection, compilation, storage** and dissemination of spatial database on forest resources.
- To conduct **training of forestry personnel in the application** of technologies related to resources survey, remote sensing, GIS, etc.
- To strengthen **research & development** infrastructure in FSI and to conduct research on applied forest survey techniques.
- To support **State/UT Forest Departments (SFD)** in forest resources survey, mapping and inventory.

Role of Non-Governmental Organizations (NGO) in Environment Protection!

Today we come across various non-governmental organizations whose concerns are focused on various areas such as social issues, health issues, and environmental issues. Non-Governmental Organization is a broad term, which includes charity organizations, advisory committees and various other professional organizations. NGOs in India are spread across the country and they have close contacts with communities.

There are large number of NGOs in India and other countries that are exclusively working for environmental, protection, conservation, and awareness. The number of these non-governmental organizations which are actively involved in environmental protection in our country is, in fact, more than in any of the developing country. Increasingly, the government is viewing NGOs not only as agencies that will help them to implement their programs, but also as partners shaping policy and programs.

Some of the international environmental organizations are Greenpeace, Worldwide Fund for Nature' (WWF), Earth First, etc. Let us now have a detailed discussion on some of the environmental organizations and their efforts in protecting environment.

Greenpeace:

Greenpeace is an environment-friendly international organization, which aims at promoting environmental awareness. It is an independent, campaigning organization, addressing the environmental abuse through direct, non-violent confrontations with governments and companies. It exposes the global environmental problems and provides solutions for a healthy environment.

Greenpeace focuses on the most crucial worldwide threats to our planets biodiversity and environment.

Greenpeace has played an important role in preserving the environment, which is proved by its successful achievements:

1. A ban on toxic waste exports to less developed countries.

2. A moratorium on commercial whaling.

3. A United Nations convention providing for better management of world fisheries.

4. A Southern Ocean Whale Sanctuary.

5. A 50-year moratorium on mineral exploitation in Antarctica.

6. Ban on the dumping at sea of radioactive and industrial waste and disused oil installations.

7. An end to high-sea, large-scale driftnet fishing.

8. A ban on all nuclear weapons testing their first ever campaign.

Worldwide Fund for Nature (WWF)—India:

WWF is an international organization for wildlife conservation with its focus on protecting particular species of wildlife fauna. As its range of activities broadened, the international organization believed that its name no longer reflected the scope of its activities and became the Worldwide Fund for Nature in 1986. But the affiliated groups in the United States and Canada retained the original name. The organization is now simply, referred to as WWF.

WWF-India is committed to protecting and saving the already degraded and threatened natural bounties in the country. The organization is today dedicated to the conservation of natural habitats and ecosystems in India.

WWF-India was established as a Charitable Trust in 1969. With its network of State/Divisional and Field Offices spread across the country to implement its programs, WWF-India is the largest and one of the most experienced conservation organizations in the country.

The Secretariat of the organization functions from New Delhi. The organization is part of the WWF family with 27 independent national organizations. The coordinating body, the WWF International, is located at Gland in Switzerland.

The WWF-India Mission has five broad program components:

1. Promoting India's ecological security; restoring the ecological balance.

2. Conserving biological diversity.

3. Ensuring sustainable use of the natural resource base.

4. Minimizing pollution and wasteful consumption, promoting sustainable lifestyles.

WWF-India implements its conservation programs through Field Programs, Public Policy, Education, Communications, NGO Networking, and Resource Mobilization.

The key environmental issues, which WWF-India has involved itself with, are:

The tiger conservation program, fresh-water and wetlands program, river dolphin conservation program, wildlife trade monitoring, managing forests, environmental law, information management and environmental education.

Some Other Environmental Organizations in India:

1. The Bombay Natural History Society (BNHS):

Founded in 1883, is recognized as one of the foremost conservation research organizations in the world. It aims to collect data on the specimens on natural history throughout the Indian sub-continent. To disseminate knowledge of flora and fauna by means of lectures, field trips, literature, expeditions and to study wildlife-related problems and recommend management plans to conserve wildlife and its habitat.

2. Development Alternatives Group:

Development Alternatives Group based in Delhi works in all parts of the country. It was established in 1983 to design options and promote sustainable development through programs of economic efficiency, equity and social justice, resource conservation, and self-reliance. Its activities cover the entire nation: It is working in the field of pollution monitoring and control, waste recycling management, wasteland development, and appropriate technology.

Its objective is to design options and promote sustainable development through programs of:

i. Economic efficiency,

ii. Equity and social justice,

iii. Environmental harmony,

iv. Resource conservation, and

v. Self-reliance.

3. The Energy Research Institute (TERI):

Established in 1974, is a wholly independent, non-profit research institute. Its mission is to develop and promote technologies, policies, and institutions for efficient and sustainable use of natural resources. It has been imparting environmental education through projects, workshops, audio-visual aids, and quiz competitions.

It deals with policy-related works in the energy sector, research on environmental subjects, development of renewable energy technologies and promotion of energy efficiency in the industry and transport sector. TERI also has a major program in biotechnology, the applications of which are oriented toward increased biomass production, conversion of waste into useful products and mitigating the harmful environmental impacts of several economic activities.

4.6 COASE THEOREM

Environmental resources are externality-ridden because they lack a clearly defined property right. Once this is acknowledged, any effort to internalize (remedy) environmental externalities requires an effective scheme of assigning property rights. This indeed captures the essence of the property rights approach. More specifically, this approach requires that property rights should be assigned to one of the parties involved in an environmental dispute. Furthermore, according to Coase (1960), the assignment of property rights could be completely arbitrary and this would have no effect on the final outcome of the environmental problem under consideration.

For example, in the case of environmental pollution, the Coasian approach suggests that the optimal level of pollution can be achieved by an arbitrary assignment of property rights to either the polluter(s) or the pollutee(s). This proposition that the assignment of property rights to a specific party has no effect on the optimal level of pollution is the core concept of what is widely known as the Coase theorem. To demonstrate the essence of this theorem in a rather simple manner, we will again use the two familiar firms: the paper mill and the fish hatchery.

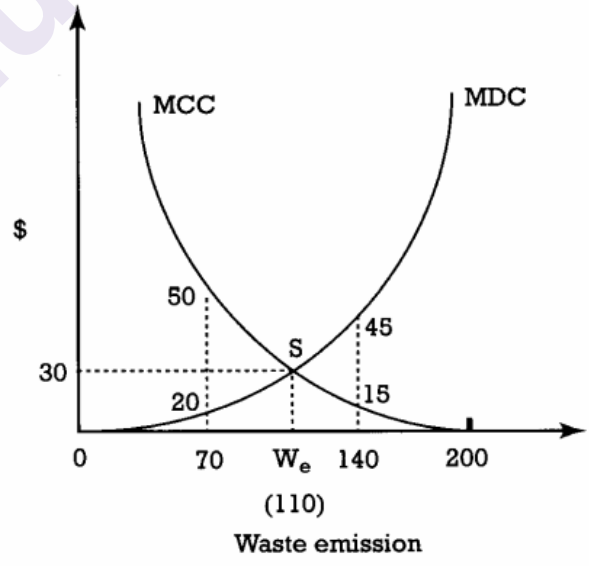


Figure 4.6

As discussed earlier, the problem between these two firms arises because their economic activities involve the joint use of a river. To demonstrate

how this problem can be remedied using a property rights approach, let us start by assuming that the legal rights to the use of the river belong to the hatchery. Given this, the hatchery, if it wishes, could completely deny the paper mill access to the river. That is, the paper mill would not be permitted to use the river to discharge its waste. In Figure 4.6, this situation is represented by the origin, where the amount of waste emitted into the river from the paper mill is zero. This means that the paper mill has to find an alternative way of disposing the waste from its current operation—a total of 200 units. The key question is, then, will this be a stable situation? Given the MDC and MCC curves presented in Figure 4.6, the answer to this question would be a nod for the following reason.

When the waste discharged by the paper mill is less than We, we observe that MCC (the incremental cost of cleanup for the paper mill using other means than the river) is greater than the MDC—the incremental damage cost to the hatchery. For example, as shown in Figure 11.2, for the seventieth unit of the waste that is emitted into the river, the marginal damage cost to the hatchery is $20. However, to achieve this same result, the cost to the paper mill is $50. Note that this $50 is the marginal control cost of treating (cleaning) the one hundred and thirtieth unit of waste (200–70).

Thus, given this situation, the paper mill will clearly have an incentive to offer a financial bribe to the fish hatchery for the right to use the river for discharging its industrial waste. For example, as shown in Figure 11.2, to discharge the seventieth unit of waste the paper mill will be willing to pay the hatchery a fee of between $20 and $50. This should be acceptable to both parties. For the hatchery, a payment exceeding $20 more than compensates for the damage caused to its fish operation from the dumping of the seventieth unit of waste into the river. Similarly, this situation should also be advantageous to the paper mill because the cost of using an alternative technology to dispose of the seventieth unit (i.e., to clean up the one hundred and thirtieth unit) of waste to this firm is at least $50. In general, then, these two firms will be in a position to engage in a mutually beneficial transaction provided that, at the point where the negotiation is taking place, MCC>MDC. Furthermore, the negotiation between these two parties ceases when, for the last unit of waste discharged by the paper mill, MCC=MDC. This is indeed the condition for the optimal level of pollution. In Figure 11.2, this is attained at We, or 110 units of emission.

As discussed earlier, the Coase theorem goes beyond the mere recognition of optimality. It also states that this optimal outcome is completely independent of the two parties who have rights to the river. To demonstrate this, let us now consider the case where the paper mill has exclusive legal rights to the use of the river. Under these circumstances the paper mill, if it wishes, can dispose of all its waste into the river. If this strategy is followed, then as shown in Figure 11.2, the paper mill will discharge a total of 200 units of waste into the river. However, this company is not limited to this option only. As shown in Figure 11.2, for each unit of waste discharged between 110 and 200 units, the MDC is

greater than the MCC. This situation will allow the fish hatchery and the paper mill to engage in a mutually beneficial transaction.

To see this, let us focus on what happens when the emission is at 140 units. When this unit of waste is discharged, the MDC to the fish hatchery is $45, but the cost to the paper mill of treating this same unit is $15. Note that the $15 is the marginal cost to the paper mill for controlling the sixtieth unit of emission (200–140). Thus, when the emission level is at 140 units the MDC is greater than the MCC. Given this, the hatchery will have an incentive to offer a financial bribe to the paper mill of anywhere between $15 and $45 to withhold this unit of waste. It is easy to see that the paper mill will most likely take this offerseriously since the cost of controlling the sixtieth unit of waste (200–140) is only $15. Thus, to the extent that the offer of the hatchery exceeds $15, the paper mill will abide by the wishes of the hatchery. A similar situation prevails for all the units where the MDC exceeds the MCC—that is, between 200 and 110 units. Thus, the optimal level of pollution is again reached at We or 110 units, where MDC=MCC. This result verifies the validity of the Coase theorem.

In the 1960s, for most economists the Coase theorem was an exciting and appealing revelation. The profound implication of this theorem has been that pollution problems can be resolved by an arbitrary assignment of property rights. What is appealing about this is that it reduces the role of public regulators to a mere assignment of enforceable ownership rights. Once this is done, as discussed above, the optimal level of pollution is attained through voluntary negotiation of private parties—which is consistent with the spirit of the private market.

Despite its appeal, however, the Coasian approach has several weaknesses.

1. In our example above, the source of the pollution as well as the parties involved in the dispute are easily identifiable. However, in many realworld situations, the sources of the pollution are likely to be multifaceted and their impacts quite diffuse. In addition, environmental disputes normally involve several parties. In a typical real-world situation, then, the cost of negotiation and enforcement—the transaction cost—could be quite high. As discussed earlier, a high transaction cost could distort the final outcome of an environmental dispute in a rather significant manner. In such a situation, a resolution reached using the property rights approach might be far removed from what is considered to be socially optimal.

2. A property rights approach, especially its Coasian variation, seems to support the ethos that "the end justifies the means." As is evident from the above discussion, in this approach the focus is singularly placed on attaining an optimal outcome. Whether the optimal outcome is attained by assigning property rights to the polluters or assigning them to the pollutees is considered entirely irrelevant. Clearly, this seems to counter what appears to be the conventional wisdom—the "polluter-pays principle."

3. According to the Coase theorem, the optimal level of pollution can be achieved irrespective of which party was given the initial property rights: — the polluters or pollutees. However, what the theorem does not address is the impact the initial assignment of property rights has on income distribution. In

general, the income position of the party empowered with property rights is positively impacted.

4. In the above analysis it is assumed that shifting the property rights from one party to another would not cause either party to cease to function. What if this is not the case? What if giving the property rights to the hatchery makes the paper mill go out of business or vice versa?

So far we have examined two possible mechanisms by which a society could attempt to control pollution, namely liability laws and property rights regimes. In both of these types of pollution control schemes, the regulatory roles of public authorities were viewed as something to be minimized. In the case of liability laws, the principal role of the court is reduced to simply setting the fine (compensation) polluters have to pay to the damaged parties. Under the property rights approach the sole responsibility of the public authorities is to assign property rights to one of the parties involved in an environmental dispute. Once these are done, at least theoretically it is presumed that the interaction of the relevant parties involved in the dispute will lead to an efficient outcome. In this sense, then, it would be fair to say that the proponents of both liability laws and property rights are advocates for a decentralized approach to pollution control.

While this may be appealing in some professional circles, especially among economists, the fact remains that the above two approaches are of limited use in a real-world situation. This is because modern environmental problems are generally widespread in their scope and involve a large number of people with varying socioeconomic circumstances. For this reason, as public awareness of environmental problems has increased, at least until recently one of the most popular and appealing methods for reducing environmental damages has been direct regulation—a centralized form of pollution control. Let us now discuss and evaluate pollution control instruments that fall into the categories most often labeled the "command-and control" approach.

4.7 SUMMARY

- The intersection of the two marginal abatement costs is where economic efficiency is achieved. This is known as the "equimarginal principle."
- Economic efficiency implies an economic state in which every resource is optimally allocated to serve each individual or entity in the best way while minimizing waste and inefficiency.
- When an economy is economically efficient, any changes made to assist one entity would harm another. In terms of production, goods are produced at their lowest possible cost, as are the variable inputs of production.
- The total monetary value of all the various damages resulting from the discharge of untreated waste into the environment is referred to as pollution damage cost.

- Pollution control (abatement) costs represent direct monetary expenditures by a society for the purpose of procuring resources to improve environmental quality or to control pollution.
- In the case of environmental pollution, the Coasian approach suggests that the optimal level of pollution can be achieved by an arbitrary assignment of property rights to either the polluter(s) or the pollutee(s). This proposition that the assignment of property rights to a specific party has no effect on the optimal level of pollution is the core concept of what is widely known as the Coase theorem.

4.8 QUESTIONS

1. Discuss the Equi- Marginal Principle Models.
2. Explain briefly the concept of Damage Cost.
3. Write a note on Abatement cost.
4. Explain the Role of institutions in Environment Protection.
5. Explain the coase approach in relation to environment protection.

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Module III

5

SUPPLEMENTARY ANALYTICAL TOOLS AND ENVIRONMENTAL ISSUES - I

Unit Structure:

5.0 OBJECTIVES

After studying this module, you shall be able to

- To know and understand the concept of Valuation of Natural Resources and learn various methods of valuation
- Understand and study the concept of Life Cycle Analysis
- Know the term pollution and study the causes, effects and measures of air, water and noise pollution
- Causes of ozone layer depletion
- Concept of Green House Gas Emission, its causes and effects
- Learn the major problem of Global Warming and Climatic Change

5.1 INTRODUCTION

These days, environmental degradation is a great concerned for every nation in the world. Subsequently, many measures have been taken up in society level to improve the quality of the environment or to reduce environmental degradation. As society developed, man's impact on environment grew in scope and strength. Nature has been increasingly damaged, restorative capabilities have progressively weakened and human environment is decaying day by day. Measures are now taken to prevent this environmental degradation.

5.2 VALUATION OF NATURALRESOURCES: DIRECT AND INDIRECT METHODS ENVIRONMENTAL IMPACT ASSESSMENT

Natural resource valuation has always had a fundamental role in the practice of cost-benefit analysis of health, safety, and environmental issues. Today, this role is becoming all the more apparent in the conduct of natural resource damage assessments (NRDA) and cost-benefit analyses of environmental restoration (ER) and waste management (WM) activities. As such, environmental professionals are more interested in how natural resource values are affected by ER and WM activities.

Monetary valuation of environmental goods has become very important and the aim of such valuation is usually to incorporate environmental concerns into a cost-benefit analysis.

Valuation can simply be defined 'as an attempt to put monetary values to environmental gooda and services or natural resources. It is a key exercise in economic analysis and its results provide important information about values of environmental goods and services. This information can be used to influence decisions about wise use and conservation of these resources. Valuation refers to the process of assigning economic values to environmental/natural resources. It is a way to understand how much something is worth to particular people or to the society as a whole. Economic valuation is done on the basis of economic theory estimating Consumer's and producer's surplus using market price and quantity data regarding the environmental goods and services traded in the market.

The economic method considers Total Economic Value which considers the use value as well as non-use value of environmental goods and services. The use value refers to the tangible features of commodity which satisfies some human requirement for which people are ready to make some payment. Whereas non-use value is the value that people assign to environmental goods and services, even if they may never use it.

The use value (an observable interaction between the individual and the environment) is further divided into following parts such as

- Direct/Actual Use Value which is obtained through those removable products in nature which directly satisfy human wants through their consumption or those which have direct consumptive uses. Such use can be for commercial purpose (profit motive) or non-commercial purpose (without profit).

- Indirect Use value is obtained through a non-removable product in nature which indirectly satisfy human wants without their consumption or which have non-consumptive uses. Non-use value does not involve actual interaction between people and the environment.

- Option Value is the price that the individuals are willing to pay for conservation of an element in view of its possible use in the future. It

is not related to current use and is used to measure the value attached to future use. Option value is related to potential, but uncertain, future resource uses-either direct or indirect or either commercial or non-commercial. It is defined as the willingness to pay by the potential user for the possible use of natural environment in future.

The non-use value is also known as non-user or passive value. It is the value assigned for existence of the natural resources. It is further divided into the following parts

- Bequest value is the value placed for maintaining or preserving a natural asset or resource, that has no use now, so that it is available for future generations. This value is placed on a resource that will never be used by current individuals and thus, it derives the value from satisfaction of preserving a natural environment or a historic environment (natural/cultural heritage) for future generation. It refers to an individual willingness to pay to preserved resource for future generation.

- Existence Value is derived from the knowledge of people about the existence of natural resources. It reflects the benefit that people receive from knowing that a particular environmental resource is existing, for example the knowledge of endangered species.It refers that the value which is individual is willing to pay for an environmental amenity even though individual received no direct benefit.

- Altruistic Value means 'selfless' or 'unselfish', it is the value assigned to the environment resources for unselfish reasons like people may want natural resources to be there for the benefit of other people during their life-time.Altruistic Value is related with the advantages, benefits and the satisfaction which people derive from their knowledge which explains that there is an existence of environmental assets for the pleasure of other people living in present times. It represents the value of scenic beauty even though no market transaction may occur to capture that value

Though these methods are used for valuation yet they suffer from several problems or limitations such as

- It has a very limited coverage. It is so because very few environmental goods and services are bought and sold in the market.
- There is a problem of market imperfections. It distorts prices and thus the efficacy of such prices in measuring the net benefit of environmental resource is inappropriate.
- Another problem is that we also get the seasonal and cyclical variations in prices.
- The scope or limit of market economy also depends on the level of development of an economy. In underdeveloped countries, many resources that contribute to the production are not brought to the market and thus they go unaccounted . Thus, they are not reflected in the prices.

5.3 THE METHODS OF ENVIRONMENTAL VALUATION ARE BROADLY DIVIDED INTO TWO CATEGORIES VIZ.

I. Market Based Methods

II. Non-Market Based Methods

I. Market Based Methods: This method uses the market price of environmental goods and services which are bought and sold in the market place. It is based on the Cost-Benefit analysis.

1. **Market Value Based on Valuation Approach** depends on the market price and quantity to derive total value. It depends on the value of environmental goods and services based on the market price and the available quantity of these goods and services. In this we get

A. Observed Market Value Approach: Demand for natural resources is measured on the assumption that many factors that might influence demand, such as personal income, the prices of related goods and services, and individual tastes and preferences, remain unchanged during the study period. Under these assumptions, the estimated demand curve is a systematic measure of how people value the resource. To illustrate, Figure 1 shows that 20,000 acres of land were sold at a market price of $1500 per acre. In the course of these land transactions, $30.0 million exchanged hands in the land market, i.e., 20,000 x $1500. Had land become increasingly scarce, this scarcity would ultimately be reflected in higher land prices. It is the most straight forward method.

B. Related Goods Approach: It is related to determine the value of non-marketed goods. It includes

- **Barter Exchange Approach:** Here we take note of gods and services exchanged for goods and services. some of the forest products such as wild fruits and vegetables are not sold in formal markets. Some of these goods, however, may be exchanged on anon-commercial basis for goods which are available in the market. The unit of exchange between the two can be used to valuation of the forest product. For example, leafy vegetables are collected from forest by villagers residing in fringe areas, which are used for self-consumption. Since these vegetables are not marketed it is not possible to find out their market prices. However, if these vegetables are regularly exchanged for some other commodity, say paddy, then the unit of exchange between leafy vegetable and paddy can be found out. The market price of paddy in this case could be used to find the value of the leafy vegetables under consideration.

- **Direct Substitute Approach:** In this case the value of a similar good is used for valuation of the natural resource. For example, the value of he1 wood collected by villagers fiom the nearby forests. Here a close substitute would be firel wood bought fiom the market or even the

value of kerosene or charcoal equivalent to the fuel wood collected. The accuracy of this method depends upon the extent to which the natural resource and the marketed product used as substitute are similar.

- **Indirect Substitute Appmach**: In many cases it is difficult to find a direct substitute. which enters into formal market, for the environmental function to be evaluated. In such cases we combine the production function approach with the direct substitute approach. First, we find a direct substitute of the environmental function. Second, we find out the value of this direct substitute through the production function approach discussed earlier. Thus we find out the value of the environmental function indirectly through the production function approach. The indirect substitute approach is based on stringent assumptions about the substitutability between the two goods, the role of the substitute good as an input in the production of the output, and the value of the output.

2. **Benefit Based approach** deals with the benefits derived from the economic activities. It takes note of the

A. **Productivity Approach:** It is a common economic technique. It relates output to different levels of inputs i.e. say different factors of production like land, labour, capital, raw material etc. It makes use of the market price.

B. **Change in Income or Human Capital or Foreign Exchange Approach**: It is estimated on the basis of changes in income either due to degradation or improvement in environment. Degradation of environment creates several health hazards and people fall sick. There are several monetary damages due to loss of work, ill health disability caused by environmental degradation. The damages are in the form of foregone earnings due to untimely death, sickness, absenteeism etc. ,increased medical expenditure and physical cost.The human capital approach values environmental attributes through their effects on the quantity and quality of labour. The loss earnings approach focuses on the impact which adverse environmental conditions have on human health and the resultant costs to society in terms of income lost through illness, accidents and spending on medical treatments. But at the same time in the healthy environment there will be an improvement in health, postponed illness, fewer deathsetc.

3. **Cost based Valuation Approach uses following techniques:**

A. **Opportunity Cost Approach:** This method values the benefits of environmental protection in terms of what is being foregone to achieve it. This forms the basis of compensation payments for the compulsory purchase by the government of land and property under eminent domain laws. The opportunity cost method is useful in cases where it is difficult to enumerate the benefits of an environmental change. For example, rather than comparing the benefits of various alternative conservation schemes in order to choose between them, the method

can be used to enumerate the opportunity costs of foregone development associated with each scheme with the preferred option, being the one with the lowest opportunity cost.

This method is used when individual labour is involved in harvesting or collecting the natural resource. A basic assumption is that capital requirement for such a job is minimal. For example, for gathering &el wood in forests individuals need to spend time and do not need much capital. The opportunity cost of such time spent could be considered as the value of the environmental resource under consideration

B. Replacement Cost Method: The replacement/restoration cost technique can be used to measure the costs incurred in restoring or replacing productive assets or restoring the natural environment or human health as a result of the impacts of environmental degradation. As with preventative expenditure, restoration costs is a relatively simple technique. The resource replacement cost method determines damages for natural resources based on the cost to restore, rehabilitate, or replace the resource or resource services without injury to the level of the resource stock or service flow. This is a Cost-based technique that measures the potential expenditures that would be required to replace or restore a productive asset that would be damaged by some project or development. These costs are then compared to the costs of preventing the damage from occurring to determine which is more efficient. A shadow project is usually designed specifically to offset the environmental damage caused by another project. For example, if the original project was a dam that inundated some forest land, then the shadow project might involve the replanting of an equivalent area of forest elsewhere. It values an environment good by the cost incurred in restoring the environment to its original state of level after it has damaged. In the following diagram the benefits and costs per unit are measured on the vertical axis while the level of restoration is at the horizontal axis. The restoration level means to replace the lost environmental good. The slope of curve B indicates that with the increase in restoration level, benefits increase at a decreasing rate.

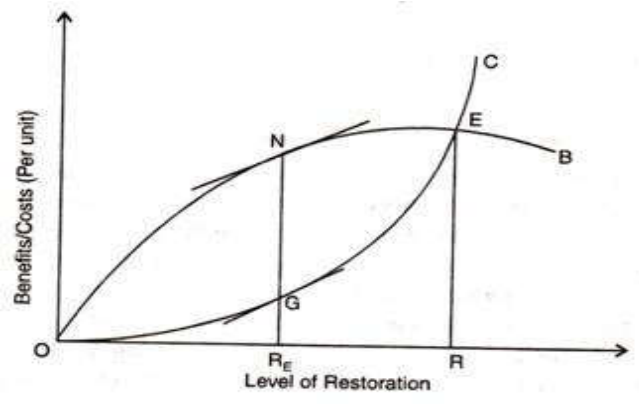


Figure : 5.1

The slope of curve C indicates that the restoration costs are an increasing function of the level of restoration. The economic efficiency is achieved at the restoration level OR_E where the difference between curve B and curve C is the maximum. The net gain is NG at this level of restoration.

C. **Relocation/Restoration Cost Method:** This is a cost-based technique used to estimate the monetary value of environmental damages based on the potential costs of relocating a physical facility that would be damaged by a change in environmental quality. This method relies on data on potential expenditures. This method is applicable in situations where natural environment in a particular area is put to some alternative use. For example, the cost of establishing a new protected forest area. In this method, the flow of ecological functions is maintained as in restoration cost and replacement cost techniques. The difference, however, is that instead of recreating ecological functions in the vicinity, the inhabitants are moved to a different locality.The restoration cost technique takes into account the cost of recreating the ecosystem. For example, degradation of forests results in a reduced flow of forest products and other functions. In order to restore the flow government intervention (in terms of policy implementation and afforestation) is required. According to the restoration cost method, the value of forest functions is its restoration or recreation cost.

D. **Preventive Expenditure:** In this method the value of environmental benefit is taken to be the cost of mitigating the adverse impact of environmental degradation. We can cite several examples to explain the method: Farmers often increase the use of inputs (fertilizer, pesticides, seed, etc.) to neutralize the effect of falling land productivity. In order to avoid cough, breathlessness or irritation in the eye residents in an industrial area may take regular medicines. The expenditure on such counts can be added to obtain the total preventive cost, which will provide an estimate of the value of environment. It is also called as 'Exclusion facilities', 'Defensive Expenditures' or 'Mitigation Expenditure'.

II. Non-Market Based Methods: The market price does not correctly measure the economic value of goods and services. Many a times many people are actually willing to pay more price for the goods than the market price. Thus, their value exceeds the market price. Non-market value tries to find the value of those environmental goods and services which do not enter into market or for which there is no market existing.

A. **Expressed/Stated Preference Methods:** The demand for environmental goods can be measured by examining individuals' expressed/stated preference for these goods relative to their demand for other goods and services. These techniques avoid the need to find a complementary good (travel or house), or a substitute good (compensating wage rate), to derive a demand curve and hence estimate how much an individual implicitly values an environmental good. Moreover, expressed preference techniques ask individuals explicitly how much they value an environmental good.

Contingent Valuation Method (CVM):

Analytic survey techniques rely on hypothetical situations to place a monetary value on goods or services. Most survey-based techniques are examples of contingent valuation method. Contingent valuation frequently elicits information on willingness to pay or willingness to accept compensation for an increase or decrease in some usually non-marketed goods or services. This method puts direct questions to individuals to determine how much they might be willing to pay for environmental resources or how much compensation they would be willing to accept if they were deprived of the same resources. This method is more effective when the respondents are familiar with the environmental good or service and have adequate information on which to base their preferences.

(1) Trade-Off Game Method:

This method relates to a set of contingent valuation techniques that rely on the creation of a hypothetical market for some good or service. In a single bid game the respondents are asked to give a single bid equal to their willingness to pay or willingness to accept compensation for the environmental good or service described. In an iterative (repeating) bid game the respondents are given a variety of bids to determine at what price they are indifferent between receiving (or paying) the bid or receiving (or losing) the environmental good at issue.

The trade-off game method is a variant of the bidding game wherein respondents are asked to choose between two different bundles of goods. Each bundle might, for example, include a different sum of money plus varying levels of an environmental resource. The choice indicates a person's willingness to trade money for an increased level of an environmental good. When no money is involved, the approach becomes similar to the costless-choice method.

(2) Costless-Choice Method:

The costless-choice method is a contingent valuation technique whereby people are asked to choose between several hypothetical bundles of goods to determine their implicit valuation of an environmental good or service. Since no monetary figures are involved, this approach may be more useful in settings where barter and subsistence production are common.

(3) Delphi Method:

The Delphi method is a variant of the survey-based techniques wherein experts, rather than consumers, are interviewed. These experts place values on a good or service through an iterative process with feedback among the group between each iteration. This expert-base approach may be useful when valuing very esoteric resources.

This is really a specialized survey technique designed to overcome the speculative and isolated nature of expert opinions. A sufficiently large sample of experts is presented individually with a list of events on which to attach probabilities and to which other events, with probabilities may be added. Some recent Delphi exercises have been recreation-specific. But

testing the accuracy of their forecasts is not yet possible, especially since the predictions are only meant to be general perspectives.

B. Revealed Preference Method: The demand for environmental goods can be revealed by examining the purchases of related goods in the private market place. There may be complementary goods or other factor inputs in the household's production function.

(1)Travel Cost Method: The travel-cost method is a widely used surrogate market approach that relies on information on time and travel costs to derive a demand curve for a recreational site. This curve is in turn used to estimate the consumers' surplus or value of the site to all users. This approach is widely used to value the recreational benefits of public parks and other natural areas.

This method seeks to determine the demand for a recreational site (i.e. number of visits per year to a park) as a function of variables like price, visitors' income, and socio-economic characteristics. The price is usually the sum of entry fees to the site, cost of travel, and opportunity cost of time spent. The consumers' surplus associated with the demand curve provides an estimate of the value of the recreational site in question.

The most common forecasting technique for a specific site is the Clawson-Knetsch-Hotelling method. It is a technique commonly associated with benefit estimation in recreation cost-benefit analysis. This method uses information on travel costs to generate a final demand curve for a recreation outlet. Hence it is most appropriate for those outlets where travel cost is a major component of total visit costs typically to free countryside outlets.

According to Clawson and Knetsch, outdoor recreation activities satisfy individual needs, such as physical, social or psychological. It is necessarily a kind of package deal involving anticipation, travel to the site, the activity itself, the return travel and finally recollection.

The travel-cost method is explained in the following Figure. Suppose there is a single lake in a city, where the entry fee is OP which is fixed per visit. Initially, recreational demand for the lake is shown by the demand curve BD_o and the environmental quantity level is E_0.

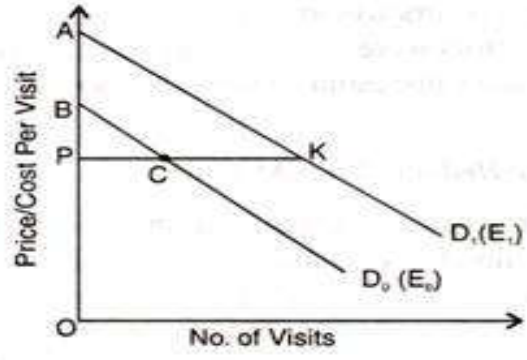


Figure : 5.2

If there is an improvement in environmental quality of lake, then the demand curve will shift outward as AD_1 and environmental quality level to E_1. With this effect, there is an increase in the number of visits to PK. The gain in consumers' surplus is equal to the area PAK. The net gain in consumers' surplus after improvement in environmental quality of the lake is shown as: PAK – PBC = ABCK.

The travel-cost approach looks at the pattern of recreational use of a lake and uses this information to derive a demand curve to estimate the total amount of consumers' surplus. To do this, visitors are divided into a number of origin zones of increasing distance from the lake. Then a survey is used to determine the time and monetary cost involved in reaching to the lake.

Its Criticism:

- This approach is most successful where there is wide variation in the travel cost of various users and where recreation at the site in question will be the primary objective of visits. But wide variations in tastes and preferences and substitute availability at different distances from the site, distort demand estimates.
- The travel-cost method is of limited value if congestion is a problem. Small changes affecting recreational quality may be difficult to evaluate using this method.
- The basic assumption of travel-cost method is that consumers treat increase in admission fees as equivalent to increase in travel cost. This is subject to question.
- Another problem associated with this method is that it assumes recreational quality remains constant over the range from zero use to full present use at the going admission fee. This is highly hypothetical.
- Bateman is of the view that the travel-cost method measures only the use value of recreation sites. Underestimation of site value due to the truncation of non-visitors would be made worse if the non-use value of both visitors and non-visitors were relevant. This method is not capable of producing any total economic value estimate in that it cannot estimate non-use items such as existence value.

(2) Hedonic Price Method: The underlying assumption of the hedonic price method is that the price of a property is related to the stream of benefits to be derived from it. The method relies on the hypothesis that the prices which individuals pay for commodities reflect both environmental and non-environmental characteristics. The implicit prices are sometimes referred to as hedonic prices, which relate the environmental attributes of the property.

Therefore, the hedonic price approach attempts to identify how much of a property differential is due to a particular environmental difference between properties, and how much people are willing to pay for an

improvement in the environmental quality that they face and what the social value of improvement is.

The hedonic price method is based on consumers which postulates that every good provides a bundle of characteristics or attributes. Again, market goods can be regarded as intermediate inputs into the production of the more basic attributes that individuals really demand.

The demand for goods, say housing can, therefore, be considered as a derived demand. For example, a house yields shelter, but through its location it also yields access to different quantities and qualities of public services, such as schools, centres of employment and cultural activities etc. Further it accesses different quantities and qualities of environmental goods, such as open space parks, lakes etc.

The price of a house is determined by a number of factors like structural characteristics, e.g. number of rooms, garages, plot sizes etc. and the environmental characteristics of the area. Controlling the non-governmental characteristics which affect the demand for housing, permits the implicit price that individuals are willing to pay to consume the environmental characteristics associated with the house to be estimated.

The hedonic price function describing the house price Pi of any housing unit is given below:

$$Pi = f [S_{1i}\ldots\ldots\ldots S_{ki}, N_{1i},\ldots\ldots\ldots\ldots N_{mi}, Z_{1i}\ldots\ldots\ldots\ldots Z_{ni}]$$

Where, S represents structural characteristics of the house ii.e. type of construction, house size and number of rooms; N represents neighbourhood characteristics of house i, that is accessibility to work, crime rate, quality of schools etc. It is assumed that only one environment variable affects the property value i.e. air quality (Z).

For example, if the linear relation exists, then the equation becomes

$$P_i = [\alpha_0 + \alpha_1 S_{1i} + \ldots.. + \alpha_K S_{Ki} + \beta_1 N_{1i} + \ldots\ldots. + \beta_m N_{mi} + \gamma_a Z_a]$$

and $y_a > 0$.

There is a positive relation between air quality and property price as shown in the following figure. The figure indicates that house price increases with air quality improvement.

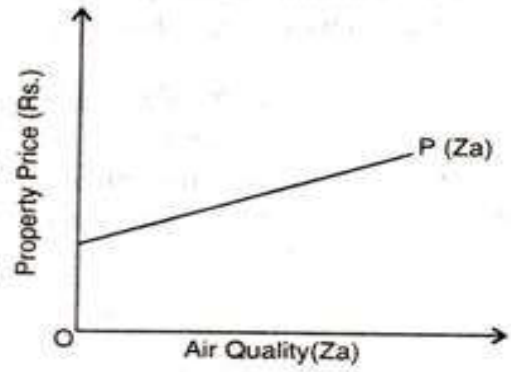


Figure :5.3

Following figure indicates that the implicit marginal purchase price of Z_a (air quality) varies according to the ambient level (Z_a) prior to the marginal change.

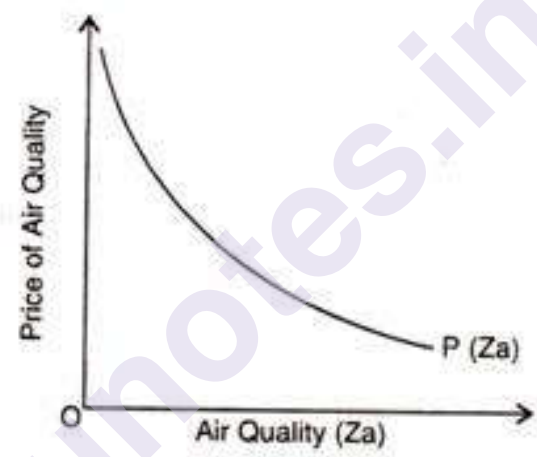


Figure 5.4

The hedonic price method has become a well-established technique for estimating the disaggregated benefits of various goods attributes. In the case of housing, these attributes include not only basic structural and amenity characteristics but also environmental characteristics such as clean air, landscape and local ecological diversity. Thus, when a particular policy is implemented which will have a very great effect on the local environment, the hedonic method offers a useful way of estimating the change in amenity benefits.

Its Criticism:

- This method is of no relevance when dealing with many types of public goods i.e. defence, nation-wise air pollution and endangered species, etc., as it prices are available for them.
- The hedonic price method may be used to estimate the environmental benefits provided to local residents by an area as it exists today. But in fact, it cannot reliably predict the benefits which will be generated by

future improvements because those improvements will have the effect of shifting the existing function.

- Another problem is whether an individual's perceptions and consequent property purchase decisions are based upon actual or historic levels of pollution and environmental quality. If expectations are not the same as measured by present pollution estimate, then there are clearly problems relating to values derived from purchases.
- Moreover, expectations regarding future environmental quality may bias present purchases away from that level dictated by present characteristic levels.
- This method has been criticised for making the implicit assumption that households continually re-evaluate their choice of location.
- Further, there is considerable doubt that such an assumption can hold in the context of spatially large study areas. If people cluster for social or transportation reasons, the results of this method will be biased.

(3)The Preventive Expenditure Method: The preventive expenditure method is a cost-based valuation method that uses data on actual expenditures made to alleviate all environmental problems. Often, costs may be incurred to mitigate the damage caused by an adverse environmental impact. For example, if drinking water is polluted, extra purification may be needed. Then, such additional defensive or preventive expenditure could be taken as a minimum estimate of the mitigation of benefits beforehand.

In the preventive expenditure method, the value of the environment is inferred from what people are prepared to spend to prevent its degradation. The averting or mitigating behaviour method infers a monetary value for an environmental externality by observing the costs people are prepared to incur in order to avoid any negative effects.

For example, by moving to an area with less air pollution at a greater distance from their place of work thus incurring additional transportation costs in terms of time and money. Both of these methods are again, conceptually closely linked.

These methods assess the value of non-marketed commodities such as cleaner air and water, through the amount individuals are willing to pay for market goods and services to mitigate an environmental externality, or to prevent a utility loss from environmental degradation, or to change their behaviour to acquire greater environmental quality.

(4) Surrogate (or Substitute) Markets: When no market exists for a good or service and therefore, no market price is observed, then surrogate (or substitute) markets can be used to derive information on values. For example, travel-cost information can be used to estimate value for visits to a recreational area; property value data are used to estimate values for

non-marketed environmental attributes such as view, location or noise levels.

The effects of environmental damages on other markets like property values and wages of workers are also evaluated. Valuation in the case of property is based on risks involved in evaluating the value of property due to environmental damage. Similarly, jobs with high environmental risks will have high wages which will include large risk premiums.

(5) Property-Value Method: In the property-value method, a surrogate market approach is used to place monetary values on different levels of environmental quality. The approach uses data on market prices for homes and other real estates to estimate consumers' willingness to pay for improved levels of environmental quality, air, noise etc.

In areas where relatively competitive markets exist for land, it is possible to decompose real estate prices into components attributable to different characteristics like house, lot size and water quality. The marginal willingness to pay for improved local environmental quality is reflected in the increased price of housing in cleaner neighbourhoods.

(6) The wage-differential Approach: The wage-differential approach is a surrogate market approach that uses information on differences in wage rate for similar jobs in different areas to estimate monetary values for different levels of environmental quality. This approach has been used to estimate values for such environmental variables as different levels of congestion, air pollution and aesthetics.

Wages also vary in response to various factors such as education and training, natural dexterity, experience, demand and supply in each labour market area, occupational risks to health, probability of death, and associated living conditions including environmental ambience etc.

The hedonic wage approach has also been used in the wage-risk analysis to determine the value of life and limb in relation to the hazards faced at work. The general hedonic wage equation can be expressed as

$P = P (J, R, S)$

Where, P is the payment rate for a given job, У is a vector of another job-related attributes e.g. working hours, holiday, sickness benefits etc., R is the risk of death and S is a vector of skills required to do the job. The hedonic wage approach has traditionally been used to measure employment attributes, principally risk of death or injury in particular labour markets. However, by observing variations in wage levels over space, and netting out the influence of other attributes, they have also been used to value the quality of life over large areas such as countries or continents.

5.4 LIFE CYCLE ANALYSIS:

Life Cycle Analysis (LCA) had its beginnings in the 1960s. Concerns over the limitations of raw materials and energy resources sparked interest in finding ways to cumulatively account for energy use and to project future resource supplies and use. In one of the first publications of its kind, Harold Smith reported his calculation of cumulative energy requirements for the production of chemical intermediates and products at the World Energy Conference in 1963.

Later in the 1960s, global modeling studies published in *The Limits to Growth* (Meadows et al., 1972) and *A Blueprint for Survival* (Goldsmith et al., 1972) resulted in predictions of the effects of the world's changing populations on the demand for finite raw materials and energy resources. The predictions for rapid depletion of fossil fuels and climatological changes resulting from excess waste heat stimulated more detailed calculations of energy use and output in industrial processes. During this period, about a dozen studies were performed to estimate costs and environmental implications of alternative sources of energy.

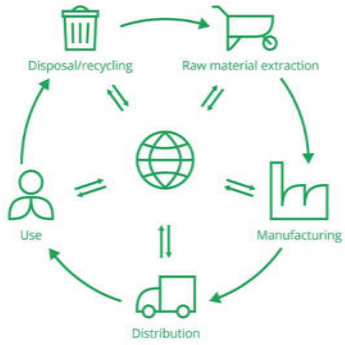
In 1969, researchers initiated an internal study for The Coca-Cola Company that laid the foundation for the current methods of life cycle inventory analysis in the United States. In a comparison of different beverage containers to determine which container had the lowest releases to the environment and least affected the supply of natural resources, this study quantified the raw materials and fuels used and the environmental loadings from the manufacturing processes for each container.

Life Cycle Analysisor Life Cycle Assessment (LCA) is a method used to evaluate the environmental impact of a product through its life cycle encompassing extraction and processing of the raw materials, manufacturing, distribution, use, recycling, and final disposal.

Life cycle analysis is the act of measuring the environmental impact of a product or service throughout its life cycle, from the resources used to create the product or service, across its use by the user, to it's final end of life destination. An LCA measures the environmental impacts of each distinct part involved in creating and using products and services, such as energy used in production, fuel used in transport, and end-of-life ecological costs. This helps us compare between products, materials, and methods used, providing useful information by which to make decisions that could help the environment**.**

Life cycle analysis (LCA) is a method of quantifying the environmental impacts associated with a given product. In LCA, researchers create an inventory of resources used and pollutants generated in product production and use. From this an impact assessment estimates the product's ultimate effects on human health, ecosystem function, and natural resource depletion.

Life cycle assessment (LCA) is the factual analysis of a product's entire life cycle in terms of sustainability. Every part of a product's life cycle – extraction of materials from the environment, the production of the product, the use phase and what happens to the product after it is no longer used – can have an impact on the environment in many ways. With LCA, you can evaluate the environmental impacts of your product or service from the very first to the very last or from cradle to grave.



Ultimately, an LCA is interested in what we have to take from the environment, in terms of raw materials and energy, and what impact the product then has on the environment during its use (or the service, or the material). It's called "life cycle" because it usually takes the entire existence of the product into account: from the raw material stage of putting the product together, through the use phase where the service, material or product serves its' purpose, to the "end-of-life" stage where the product is broken down in whatever fashion occurs.

The stated purpose of an LCA is to find the environmental impacts of a product, service or material, typically so some decision can be made in the design of that item or in the formulation of some policy. It might be that different alternative ways of creating a product or providing a service are being compared to see which has a lower environmental impact. The application of LCA helps to promote the sustainable design and redesign of products and processes, leading to reduced overall environmental impacts and the reduced use and release of non-renewable or toxic materials.

An LCA can be used by different people for different things. But it's all about environmental impact and performance.

Design: what changes can we make to the product to lessen its environmental impact?

Purchasing: which product has the least environmental impact?

Marketing: is this product "greener" than a competitor?

Benchmarking: how's our company doing next to all the others in our industry?

Tracking: how's our environmental performance doing this year compared with last years?

Policy: what initiatives will help improve overall environmental outcomes?

5.4.1.Four steps of life cycle assessment

LCA is a standardized methodology, which gives it its reliability and transparency. The standards are provided by the International Organisation for Standardisation (ISO) in ISO 14040 and 14044, and describe the four main phases of an LCA:

1. Goal and scope definition
2. Inventory analysis
3. Impact assessment
4. Interpretation

1. Goal and scope definition: The goal & scope definition step ensures that your LCA is performed consistently. An LCA models a product, service, or system life cycle. A model is a simplification of a complex reality and as with all simplifications, this means that the reality will be distorted in some way. The challenge for an LCA practitioner is to make sure the simplification and distortions do not influence the results too much. The best way to do this is to carefully define the goal and scope of the LCA study.

The goal and scope describe the most important choices, which are often subjective. For instance, the reason for executing the LCA, a precise definition of the product and its life cycle and a description of the system boundaries.

What are we looking at? The point at which all decisions are made about what to include in the study, why it's being carried out, the "functional unit" that is being focused on, the different systems that need to be investigated, as well as the boundaries – it's often not practical (or possible) to measure every single input and output and in the cases where there is good reason to think they are small or where they are deemed to be beyond the scope of what you are interested in, they are left out. Every LCA has boundaries.

Another task at this point involves "screening", which is the preliminary execution of the LCA and any adjustment in the plan.

Thus.this step includes the objectives of the study, the functional unit, the system boundaries, the data needed, the assumptions, and the limits that must be defined. Particularly, the functional unit is the reference unit used to normalize all the inputs and outputs in order to compare them with each other.

2. Inventory: Inventory analysis of extractions and emissions. This step refers to the analysis of the material and energy flows and the study of

the working system. On the other hand the data collection for the entire life cycle implies the modelization of the analyzed system. Moreover, one of the most critical aspects of this phase is the quality of inputs, which must be verified and validated in order to guarantee the data reliability and correct use. During this stage, a conversion of the available data to appropriate indicators takes place. The indicators are given per functional unit used. In the inventory analysis, you look at all the **environmental inputs and outputs** associated with a product or service. An example of an environmental input – something you take out of the environment to put into the product's life cycle – is the use of raw materials and energy. Environmental outputs – which your product's life cycle puts out into the environment – include the emission of pollutants and the waste streams. Together, this gives you the complete picture.

Every LCA has an inventory. This is the data that you are collecting. The inventory includes things like emissions, energy requirements and material flows for each process involved. These are the flows into and out of the system you are studying. The data of these are adjusted depending on the functional unit you're looking at.

This is known as a Life Cycle Inventory (LCI)
This can be extremely complex because it can involve dozens of separate processes, as well as hundreds of tracked substances. This is where most of the complexity of an LCA is involved.

3. Impact Assessment: Life cycle impact assessment (LCIA):This step includes the assessment of the potential impacts associated with the identified forms of resource use and environmental emissions. The impact assessment methods, which are used in LCA can be divided into two categories: those that focus on the amount of resources used per unit of product (upstream methods) and those which estimate the emissions of the system (downstream methods). In the life cycle impact assessment (LCIA), you draw the conclusions that allow you to make **better business decisions**. You classify the environmental impacts, evaluate them by what is most important to your company, and translate them into environmental themes such as global warming or human health.

The most important choice you have to make is how integrated you want the results to be. Would you like a single score to show how sustainable your product is? Or to be able to see whether your new design improves on CO_2 emissions and keeps land use change at least the same? This usually depends on how you would like to address your audience and the ability of your audience to understand detailed results.

The Life Cycle Impact Assessment (LCIA) is where the impacts on the environment are calculated. The categories of impacts are chosen and the impacts on them based on the flow of emissions, energy and material from the inventory, are assessed.

There are lots of different types of impacts (depletion of abiotic resources, global warming, ozone layer depletion, acidification, etc) so this stage accounts for all the different impacts that have been chosen.

4. **Interpretation:** In this phase the analyst aims to scrutinize the results and discuss them, giving as much precise information as possible to the decision makers. Moreover, this step may highlight some problems in the LCA development which need a more detailed approach: for instance, it can be decided to improve the quality level of some data collected from the literature, because they describe a process which significantly influences an environmental pressure and therefore a more elevated accuracy of them may guarantee less variability in the results. This mechanism of the LCA assures the improvement of results.During the interpretation phase, you check that your conclusions are well-substantiated. The ISO 14044 standard describes a number of checks to test whether conclusions are adequately supported by the data and by the procedures you used. This way, you can share your results and improvement decisions with the world without any surprises. Finally, the results are analysed in the context of the goal and scope of the study set out at the beginning. What have we learned about the system from this LCA? This is where recommendations are typically included.

5.4.2 Life cycle assessment vs other methods

Life cycle studies can be performed for various scopes: cradle to gate (raw materials until factory gate), gate to gate (only focusing on the manufacturing processes) or cradle to grave (raw materials until disposal). What makes it different from other models is mainly its data-driven methodology. The two main other methods, **cradle-to-cradle and the circular economy,** are designed to capture the hearts of audiences. LCA is designed to capture the mind as well.

Cradle to cradle

The cradle-to-cradle certification system is about qualitative visions and storytelling, using qualitative criteria to judge whether a product can be certified. Criteria include material health, material reuse, renewable energy and carbon management, water stewardship and social fairness. The lowest score on these criteria becomes the product's overall mark. In contrast to LCA, cradle to cradle does not measure whether a certified product actually has a lower overall environmental impact, so a cradle to cradle-certified product may end up having a shifted or even increased burden.

Circular economy

The circular economy is an inspirational strategy for creating value for the economy, society and business while minimizing resource use and environmental impacts through reducing, re-using and recycling. In contrast, life cycle assessment is a robust and science-based tool to measure the environmental impacts of products, services and business models with a sort of accountancy approach. Combine both the robustness

of the LCA methodology and the inspirational principles of circular economy and you have a holistic approach for innovation

5.4.3.Limitations of LCAs

As with every scientific method, there are always some limitations that we should be aware of. In the case of LCAs, they do not detract from the depth of understanding that is available only through the comprehensive LCA route. These limitations include:

- Studies relate to normal operations, rather than where incidents occur, which must be understood through separate risk assessments
- The quality of the available data: obviously this is what determines the validity of the whole LCA
- Reliability of the environmental scores is dependent on the skill of the LCA practitioners employed
- Investment decisions are delayed as a consequence of how long LCAs take

5.5 QUESTIONS

1) Explain in details the Direct & Indirect method of Environmental Impact Assessment.
2) Discuss market based methods of environmental valuation.
3) Explain non-market based methods of environmental valuation.
4) Explain the importance Life Cycle Analysis in environmental impact of a product.
5) Examine the different steps of life cycle analysis assessment.

6

SUPPLEMENTARY ANALYTICAL TOOLS AND ENVIRONMENTAL ISSUES - II

Unit Structure

6.0 OBJECTIVES

- To study various types of pollution, their causes, effects and solutions.
- To understand the concept of Ozone Layer Depletion, its causes and effects.
- To study the concept of Green House Gas Emissions, its causes and consequences.
- To understand the causes, effect and preventing measures of Global Warming.

6.1 POLLUTION

The word pollution originates from the Latin word "Polluere" which means "to soil or defile". Pollution is the introduction of containments into the natural environment that cause adverse change. According to The National Academy's report review of US Water Management and Control defines, "pollution as undesirable change in the physical, chemical and biological characteristics of air, water and land, that will be or may be harmful to human and other life". Pollution causes an undesirable change in physical, chemical or biological characteristics of environment.

We come across different types of pollution. Let us study the concepts of Air, Water and Noise pollution.

(A) Air Pollution: Air pollution means presence of either undesirable gases or the excess of any of the gases in more than normal proportion or presence of both the above factors, in the atmosphere, as a result of which,

the natural quality of air is adversely affected, hence, it becomes unfit to breathe. Several factors are responsible for air pollution

- **Oxides of carbon:** The combustion of fossil fuels to provide a source of energy is the major means by which man pollutes the atmosphere. Carbon monoxide (CO), and carbon dioxide (CO2) are the gaseous pollutants produced in largest quantities from natural and anthropogenic sources. Consumption of transport fuels are the principal source of Co and CO2.

- **Oxides of Sulphur:** Gaseous sulphur dioxide (SO2) and sulphur trioxide (SO3) are serious pollutants of our atmosphere. Coal combustion, oil refineries, copper, lead and zinc smelting are the important sources of oxides of SO2 andSO3.

- Oxides of Nitrogen: Number of Oxides of Nitrogen exist in the polluted atmosphere play a significant role in air pollution. The principal sources of nitrogen oxides are combustion of coal, transport and industrial processes.

- **Industry:** Industries are a major contributor to air pollution. Industrial processes discharge pollutants such as nitrous oxide and hydro fluorocarbons into the air. Petroleum refineries also liberate lots of hydrocarbons into the air. Agricultural practices like livestock rearing and landfills also add to atmospheric methane concentrations. The overall effect is amplification in the global warming probability.

- **Vehicle Emissions:** Vehicle emissions are another source of fossil fuel emissions which invariably leads to air pollution. Cars, heavy duty trucks, shipping vessels, trains, and airplanes all burn lots of fossil fuels to work. Emissions from automobile engines hold both primary and secondary pollutants. This is a major cause of pollution and one that is very difficult to deal with as transportation is a major industry in itself. Private transportation accounts for about 10 percent of an individual's carbon footprint, or the amount of carbon dioxide our activities and lifestyle contribute to the atmosphere.

- **Household and Farming Chemicals:** Fumigating homes, crop dusting, painting supplies, household cleaning products, over the counter insect/pest killers, fertilizer dust, all of these emit harmful chemicals into the air and lead to pollution. In many cases, when we use these chemicals at offices or homes with no or little ventilation, we may fall sick if we breathe them in for an extended period of time.

- **Deforestation:** Deforestation affects the atmosphere in more than a few ways. Forests act as sponges for carbon dioxide through a process called carbon sequestration. Trees amass carbon dioxide in their plant tissue as they take in this gas to undertake food-making. In effect, this action gets rid of carbon dioxide from the air. When forests are burned and destroyed on purpose and to tremendous extents, this storage area for carbon dioxide is removed, thus increasing the amount of atmospheric carbon dioxide. Wood fires are also another effect of

deforestation and can be cause air pollution by discharging particulate matter into the air. These particles can become lodged in the respiratory system, causing irritation to lung tissues. The particles can also worsen existing health conditions such as asthma and other respiratory disorders.

- **Smoking:** One can still be at a risk of the dangers of smoking even if they are a non-smoker. The University of Minnesota estimated that up to 90 percent of the population is habitually exposed to second-hand smoke. Tobacco smoke contains up to 40 carcinogens, making it an especially fatal form of air pollution. If you have smokers in the family air purifiers will ensure that the other members don't suffers from second hand smoke.

- **Indoor Air Pollution:** Use of toxic products also called as Volatile Organic Compounds (VOCs), inadequate ventilation, uneven temperature, and humidity level can cause indoor air pollution, whether you are in office, school or at your comfortable home. House air pollution can take place due to ignorant factors, for instance, smoking tobacco inside a room or leaving mold infected wall untreated. Use of wood stove or space heaters is capable to increase the humidity level which can directly affect the health a person in no time.

- **Microbial Decaying Process:** Manufacturing, chemical, and textiles industries release a large number of carbon monoxides, hydrocarbons, chemicals and organic compounds which contaminate our environment. Bacteria and fungi play a fundamental role in the biogeochemical cycles in nature. They are the key indicators of abnormal environmental conditions. Decaying of these microorganisms present in the surrounding releases methane gas which is highly toxic. Breathing toxic gas like methane may lead to death.

- **Open Burning of Garbage Waste:** Open burning of garbage is much more harmful to your health and the environment than one may think. As per Engage EPW, Delhi Air Pollution is choking public health. Delhi generates a whopping 9500 tons of waste every day, which makes it India's second waste dumping city. Exposure to open burning of garbage waste can pose serious health risk including cancer, liver issues, impairment of immune system, reproductive functions; can also affect the developing nervous system.

- **Agricultural Activities:** Agricultural activities have had a serious impact on the decreasing air quality. To begin with pesticides and fertilizers are the main source to contaminate the surrounding air. Nowadays, pesticides and fertilizers are mixed with new invasive species which are not found in nature, for quick growth of the crops and vegetation. Once they are sprayed over, the smell and the effect of the pesticides are left in the air. Some mix with water and some seeps into the ground which not only destroys the crops but also causes numerous health-related issues.

- **Use of chemical and synthetic products:** Talking about air pollution, we always consider outdoor air pollution dangerous for our lives but never talk about indoor air pollution. Household products cause indoor air pollution which is 10 times more harmful than outdoor air pollution. Volatile Organic Compounds (VOCs) found in paints, cleaners and personal care products such as perfume and deodorants are a reason for common heath issues. Risks like asthma or other respiratory issues and lung disease are other issues cause by inhaling poor house air quality.

  The rate with which the air pollution is increasing in the country, immediate action has become an absolute necessity. Not only does it affect human lives but also causes havoc in nature.

  Nelson Mandela once expressed his concern about the air pollution and particularly its effect on human lives, said, "Everyone has the right to an environment that is not harmful to their health or well-being; and to have that environment protected, for the benefit of present and future generations."
  - Conserve the energy is the first step towards a better future with clean air to breathe.
  - Understanding the concept and imbibing the habit of reducing, reuse, and recycle is crucial.
  - Use public transport whenever it is feasible to save fuel and reduce vehicle pollution.

Effects of Air Pollution:

- **Accelerated Global Warming.** Air pollution directly accelerates the rate at which global warming happens by depleting the Ozone layer. Global warming refers to the increased temperatures Earth continues to experience. These higher temperatures lead to the melting of the polar ice caps and icebergs, which elevates sea levels and creates concern for the human race.

- **Human Respiratory And Heart Concerns.** Air pollution is known to cause irritation in the eyes, lungs, nose, and throat. It creates respiratory problems and exacerbates existing conditions such as asthma and emphysema. When continually exposed to air pollution, humans become at higher risk for cardiovascular disease. Air filled with toxins can have a number of adverse effects on the arteries, and have even been a contributor to heart attacks. The effects of air pollution are alarming. They are known to create several respiratory and heart conditions like asthma, chronic bronchitis, emphysema, heart attacks and strokes along with cancer, among other threats to the body. Several million are known to have died due to the direct or indirect effects of Air pollution.

- **Wildlife Endangerment.** Most diseases and conditions that humans are susceptible to, animals are as well. Air pollution creates many of the same issues that humans face. Heavily polluted areas force inhabitants to seek new homes, which can negatively impact the ecosystem. Toxic chemicals, which we'll discuss in the next bullet, also deposit over surfaces of water that can lead to the endangerment of marine life animals.

- **Acid Rain.** When air pollution, specifically sulfur oxides and nitrogen oxides, are released into sky through fossil fuel burning, it creates the phenomenon known as acid rain. Water, high in the atmosphere, combines with these chemicals and becomes acidic in nature. It then scatters the ground, disguised as normal rainfall. Acid rain has been known to cause harm to humans and animals alike, and even damage crops.

- **Child Health Problems** Air pollution is detrimental to your health even before you take your first breath. Exposure to high air pollution levels during pregnancy causes miscarriages as well as premature birth, autism, asthma and spectrum disorder in young children. It also has the potential to damage early brain development in a child and cause pneumonia that kills almost a million children below 5 years. Children are at a greater risk of short term respiratory infections and pulmonary diseases in areas exposed to air pollutants.

- **Eutrophication.** Eutrophication is a condition where a high amount of nitrogen present in some pollutants gets developed on the sea surface and turns itself into algae and adversely affects fish, plants, and animal species.

- **Effect on Wildlife.** Just like humans, animals also face some devastating effects of air pollution. Toxic chemicals present in the air can force wildlife species to move to a new place and change their habitat. The toxic pollutants deposit over the surface of the water and can also affect sea animals.

- **Depletion of the Ozone Layer.** Ozone exists in the Earth's stratosphere and is responsible for protecting humans from harmful ultraviolet (UV) rays. Earth's ozone layer is depleting due to the presence of chlorofluorocarbons, hydro chlorofluorocarbons in the atmosphere. As the ozone layer becomes thin, it will emit harmful rays back on earth and can cause skin and eye-related problems. UV rays also have the capability to affect crops.

Measures to Control Air Pollution

- **Use thePublic Mode of Transportation.**

Encourage people to use more and more public modes of transportation to reduce pollution. Also, try to make use of carpooling. If you and your colleagues come from the same locality and have the same timings, you can explore this option to save energy and money.

- **Better Household Practices**

Discard fireplaces and/or wooden stoves used for heating homes. Use gas logs in place of wood. Also, eliminate the use of gas-powered lawn and gardening equipment. Avoid setting fire to garbage, dry leaves, or other materials in your yard, and lighting bonfires in the open. Try to mulch or compost your yard waste. Use cleaning products and paints that are environmentally friendly. When you're leaving home, be sure to turn off the lights, TV, and any other electronic appliances.

Fossil fuel plants are a major cause of air pollutants, and the less energy you need, the less we have to rely on those plants to generate electricity.This also means turning to energy efficient devices when possible. Fluorescent lightbulbs over the course of their lifespan can reduce energy consumption while adding significant savings to your pocket.

- **Conserve Energy**

Switch off fans and lights when you are going out. A large number of fossil fuels are burnt to produce electricity. You can save the environment from degradation by reducing the number of fossil fuels to be burned.

- **Understand the Concept of Reduce, Reuse and Recycle**

Do not throw away items that are of no use to you. Instead, reuse them for some other purpose. For example, you can use old jars to store cereals or pulses.

- **Emphasis on Clean Energy Resources**

Use of Clean energy technologies like solar, wind and geothermal is on the rise these days. Governments of various countries have been providing grants to consumers who are interested in installing solar panels for their homes. Undoubtedly, this can go a long way to curb air pollution.

- **Use Energy-Efficient Devices**

CFL lights consume less electricity than their counterparts. They live longer, consume less electricity, lead to lower electricity bills, and also help you to reduce pollution by consuming less energy.

- **Become An Advocate For Clean Energy.**

Every day, technology continues to advance that improves the efficiency and cost of clean energy such as solar, wind, and geothermal. These types of energy sources create much less air pollution. Even nuclear is leaps and bounds better than traditional fossil fuel plants when it comes to air pollution. Find ways to promote and educate the public on clean energy alternatives. A small contribution goes a long way in the grand scheme of things.

(B) Water Pollution: Water is an essential resource of life on earth. The quality of water is the most important factor. Fresh water is a scarce commodity with greatest amount locked in glaciers and ice-caps. Water pollution simply means contamination of water due to any external material or in other words, introduction of something to natural water which makes in unsuitable for human consumption. WHO has defined water pollution as "any foreign material either from natural or other sources that may counterminate water and makes it harmful to life, cause of their toxicity leads to reduction of normal oxygen level of water causes aesthetically unpalatable afflicts as spread of epidemic diseases".

Jacques Yves Cousteau said that "Water and air, the two essential fluids on which all life depends, have become global garbage cans". In simple words, the contamination of water bodies is water pollution. It is the abuse of lakes, ponds, oceans, rivers, reservoirs, etc. Pollution of water usually occurs when substances discharged in it negatively modify the water. This discharge of pollutants can be direct as well as indirect.

There are many causes of water pollution.

- **Industrial Waste:** Industries and industrial sites across the world are a major contributor to water pollution. Many industrial sites produce waste in the form of toxic chemicals and pollutants, and though regulated, some still do not have proper waste management systems in place. In those rare cases, industrial waste is dumped into nearby freshwater systems. When industrial waste is not treated properly (or worse, not treated at all), it can very easily pollute the freshwater systems that it comes into contact with.

Industrial waste from agricultural sites, mines and manufacturing plants can make its way into rivers, streams and other bodies of water that lead directly to the sea. The toxic chemicals in the waste produced by these industries not only have the potential to make water unsafe for human consumption, they can also cause the temperature in freshwater systems to change, making them dangerous for many water dwelling organisms.

- **Marine Dumping:** The process of marine dumping is exactly what it sounds like, dumping garbage into the waters of the ocean. It might seem crazy, but household garbage is still collected and dumped into oceans by many countries across the world. Most of these items can take anywhere from two to 200 years to decompose completely.

- **Sewage and Wastewater:** Harmful chemicals, bacteria and pathogens can be found in sewage and wastewater even when it's been treated. Sewage and wastewater from each household is released into the sea with fresh water. The pathogens and bacteria found in that wastewater breed disease, and therefore are a cause of health-related issues in humans and animals alike.

- **Oil Leaks and Spills:** The age-old phrase "like water and oil" is used when describing two things that do not mix easily or at all. Just as the saying states, water and oil do not mix, and oil does not dissolve in water.

Large oil spills and oil leaks, while often accidental, are a major cause of water pollution. Leaks and spills often are caused by oil drilling operations in the ocean or ships that transport oil. wildlife.

- **Agriculture:** In order to protect their crops from bacteria and insects, farmers often use chemicals and pesticides. When these substances seep into the groundwater, they can harm animals, plants and humans. Additionally, when it rains, the chemicals mix with rainwater, which then flows into rivers and streams that filter into the ocean, causing further water pollution.

- **Global Warming:** Rising temperatures due to global warming are a major concern in terms of water pollution. Global warming causes water temperatures to rise, which can kill water-dwelling animals. When large die-offs occur, it further pollutes the water supply, exacerbating the issue. There are many everyday ways we can help reduce global warming, which will in turn help lower water pollution. These methods include recycling, carpooling and using CFL bulbs in our houses.

- **Radioactive Waste:** Radioactive waste from facilities that create nuclear energy can be extremely hazardous to the environment and must be disposed of properly. This is because uranium, the element used in the creation of nuclear energy, is a highly toxic chemical. Unfortunately, accidents still occur at these facilities, and toxic waste is released into the environment. The coal and gas industries are, in many ways, no better. This is one of the major impetuses behind the development of alternative, clean sources of energy, including solar and wind.

- **Mining Activities:** Mining is the process of crushing the rock and extracting coal and other minerals from the underground. These elements, when extracted in the raw form, contain harmful chemicals and can increase the number of toxic elements when mixed up with water, which may result in health problems. Mining activities emit a large amount of metal waste and sulfides from the rocks, which is harmful to the water.

- **Chemical fertilizers and pesticides:** Chemical fertilizers and pesticides are used by farmers to protect crops from insects and bacterias. They are useful for the plant's growth. However, when these chemicals are mixed up with water, they produce harmful pollutants for plants and animals. Also, when it rains, the chemicals mix up with rainwater and flow down into rivers and canals, which pose serious damages for aquatic animals.

- **Urban Development:** As the population has grown exponentially, so has the demand for housing, food, and cloth. As more cities and towns are developed, they have resulted in increasing use of fertilizers to produce more food, soil erosion due to deforestation, rise in construction activities, inadequate sewer collection and treatment, landfills as more garbage is produced, increase in chemicals from industries to produce more materials.

Effects of Water Pollution

1. Affects Aquatic Life: Water contamination has a significant impact on aquatic life. It affects their metabolism and behaviour, as well as causing disease and death. Dioxin is a toxin that causes a variety of issues, ranging from reproductive issues to uncontrolled cell development and cancer. This chemical accumulates in fish, poultry, and meat. Chemicals like these make their way up the food chain before entering the human body.

2. Affects Food chain: Water contamination may have a significant influence on the food chain. It upsets the food chain. Cadmium and lead are two hazardous chemicals that enter the food chain via animals (fish when ingested by animals and people) and can continue to disturb at greater levels.

3. Groundwater contamination: Pesticides and fertilisers used in agricultural production pollute groundwater as well as our ecology. If this groundwater is directly delivered to our home via bore-wells or tube-wells, it will cause a multitude of health issues.

4. Affects Human Health: Pollution affects humans, and faecal matter in water sources can cause illnesses such as hepatitis. Poor drinking water treatment and contaminated water can always lead to an epidemic of infectious illnesses like cholera.Water pollution has very negative effects on public health. A lot of diseases result from drinking or being in contact with contaminated water, such as diarrhea, cholera, typhoid, dysentery or skin infections. In zones where there is no available drinking water, the main risk is dehydration obviously.

5. High TDS in water: Water is the best solvent since it quickly dissolves a wide range of compounds. TDS in drinking water should be less than 500 mg/litre. The presence of a high level of TDS in water can cause a variety of health issues in humans.

Measures to Control water Pollution

1. **Wastewater treatment:** Wastewater treatment consists of removing pollutants from wastewater through a physical, chemical or biological process. The more efficient these processes are, the cleaner the water becomes.

2. **Green agriculture:** Globally, agriculture accounts for 70% of water resources, so it is essential to have climate-friendly crops, efficient irrigation that reduces the need for water and energy-efficient food production. Green agriculture is also crucial to limit the chemicals that enter the water.

3. Stormwater management: Stormwater management is the effort to reduce runoff of rainwater or melted snow into streets, lawns and other sites and the improvement of water quality" according to the US Environmental Protection Agency (EPA). It is important to avoid

pollutants from contaminating the water and helps to use water more efficiently.

4. Air pollution prevention: Air pollution has a direct impact on water contamination as 25% of human induced CO2 emissions are absorbed by oceans. This pollution causes a rapid acidification of our oceans, and threatens marine life and corals. Preventing air pollution is the best way to prevent this from happening.

5. Plastic waste reduction:80% of plastic in our oceans is from land sources. In order to reduce the amount of plastic entering our ocean, we need to both reduce our use of plastic globally, and to improve plastic waste management.

6. Water conservation: Without water conservation, we won't go very far. It is central in making sure the world has better access to clean water. It means being aware that water is a scarce resource, taking care of it accordingly, and managing it responsibly.

(C) Noise Pollution: Noise pollution can be defined as " an undesirable and harmful sound in the environment, the presence of which causes discomfort to individuals and also to the animals". By definition, noise pollution takes place when there is either an excessive amount of noise or an unpleasant sound that causes a temporary disruption in the natural balance. This definition is usually applicable to sounds or noises that are unnatural in either their volume or their production. Our environment is such that it has become difficult to escape the noise. Even electrical appliances at home have a constant hum or beeping sound. By and large, lack of urban planning increases the exposure to unwanted sounds. This is why understanding noise pollution is necessary to curb it in time.

Causes of Noise Pollution:

- **Industrialization:** Most of the industries use big machines which are capable of producing a large amount of noise. Apart from that, various equipment like compressors, generators, exhaust fans, grinding mills also participates in producing big noise. We are familiar with the sight of workers in these factories and industries wearing earplugs to minimize the effect of noise.However, even after taking precautionary measures like these, extensive exposure to high levels of noise might damage their hearing abilities in the long run.

- **Poor Urban Planning:** In most of the developing countries, poor urban planning also plays a vital role. Congested houses, large families sharing small space, fight over parking, frequent fights over basic amenities lead to noise pollution, which may disrupt the environment of society.Noise pollution in urban settings may also be caused when residential properties and industrial buildings are in proximity. In situations like these, the noise from the nearby industrial property might hinder the basic well-being of the individuals living in residential properties.It doesn't just affect their sleep and hours of rest but also has an adverse effect on the development and well-being of children.

- **Social Events:**Noise is at its peak in most of the social events. Whether it is marriage, parties, pub, disc or place of worship, people normally flout rules set by the local administration and create a nuisance in the area.People play songs on full volume and dance till midnight, which makes the condition of people living nearby pretty worse. In markets, you can see people selling clothes via making a loud noise to attract the attention of people.While this may not seem like much at the outset, over time, it affects the hearing abilities of the individuals who are constantly exposed to these sounds.

- **Transportation:** A large number of vehicles on roads, airplanes flying over houses, underground trains produce heavy noise, and people find it difficult to get accustomed to that. The high noise leads to a situation wherein a normal person loses the ability to hear properly.

- **Construction Activities:** Under construction activities like mining, construction of bridges, dams, buildings, stations, roads, flyovers takes place in almost every part of the world. These construction activities take place every day as we need more buildings, bridges to accommodate more people. However, while this does help us to some degree, in the long run, the noise from construction activities hinders the hearing abilities of individuals exposed to this sound. A part of it includes construction workers who participate in these activities, while another part of it consists of people who encounter this noise either from their homes or while traveling. Even remodelling buildings can cause hearing loss when performed in enclosed spaces. The sound of jackhammers chipping away at concrete is enough to upset nearby workers and residents.

- **Household Chores:** We people are surrounded by gadgets and use them extensively in our daily life. Gadgets like TV, mobile, mixer grinder, pressure cooker, vacuum cleaners, washing machine and dryer, cooler, air conditioners are minor contributors to the amount of noise that is produced. Still, it affects the quality of life of your neighborhood in a bad way. While this form of pollution may seem harmless, it, in fact, has far-reaching consequences. The adverse effects on the health of the environment are quite severe. Not only is the local wildlife affected by pollution, but humans also face a number of problems due to it.

- **Noise From Air Traffic:** While many find it difficult to believe, air traffic too contributes to significant levels of noise pollution. Noise from a single aircraft may produce sounds of up to 130 dB. Now, imagine the amount of noise produced by the numerous aircraft traveling our airspace.

- **Catering and Nightlife:** When the weather is good, restaurants, bars, and terraces spill outside. Late night parties continue with loud music and unnecessary noise made by the party mongers. These can produce more than 100 dB. The noise from pubs and clubs are also included.

- **Animals' Sound:** The noise made by animals cannot go unnoticed, particularly a howling or barking dog. These can produce noise around 60-80 dB.

Effects of Noise Pollution:

1. **Hearing Problems:** Any unwanted sound that our ears have not been built to filter can cause problems within the body. Our ears can take in a certain range of sounds without getting damaged. Man-made noises such as jackhammers, horns, machinery, airplanes, and even vehicles can be too loud for our hearing range. Constant exposure to loud levels of noise can easily result in the damage of our eardrums and loss of hearing, causing tinnitus or deafness. It also reduces our sensitivity to sounds that our ears pick up unconsciously to regulate our body's rhythm.

2. Psychological Issues: Excessive noise pollution in working areas such as offices, construction sites, bars and even in our homes can influence psychological health. Studies show that the occurrence of aggressive behavior, disturbance of sleep, constant stress, fatigue, depression, anxiety, hysteria and hypertension in humans as well as animals can be linked to excessive noise levels. The level of irritation increases with increased noise, and people tend to become less and less patient. These, in turn, can cause more severe and chronic health issues later in life.

3. Physical Problems: Noise pollution can cause headaches, high blood pressure, respiratory agitation, racing pulse, and, in exposure to extremely loud, constant noise, gastritis, colitis and even heart attacks may occur.

4. Cognitive Issues & Behavioral Changes: Noise affects brain responses and people's ability to focus, which can lead to low-performance levels over time. Like other sound waves, too much noise when it goes to the brain leads to lower response rates as well as making the mind dull. It is also poor for memory, making it hard to study. The studies have shown that school children living near railway stations or airports have problems in learning. Research has shown that people who live near airports or busy roads, usually have a higher incidence of headaches, take more sleeping pills and sedatives, are more prone to minor accidents, and are more likely to seek psychiatric treatment.

5. Sleeping Disorders: While it may not seem like much at this point, excessively high levels of noise are likely to hamper your sleeping pattern, thereby leading to irritation and uncomfortable situations. Without a good night's sleep, you might experience multiple problems related to fatigue. This will affect your performance in the office as well as at home. It is therefore recommended to take a sound sleep to give your body proper rest. If a certain noise is disturbing your sleep, take an actionable measure to reduce it. While in some instances, it is completely unavoidable; there are other instances (like noise from TV or gadgets) that can be easily avoided by making good lifestyle changes. Interestingly, our ears need rest for 16 hours and even more to make up for two hours of exposure to 100 dB.

6. Cardiovascular Issues: Blood pressure levels, cardiovascular disease, and stress-related heart problems are on the rise. Studies suggest that high-

intensity noise causes high blood pressure and increases heartbeat rate as it disrupts the normal blood flow. Since bringing these rates to a manageable level depends on our understanding of noise pollution, we need to be wary of the ill-effects and tackle these situations mindfully.

7. Trouble Communicating: High decibel noise can put trouble and affect free communication between people. This may lead to misunderstanding, and you may get difficult understanding the other person. Constant sharp noise can give you a severe headache and disturb your emotional balance.

8. Effect on Wildlife: Wildlife faces far more problems than humans because of noise pollution since they are more dependent on sound. Animals develop a better sense of hearing than us since their survival depends on it. A recent study published in Biology Letters found that human-created noise affects a wide range of animals. The ill-effects of excessive noise begin at home. Pets react more aggressively in households where there is constant noise. They become disoriented more easily and face many behavioral problems. In nature, animals may suffer from hearing loss, which makes them easy prey and leads to dwindling populations. Others become inefficient at hunting, disturbing the balance of the eco-system.

9. Effects on Species Depending on Mating Call: Species that depend on mating calls to reproduce are often unable to hear these calls due to excessive man-made noise. As a result, they are unable to reproduce and cause declining populations. Others require sound waves to locate and find their way when migrating. Disturbing their sound signals means they get lost easily and do not migrate when they should. To cope up with the increasing sound around them, animals are becoming louder, which may further add to the pollution levels. This is why understanding noise pollution can help us lower the impact it has on the environment.

Measures to control Noise Pollution: WHO agrees that awareness of noise pollution is essential to beat this invisible enemy. As of now, there are not many solutions to reduce sound pollution. However, governments can help in the following ways:

- Establishing regulations that include preventive and corrective measures.
- Governments can take measures such as protecting certain areas, parts of the countryside, areas of natural interest, city parks, etc. to ensure noise management and reduce noise pollution.
- The mandatory separation between residential zones and sources of noise, like airports.
- Creating pedestrian areas where traffic is not allowed to enter other than offload goods at certain times.
- Fines for exceeding noise limits.

- Other ways to battle noise pollution are by controlling the sound levels in clubs, bars, parties, and discos.
- Removal of public loudspeakers is another way in which pollution can be countered.
- Again, better urban planning can help create 'No-Noise' zones, where honking and industrial noise is not tolerated.
- Replacing traditional asphalt with more efficient options can also help reduce traffic noise by up to 3 dB.

6.2. OZONE LAYER DEPLETION

Earlier there was a perfect balance between ozone consumption and ozone reformed. This balance has beebn disturbed as a result of increasing human activities especially, the manufacture and use of synthetic chemical substances known as CFCs and HCFCs. Such chlorine containing compounds are used in aerosols, refrigeration, solvents, and foam insulation. Through a number of complicated chemical chain reactions, even small amount of theses chemical compounds are able to destroy very large quantities of ozone. As a result of this, ozone is broken down at a faster rate than it is forming and parts of ozone layers are becoming thinner and 'ozone holes' are being developed.

"The ozone layer is a region in the earth's stratosphere that contains high concentrations of ozone and protects the earth from the harmful ultraviolet radiations of the sun."Ozone layer depletion is the gradual thinning of the earth's ozone layer in the upper atmosphere caused due to the release of chemical compounds containing gaseous bromine or chlorine from industries or other human activities."

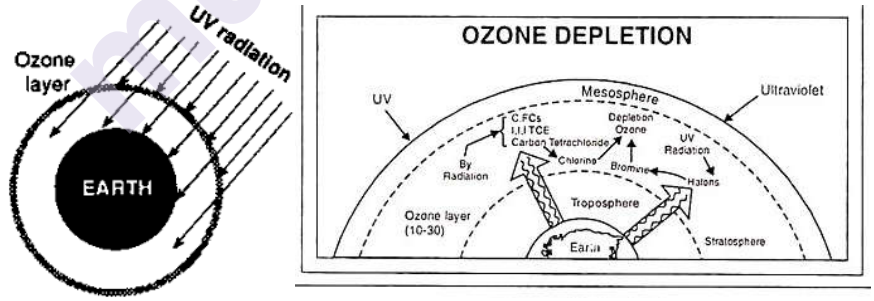


Fig 6.1 Ozone Depletion

Ozone Hole

Ozone hole is created in the region where ozone layer has been depleted. The term "Ozone hole" is applied when the depletion level is below 200 Dobson Unit (D.U). Ozone holes are first discovered in Antarctica in 1970. Few years ago, ozone holes are also discovered in arctic region. Since 2000 rate of ozone depletion is increasing 0.5 percent per year. Due to depletion of Ozone UV rays are penetrating in troposphere and leading

to more ozone formation in troposphere which is causing injurious effects on our health as ozone is toxic for our body.

6.2.1.Causes of Ozone Depletion

1. Chlorofluorocarbon: Ozone depletion occurs when the natural balance between the production and destruction of stratospheric ozone is disturbed. Although natural phenomenon can cause ozone depletion but human activities such as CFCs are now accepted as major cause of depletion . All ozone depleting chemicals contain chlorine and bromine . CFCs are highly volatile and non combustible so they are very quickly evaporated and can easily reach in stratosphere where ozone is present here they start depleting ozone molecules. These CFCs have also adverse affects on human health. According to the chemical model for ozone destruction proposed about 20 years ago, the photolysis of Cl_2O_2 is key to ozone depletion reaction. But now atmospheric researchers studied that the rate of this reaction is not extremely high as it was thought previously so we can no longer say that CFCs are the main cause of ozone depletion.

2. Unregulated Launches of Rockets: Another major cause of large scale ozone depletion is Rocket launches. It has been studied that unregulated rocket launches can result in much more ozone depletion than CFCs. It is estimated that if rocket launches will be let unregulated then it would cause huge ozone loss by the year 2050 than the CFCs have done.

3. Global Warming: Global warming also leads to ozone layer depletion. Due to global warming and greenhouse effect most of the heat is trapped in troposphere which is the layer below the stratosphere. As we all know ozone is present in stratosphere so heat don't reach troposphere and it remain cold as recovery of ozone layer requires maximum sunlight and heat so it leads to depletion of ozone layer.

4. Nitrogenous Compound: Nitrogenous Compounds emitted by human activities in small amount like NO, N_2O and NO_2 are considered to be greatly responsible for the depletion of ozone layer.NO_2, NO, N_2O are responsible for ozone depletion. The sources of Nitrogen Oxides are mainly explosions of thermonuclear weapons, agricultural fertilizers and industrial emissions.

5. Bromine Compounds: These are called HydrobromoFuorocarbons (HBFCs) and are used in fire extinguishers. Each bromine atom destroys a hundred times more ozone molecules than a chlorine atom does.

6. Natural Causes: The ozone layer is depleted by a number of natural causes like the sunspot cycle, volcanic eruption. However, the percentage effect is less i.e around 1-3%.

6.2.2. Effects of Ozone Depletion: Ozone depletion is affecting the human health and environment negatively, as it allows the penetration of UV radiations to reach the Earth. These radiations can cause severe diseases in humans such as skin cancer, eye damage and genetic mutations etc. Furthermore the ozone depletion is affecting the aquatic life,

biogeochemical cycles, air quality and also contributing in Global warming but in this review paper our main focus is on the effects of ozone depletion on human health.

1. Effects oh Human Health and Animal Health: People become vulnerable due to the increase in the incidence of morbidity from eye diseases, skin cancer and infectious diseases. In light skin coloured populations, UV_B radiation is the main risk factor for the development of Non-Melanoma skin cancer. The major cause of blindness in this world is cataracts. There would be 0.3% - 0.6% increase in risk of cataract if there will be 1% decrease in Ozone level. Eye lens can be damaged by oxidative agents. Oxidative oxygen produced by UV radiation can severely damage eye lens and cornea of eye is also badly damaged by UV radiation. Photokeratitis, cataract, blindness all are caused due to UV rays. Exposure to UV radiations can cause skin cancer. UV radiations alter the structure of biomolecules and thus lead to different diseases .Skin is the most often exposed part of body to UV radiations There are two types of skin cancer, Melanoma and Non-melanoma. Melanoma is most serious form of cancer and is often fatal, while non-melanoma is most common type and less fatal. Depletion of ozone layer leads to both Sun burn and skin cancer. UV radiations are also responsible for breast cancer and leukemia.More increase in depletion of ozone results in more decrease in immune system. Short exposure to UV-B radiations can cause the DNA damage because UV radiations can disturb biomolecules such as lipids, proteins and Nucliec acids. Due to UV-B radiations there would be cryptic transposable elements which may lead towards the mutations which is more dangerous than the immediate DNA damage.

2. Effect of Food Shortage on Human Population: Depletion of ozone layer is also causing the problem of food shortage to humans. UV radiations are disturbing developmental and physiological processes which is decreasing the productivity of crops. As humans are heavily dependent on crops for food so there is a great chance if depletion of ozone layer is not checked it may cause seriously shortage of food to humans . Researches also show that UV radiations can also be used to enhance yield of crops by the use and application of phytohormones

3. Effects on Plants: Psychological processes of plants are affected by UV-B radiation.

Response to UV-B also varies voraciously among different species. Therefore, in agriculture, it becomes necessary to use more UV-B tolerant species. In forests and grasslands, it results in changing the composition of species. There are several indirect changes like plant form, biomass allocation of the plant, timing of development phases triggered due to UV-B radiation.

4. Effects on Aquatic Ecosystem: More exposure to UV-B radiation has affected motility in phytoplanktons which results in reduced survival rates of these organisms.

UV-B radiation has been found to cause damage in the early development stages of fish, crabs, amphibians and various other animals. The more severe effect is a decrease in reproductive capacity.

5. Effects on Air Quality: Reduction of Ozone in upper layers of atmosphere and the direct increase of UV-B radiation penetrating to the lower atmosphere results in higher photodissociation rates of gases that control the chemical reactivity of the Troposphere. Products formed due to these reactions are known to have adverse effects on human health, plants and outdoor materials. Increase in tropospheric reactivity will lead to increased production of particulates due to oxidation and nucleation of sulfur due to anthropogenic and natural causes.

6. Effects on Material: Materials like polymers, naturally occurring biopolymers and some other materials of commercial interest are affected by UV radiations. Increase in solar UV-B content due to partial ozone depletion accelerates the photodegradation rate of these materials and therefore limits their life outdoors.

6.2.3 Solutions to Ozone Depletion: Thus, instead of using chemicals, one should stop using pesticides and switch to natural methods to get rid of pests. A significant amount of greenhouse gases are produced by cars, contributing to global warming as well as ozone depletion. The use of vehicles should therefore be reduced as far as possible. Many of the materials used for cleaning have chemicals that damage the ozone layer. We should substitute eco-friendly goods for that. Maintain air conditioners, as CFC escapes into the atmosphere via their malfunctions.

1. Desist From Using Pesticides

Pesticides are great chemicals to rid your farm of pests and weeds, but they contribute enormously to ozone layer depletion. The surefire solution to get rid of pests and weeds is to apply natural methods. Just weed your farm manually and use alternative eco-friendly chemicals to alleviate pests.

2. Discourage Driving of Private Vehicles

The easiest technique to minimize ozone depletion is to limit the number of vehicles on the road. These vehicles emit a lot of greenhouse gases that eventually form smog, a catalyst in the depletion of the ozone layer.

3. Utilize Environmentally Friendly Cleaning Products

Most household cleaning products are loaded with harsh chemicals that find way to the atmosphere, eventually contributing to the degradation of the ozone layer. Use natural and environmentally friendly cleaning products to arrest this situation.

4. Prohibit the Use of Harmful Nitrous Oxide

The Montreal Protocol formed in 1989 helped a lot in the limitation of Chlorofluorocarbons (CFCs). However, the protocol never covered nitrous oxide, which is a known harmful chemical that can destroy the ozone

layer. Nitrous oxide is still in use today. Governments must take action now and outlaw nitrous oxide use to reduce the rate of ozone depletion.

6.3 GREEN HOUSE GAS EMISSION:

Greenhouse gas, any gas that has the property of absorbing infrared radiation (net heat energy) emitted from Earth's surface and reradiating it back to Earth's surface, thus contributing to the greenhouse effect. Carbon dioxide, methane, and water vapour are the most important greenhouse gases.

Gases of natural origin (water vapour) or anthropogenic (linked to human activities) absorbing and release again part of the solar rays (infrared radiation), phenomena at the origin of the greenhouse effect.

The main gases responsible for the greenhouse effect, linked to human activities, are carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O) and the fluorinated gases (HFC, PFC, SF6 and NF3).

Emissions of these gases are weighted by their global warming potential (GWP) and expressed in CO2 equivalents.

The six gases monitored in the Kyoto protocol are carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), HFC and PFC.It is the emission into the earth's atmosphere of any of various gases, especially carbon dioxide, that contribute to the greenhouse effect.

Identified by scientists as far back as 1896, the greenhouse effect is the natural warming of the earth that results when gases in the atmosphere trap heat from the sun that would otherwise escape into space.

Since the start of the Industrial Revolution and the advent of coal-powered steam engines, human activities have vastly increased the volume of greenhouse gases emitted into the atmosphere. It is estimated that between 1750 and 2011, atmospheric concentrations of carbon dioxide increased by 40 percent, methane by 150 percent, and nitrous oxide by 20 percent. In the late 1920s, we started adding man-made fluorinated gases like chlorofluorocarbons, or CFCs, to the mix.

There are several ways of measuring greenhouse gas emissions. Some variables that have been reported include:

- **Definition of measurement boundaries:** Emissions can be attributed geographically, to the area where they were emitted (the territory principle) or by the activity principle to the territory that produced the emissions. These two principles result in different totals when measuring, for example, electricity importation from one country to another, or emissions at an international airport.

- **Time horizon of different gases:** The contribution of given greenhouse gas is reported as a CO_2 equivalent. The calculation to determine this takes into account how long that gas remains in the atmosphere. This is not always known accuratelyand calculations must be regularly updated to reflect new information.

The measurement protocol itself: This may be via direct measurement or estimation. The four main methods are the emission factor-based method, mass balance method, predictive emissions monitoring systems, and continuous emissions monitoring systems. These methods differ in accuracy, cost, and usability. Public information from space-based measurements of carbon dioxide by Climate Trace is expected to reveal individual large plants before the 2021 United Nations Climate Change Conference.

6.3.1 Five Major Greenhouse Gases

The most significant gases that cause global warming via the greenhouse effect are the following:

a) Carbon Dioxide : Accounting for about 76 percent of global human-caused emissions, carbon dioxide (CO_2) sticks around for quite a while. Once it's emitted into the atmosphere, 40 percent still remains after 100 years, 20 percent after 1,000 years, and 10 percent as long as 10,000 years later.

b) Methane: Although methane (CH_4) persists in the atmosphere for far less time than carbon dioxide (about a decade), it is much more potent in terms of the greenhouse effect. In fact, pound for pound, its global warming impact is 25 times greater than that of carbon dioxide over a 100-year period. Globally it accounts for approximately 16 percent of human-generated greenhouse gas emissions.

c) Nitrous Oxide : Nitrous oxide (N_2O) is a powerful greenhouse gas: It has a GWP 300 times that of carbon dioxide on a 100-year time scale, and it remains in the atmosphere, on average, a little more than a century. It accounts for about 6 percent of human-caused greenhouse gas emissions worldwide.

d) Fluorinated Gases : Emitted from a variety of manufacturing and industrial processes, fluorinated gases are man-made. There are four main categories: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).

Although fluorinated gases are emitted in smaller quantities than other greenhouse gases (they account for just 2 percent of man-made global greenhouse gas emissions), they trap substantially more heat. Indeed, the GWP for these gases can be in the thousands to tens of thousands, and they have long atmospheric lifetimes, in some cases lasting tens of thousands of years.

HFCs are used as a replacement for ozone-depleting chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), usually in air conditioners and refrigerators, but some are being phased out because of their high GWP. Replacing these HFCs and properly disposing of them is considered to be one of the most important climate actions the world can take.

e) Water Vapor : The most abundant greenhouse gas overall, water vapor differs from other greenhouse gases in that changes in its atmospheric concentrations are linked not to human activities directly, but rather to the warming that results from the other greenhouse gases we emit. Warmer air holds more water. And since water vapor is a greenhouse gas, more water absorbs more heat, inducing even greater warming and perpetuating a positive feedback loop. (It's worth noting, however, that the net impact of this feedback loop is still uncertain, as increased water vapor also increases cloud cover that reflects the sun's energy away from the earth.)

6.3.2 Causes

Population size, economic activity, lifestyle, energy use, land use patterns, technology, and climate policy: According to the Intergovernmental Panel on Climate Change (IPCC), these are the broad forcings that drive nearly all human-caused greenhouse gas emissions. Here's a closer look at greenhouse gas emissions by source.

a) Electricity and Heat Production : The burning of coal, oil, and natural gas to produce electricity and heat accounts for one-quarter of worldwide human-driven emissions, making it the largest single source. In the United States it's the second-largest (behind transportation), responsible for about 27.5 percent of U.S. emissions in 2017, with carbon dioxide the primary gas released (along with small amounts of methane and nitrous oxide), mainly from coal combustion.

b) Agriculture and Land Use Changes: About another quarter of global greenhouse gas emissions stem from agriculture and other land-use activities (such as deforestation). In the United States, agricultural activities—primarily the raising of livestock and crops for food—accounted for 8.4 percent of greenhouse gas emissions in 2017. Of those, the vast majority were methane (which is produced as manure decomposes and as beef and dairy cows belch and pass gas) and nitrous oxide (often released with the use of nitrogen-heavy fertilizers).

Trees, plants, and soil absorb carbon dioxide from the air. The plants and trees do it via photosynthesis (a process by which they turn carbon dioxide into glucose); the soil houses microbes that carbon binds to. So nonagricultural land-use changes such as deforestation, reforestation (replanting in existing forested areas), and afforestation (creating new forested areas) can either increase the amount of carbon in the atmosphere (as in the case of deforestation) or decrease it via absorption, removing more carbon dioxide from the air than they emit. (When trees or plants are

cut down, they no longer absorb carbon dioxide, and when they are burned or decompose, they release carbon dioxide back into the atmosphere.) In the United States, land-use activities currently represent a net carbon sink, absorbing more carbon dioxide from the air than they emit.

c) Industry : About one-fifth of global human-driven emissions come from the industrial sector, which includes the manufacturing of goods and raw materials (like cement and steel), food processing, and construction. In 2017, industry accounted for 22.4 percent of U.S. man-made emissions, of which the majority was carbon dioxide, though methane, nitrous oxide, and fluorinated gases were also released.

d) Transportation : The burning of petroleum-based fuels, namely gasoline and diesel, to power the world's transportation systems accounts for 14 percent of global greenhouse gas emissions. In the United States, with Americans buying larger cars and taking more flights and with low gas prices encouraging drivers to use their cars more, transportation is the largest contributor of greenhouse gases. (It accounted for 28.7 percent of U.S. emissions in 2017.) Carbon dioxide is the primary gas emitted, though fuel combustion also releases small amounts of methane and nitrous oxide, and vehicle air conditioning and refrigerated transport release fluorinated gases too.

Nationwide, cars and trucks are responsible for more than 80 percent of transportation-related carbon emissions.

e) Buildings Operating buildings around the world generates 6.4 percent of global greenhouse gases. In the United States, homes and businesses accounted for about 11 percent of warming emissions. These emissions, made up mostly of carbon dioxide and methane, stem primarily from burning natural gas and oil for heating and cooking, though other sources include managing waste and wastewater and leaking refrigerants from air-conditioning and refrigeration systems.

f) Other Sources : This category includes emissions from energy-related activities other than fossil fuel combustion, such as the extraction, refining, processing, and transportation of oil, gas, and coal. Globally, this sector accounts for 9.6 percent of emissions**.**

6.3.3 The Consequences of the Greenhouse Effect

Today's human-caused greenhouse gas emissions are higher than ever, the concentration of greenhouse gases in the atmosphere is rising rapidly, and according to the IPCC, the planet is heating up. Between preindustrial times and now, the earth's average temperature has increased 1.8 degrees Fahrenheit (1.0 degrees Celsius), with approximately two-thirds of that warming occurring in the last handful of decades alone. According to the IPCC, 1983 to 2012 was likely the warmest 30-year period of the last 1,400 years (in the Northern Hemisphere, where assessment is possible). And all five of the years from 2014 to 2018 were the hottest on

record globally. If warming trends continue at the current rate, it's estimated global warming will reach 2.7 degrees Fahrenheit (1.5 degrees Celsius) above preindustrial levels between 2030 and 2052.

Fueled by man-made greenhouse gas emissions, global warming is altering the earth's climate systems in many ways. It is:

- Causing more frequent and/or intense extreme weather events, including heat waves, hurricanes, droughts, and floods.
- Exacerbating precipitation extremes, making wet regions wetter and dry regions drier.
- Raising sea levels due to melting glaciers and sea ice and an increase in ocean temperatures (warmer water expands, which can contribute to sea level rise).
- Altering ecosystems and natural habitat, shifting the geographic ranges, seasonal activities, migration patterns, and abundance of land, freshwater, and marine species.

These changes pose threats not only to plants and wildlife, but directly to people. Warmer temperatures mean insects that spread diseases like dengue fever and Zika can thrive—and heat waves are getting hotter and more lethal to humans. People could go hungry when our food supply is diminished thanks to droughts and floods—a 2011 National Research Council study found that for every degree Celsius that the planet heats up, crop yields will go down 5 to 15 percent. Food insecurity can lead to mass human migration and political instability. And in January 2019, the Department of Defense released a report that described the threats to U.S. military installations and operations around the world due to flooding, droughts, and other impacts of climate change.

6.3 GLOBAL WARNING AND CLIMATE CHANGE

Global warming is the slow increase in the average temperature of the earth's atmosphere because an increased amount of the energy (heat) striking the earth from the sun is being trapped in the atmosphere and not radiated out into space.

The earth's atmosphere has always acted like a greenhouse to capture the sun's heat, ensuring that the earth has enjoyed temperatures that permitted the emergence of life forms as we know them, including humans.

Without our atmospheric greenhouse the earth would be very cold. Global warming, however, is the equivalent of a greenhouse with high efficiency reflective glass installed the wrong way around.

Global warming is a phenomenon of climate change characterized by a general increase in average temperatures of the Earth, which modifies the weather balances and ecosystems for a long time. It is directly linked to

the increase of greenhouse gases in our atmosphere, worsening the greenhouse effect.

6.3.1. Causes Of Global Warming:

Global warming is the extra heat within the earth's atmosphere which has caused the rise in global temperature. Global warming leads and continues to cause climate change. Climate change can cause rising sea levels, destruction of communities, as well as extreme weather conditions.

1. Oil and Gas

Oil and Gas is used all the time in almost every industry. It is used the most in vehicles, buildings, production and to produce electricity. When we burn coal, oil and gases it largely adds to the climate problem. The use of fossil fuels is also a threat to wildlife and the surrounding environments, because of the toxicity it kills off plant life and leaves areas uninhabitable.The massive use of fossil fuels as burning coal, oil and gas produces carbon dioxide - the most important greenhouse gas in the atmosphere - as well as nitrous oxide causes global warning.

2. Deforestation

Deforestation is the clearance of woodland and forest, this is either done for the wood or to create space for farms or ranches. Trees and forests turn carbon dioxide into oxygen, so when they are cleared like the stored carbon is then released into the environment. Deforestation can also occur naturally which has a greater effect because of the fumes released from the fire.The exploitation of forests has a major role in climate change. Trees help regulate the climate by absorbing CO_2 from the atmosphere. When they are cut down, this positive effect is lost and the carbon stored in the trees is released into the atmosphere.

3. Waste / WASTE DISPOSAL

Humans create more waste now than ever before, because of the amount of packaging used and the short life cycle of products. A lot of items, waste and packaging isn't recyclable, which means it ends up in landfills. When the waste in landfills begins to decompose/break down it releases harmful gases into the atmosphere which contribute to global warming.Waste management methods like landfills and incineration emit greenhouse and toxic gases - including methane - that are released into the atmosphere, soil and waterways, contributing to the increase of the greenhouse effect.

4. Power Plants

Power plants burn fossil fuels to operate, due to this they produce a variety of different pollutants. The pollution they produce not only ends up in the atmosphere but also in the water ways, this largely contributes to global warming. Burning coal which is used in power plants is responsible for around 46% of total carbon emissions.

5. Oil Drilling

Oil drilling is responsible for 30% of the methane population and around 8% carbon dioxide pollution. Oil drilling is used to collect petroleum oil hydrocarbons in this process other gases are released into the atmosphere, which contribute to climate change, it is also toxic to the wildlife and environment it surrounds.

6. Transport and Vehicles

The large amount of transportation is done through cars, planes, boats and trains, almost all of which rely on fossil fuels to run. Burning fossil fuels releases carbon and other types of pollutants into the atmosphere. This makes transportation partly responsible for the greenhouse gases. This effect could be reduced with the introduction of electric vehicles.

7. Consumerism

Due to the innovations in technology and manufacturing customers are able to purchase any product at any time. This means we are producing more and more products every year, and over producing them. Most items we purchase aren't very sustainable, and because of the reduced lifetime of electronics and clothing items, we are creating more waste than ever.Overconsumption also plays a major role in climate change. In fact, it is responsible for the overexploitation of natural resources and emissions from international freight transport, which both contribute to global warming.

8. Farming

Farming takes up a lot of green space meaning local environments can be destroyed to create space for farming. These animals produce a lot of greenhouse gases for example methane, as well as this they also produce an extreme amount of waste. Factory farming is responsible for even more climate issues because of the extra pollution it produces and the more animals it can hold.intensive farming, not only with the ever-increasing livestock, but also with plant protection products and fertilizers. In fact, cattle and sheep produce large amounts of methane when digesting their food, while fertilizers produce nitrous oxide emissions.

9. Industrialization

Industrialisation is harmful in a variety of ways. The waste this industry produces all ends up in landfills, or in our surrounding environment. The chemicals and materials used within industrialisation can not only pollute the atmosphere but also the soil underneath it.

10. Overfishing

Fish is one of humans main sources of protein and a lot of the world now rely on this industry. Due to the amount of people buying and consuming fish, there is now a reduced amount of marine life. Overfishing has also caused a lack of diversity within the ocean.

11. MINING

Modern life is highly dependent on the mining and metallurgical industry. Metals and minerals are the raw materials used in the construction, transportation and manufacturing of goods. From extraction to delivery, this market accounts for 5% of all greenhouse gas emission.

6.3.2. Global warming effects

1. On biodiversity

The increase of temperatures and the climate upheavals disturb the ecosystems, modify the conditions and cycles of plant reproduction. The scarcity of resources and climate change are changing life habits and migratory cycles of animals. We are already witnessing the disappearance of many species - including endemic species - or, conversely, the intrusion of invasive species that threaten crops and other animals. Global warming therefore impacts biodiversity. It is the balance of biodiversity that is modified and threatened. According to the IPCC, a 1.5°C (34.7°F) average rise might put 20-30% of species at risk of extinction. If the planet warms by more than 2°C, most ecosystems will struggle.

2. On oceans

Because of global warming, permafrost and ice are melting massively at the poles, increasing the sea level at a rate never known before. In a century, the increase reached 18 cm (including 6 cm in the last 20 years). The worst case scenario is a rise of up to 1m by 2100.

The acidification of the oceans is also of great concern. In fact, the large amount of CO_2 captured by the oceans makes them more acidic, arousing serious questions about the adaptability of seashells or coral reefs.

3. On humans

Human beings are not spared by these upheavals. Climate change is affecting the global economy. It is already shaking up social, health and geopolitical balances in many parts of the world. The scarcity of resources like food and energy gives rise to new conflicts.

Rising sea levels and floods are causing population migration. Small island states are in the front line. The estimated number of climate refugees by 2050 is 250 million people.

4. On the weather

For decades now, meteorologists and climatologists around the world have been watching the effects of global warming on the weather phenomena. And the impact is huge: more droughts and heatwaves, more precipitations, more natural disasters like floods, hurricanes, storms and wildfires, frost-free season, etc.

6.3.3. Global Warming Prevention:

Good news - there are ways to reduce global warming. But how to react to climate change? What solutions to consider?

1. Renewable energies

The first way to prevent climate change is to move away from fossil fuels. What are the alternatives? Renewable energies like solar, wind, biomass and geothermal.

2. Energy & water efficiency

Producing clean energy is essential, but reducing our consumption of energy and water by using more efficient devices (e.g. LED light bulbs, innovative shower systems) is less costly and equally important.

3. Sustainable transportation

Promoting public transportation, carpooling, but also electric and **hydrogen mobility**, can definitely help reduce CO_2 emissions and thus fight global warming.

4. Sustainable infrastructure

In order to reduce the CO_2 emissions from buildings - caused by heating, air conditioning, hot water or lighting - it is necessary both to build new low energy buildings, and to renovate the existing constructions.

5. Sustainable agriculture & forest management

Encouraging better use of natural resources, stopping massive deforestation as well as **making agriculture greener** and more efficient should also be a priority.

6. Responsible consumption & recycling

Adopting responsible consumption habits is crucial, be it regarding food (particularly meat), clothing, cosmetics or cleaning products. Last but not least, recycling is an absolute necessity for dealing with waste.

6.5. QUESTIONS:

1. Define air pollution. What are the causes of air pollution?
2. Define water pollution. What are the causes of water pollution?
3. Define noise pollution. What are the causes of noise pollution?
4. Explain the effects of air, water and noise pollution.
5. Explain in brief the measures taken to control air, water and noise pollution.
6. Write an explanatory note on Ozone Layer Depletion.
7. Write an explanatory note on Global Warming and Climate Change.

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Module IV

7

ENVIRONMENTAL POLICY AND PRACTICES - I

Unit Structure:

7.0 OBJECTIVES

- To understand the concept of Environmental Policy.
- To familiar students with the Command & control approach and other approaches to environmental policy.
- To enable the learners to grasp fully the theoretical rationale behind Environmental Standards
- To explain the students technology mandates.

7.1 INTRODUCTION

Environmental economics is a sub-field of economics that is concerned with environmental issues. It has become a widely studied topic due to

growing concerns in regards to the environment in the twenty first century. Quoting from the National Bureau of Economic Research Environmental Economics program:

Environmental Economics undertakes theoretical or empirical studies of the economic effects of national or local environmental policies around the world. Particular issues include the costs and benefits of alternative environmental policies to deal with air pollution, water quality, toxic substances, solid waste, and global warming.

Environmental economics is distinguished from ecological economics in that ecological economics emphasizes the economy as a subsystem of the ecosystem with its focus upon preserving natural capital. One survey of German economists found that ecological and environmental economics are different schools of economic thought, with ecological economists emphasizing "strong" sustainability and rejecting the proposition that natural capital can be substituted by human-made capital.

Environmental economics is a sub discipline of economics focusing on the inter-relationships between the environment and the economy. It explains how the concept of economic efficiency in the allocation of scarce resources

Environmental economics is the subset of economics that is concerned with the efficient allocation of environmental resources. The environment provides both a direct value as well as raw material intended for economic activity, thus making the environment and the economy interdependent. For that reason, the way in which the economy is managed has an impact on the environment, which, in turn, affects both welfare and the performance of the economy.

7.2 ENVIRONMENTAL POLICY

Environmental policy can include **laws and policies addressing water and air pollution, chemical and oil spills, smog**, drinking water quality, land conservation and management, and wildlife protection, such as the protection of endangered species**. Environmental policy**, any measure by a government or corporation or other public or private organization regarding the effects of human activities on the environment, particularly those measures that are designed to prevent or reduce harmful effects of human activities on ecosystems.

Environmental policies are needed because environmental values are usually not considered in organizational decision-making. There are two main reasons for that omission. First, environmental effects are economic externalities. Polluters do not usually bear the consequences of their actions; the negative effects most often occur elsewhere or in the future. Second, natural resources are usually underpriced because they are often assumed to have infinite availability. Together, those factors result in what American ecologist Garrett Hardin in 1968 called "the tragedy of the commons." The pool of natural resources can be considered as a commons

that everyone can use to their own benefit. For an individual, it is rational to use a common resource without considering its limitations, but that self-interested behaviour will lead to the depletion of the shared limited resource—and that is not in anyone's interest. Individuals do so nevertheless because they reap the benefits in the short term, but the community pays the costs of depletion in the long term. Since incentives for individuals to use the commons sustainably are weak, government has a role in the protection of the commons.

7.3 ENVIRONMENTAL POLICY INSTRUMENTS

Numerous instruments have been developed to influence the behaviour of actors who contribute to environmental problems. Traditionally, public policy theories have focused on regulation, financial incentives, and information as the tools of government. However, new policy instruments such as performance requirements and tradable permits have been used.

7.3.1 Regulation

Regulation is used to impose minimum requirements for environmental quality. Such interventions aim to encourage or discourage specific activities and their effects, involving particular emissions, particular inputs into the environment (such as specific hazardous substances), ambient concentrations of chemicals, risks and damages, and exposure. Often, permits have to be acquired for those activities, and the permits have to be renewed periodically. In many cases, local and regional governments are the issuing and controlling authorities. However, more-specialized or potentially hazardous activities, such as industrial plants treating dangerous chemical substances or nuclear power stations using radioactive fuel rods, are more likely to be controlled by a federal or national authority.

Regulation is an effective means to prescribe and control behaviour. Detailed environmental regulations have resulted in a considerable improvement in the quality of air, water, and land since the early 1970s. The strengths of regulation are that it is generally binding—it includes all actors who want to undertake an activity described in the regulation—and it treats them in the same framework. Regulations are also rigid: they are difficult to change. That can be considered as a strength, since rigidity ensures that regulations will not change too suddenly. However, rigidity can also be considered a weakness, because it slows down innovation, as actors seek to stay within the letter of the law rather than creating new technologies, such as more-efficient emission scrubbers on smokestacks that would remove more pollution than what the regulation mandates. When regulations demand standards that are difficult or impossible to meet—because of a lack of knowledge, skills, or finances on the part of the actors or mismanagement by policymakers—regulations will not be effective.

One common improvement in environmental regulation made since the 1970s has been the development of performance requirements, which allow actors to determine their own course of action to meet the standard. For example, they are not required to purchase a particular piece of equipment to meet an emissions standard. They can do it another way, such as developing a technology or process that reduces emissions. The advantage of performance requirements is that actors addressed by the regulation are encouraged to innovate in order to meet the requirements. Despite that advantage, performance requirements cannot keep actors who lack incentives from achieving more than the minimum requirements.

7.3.2 Financial incentives

Governments can decide to stimulate behavioral change by giving positive or negative financial incentives—for example, through subsidies, tax discounts, or fines and levies. Such incentives can play an important role in boosting innovation and in the diffusion and adoption of innovations. For example, in Germany the widespread subsidizing of solar energy systems for private homeowners increased the large-scale adoption of photovoltaic (PV) panels. Financial incentives or disincentives can also stimulate professional actors to change. A potential drawback of financial incentives is that they distort the market. When not used for a limited period, they can make receivers dependent upon the subsidy. A final drawback is that subsidies are expensive instruments, especially when they are open-ended.

7.4 ENVIRONMENTAL REPORTING AND ECO-LABELING

Several instruments aim to inform decision makers about the environmental effects of their actions. Decisions are usually based on a cost-benefit analysis of which environmental costs and benefits are not part. The environmental impact assessment (EIA) is an instrument that helps public decision makers to decide on initiatives with a certain

environmental impact, such as the construction of roads and industrial plants. The EIA, which has become a legal requirement in many countries, requires that the environmental effects of a project, such as the building of a dam or shopping mall, be studied and that the actors be informed of how to mitigate environmental damage and what compensation they could receive for doing so. EIAs allow decision makers to include environmental information in a cost-benefit analysis. Although all EIAs cannot stop initiatives from taking place, they can reduce the negative environmental impacts.

Environmental management systems are comprehensive approaches that help organizations reduce their use of natural resources while reducing costs and—when certified—contributing to a positive image. The most commonly known standard for such systems is the ISO 14000 standards, first issued by the International Organization for Standardization (ISO) in 1996. Such standards help an organization control its environmental impact, formulate and monitor environmental objectives, and demonstrate that they have been achieved.

Ecolabels and certificates applied to specific products and services inform consumers about their environmental performance. Sometimes governments require such labels and certificates, such as the "EU Ecolabel" marking in Europe, which certifies that a product has met minimum requirements for consumer safety, health, and environmental friendliness. To push organizations to develop products and services that perform beyond those minimum requirements, there are labels that specifically express the environmental friendliness of the product or service. For example, the Energy Star rating in the United States indicates the energy performance level of household appliances. Ecolabels are often applied in the food industry (such as for certified organic or fair-trade certified products) and for energy performance in buildings (LEED standards). The underlying assumption of ecolabeling is that informed consumers buying environmentally responsible products will stimulate industry to innovate and produce cleaner products.

7.5 GLOBAL POLICY AGREEMENTS

From the early 1970s, the United Nations (UN) has provided the main forum for international negotiations and agreements on environmental policies and objectives. The 1972 Stockholm conference was the first international conference on environmental issues and was followed by the United Nations Conference on Environment and Development (UNCED) summits in Rio de Janeiro in 1992 and in Johannesburg in 2002. The UN also hosted special conferences on climate change, such as those of 1996 in Kyoto and 2009 in Copenhagen.

Those conferences and summits responded to the global character of some of the most-challenging environmental problems, which would require international cooperation to solve. Those conferences were effective in setting an international agenda for regional and national environmental policy making that resulted in treaties and protocols, also known as "hard

law," and in nonbinding resolutions, statements, and declarations, or "soft law." Whereas the 1992 Rio conference agreement was a soft law, the Kyoto Protocol was a hard law, with clear-cut reduction targets of greenhouse gas emissions for regions and countries. Nation-states, in their efforts to meet the targets, could make use of three so-called flexibility mechanisms designed to lower the costs of compliance.

Joint implementation, the first mechanism, allowed countries to invest in lowering emissions in other countries that had ratified the Kyoto Protocol and, thus, had a reduction target to meet. For industrialized, developed countries that had already invested in emission reductions in their own economies, it was cheaper to invest in emission reductions in other countries with economies in transition, where the same investment would lead to greater reductions. In other words, the investing country could get credit for helping a country with an economy in transition to lower its emissions.

Clean development, the second mechanism, allowed industrialized countries that have ratified the protocol to meet their targets in any country where it is cheapest to invest—that is, in developing countries—even if that country did not ratify the protocol. That mechanism is not undisputed, since it involves questions of intervention in the economies of developing countries, which may have an impact on the economic development of those countries. To prevent industrialized countries from not reducing their own emissions, the mechanism can only be used in supplement to domestic reductions, but no definition of such supplemental action was given, which led some countries to achieve 50 percent of their reduction target through that mechanism.

The third mechanism, carbon-emission trading (which is also known as "cap and trade"), is a market-based instrument and can be applied in the form of voluntary markets or in a mandatory framework. Most trading schemes are based on a cap-and-trade model. A central authority puts a cap on the overall carbon emissions allowed in a country or region. Within that cap, emission rights are allocated to the polluters, and emissions produced beyond those rights are penalized. The idea is that polluters choose between investing in emission reductions or emission permits. By lowering the cap over time, total emission reduction can be achieved. The trade of permits will ensure that emissions reduction is achieved at the lowest costs.

How emissions trading works ?Assume two emitting plants, A and B. Each plant emits 100 tons of pollutants (for a total emission of 200 tons), and the requirement is that these emissions be cut in half, for an overall reduction of 100 tons.(Left). In a traditional **command-and-controlsystem,** each plant might be required to reduce by 50 percent, or 50 tons, to meet the overall reduction of 100 tons. Plant A might be able to reduce at only $100 a ton, for a total expenditure of $5,000. Plant B might have to spend $200 a ton, for a total of $10,000. The cost for both plants to reach the overall reduction of 100 tons would therefore be $15,000.(Right) In a cap-and-trade system, each plant might be given allowances for only

half its previous emissions. Plant A, where reduction costs only $100 a ton, might be able to reduce emissions to as little as 25 tons, leaving it with unused allowances for 25 tons of pollutants that it is not emitting. Plant B, where reduction costs $200 a ton, might find it less costly to reduce to only 75 tons and then buy Plant A's unused allowances, effectively paying Plant A to make the 25 tons of reductions that Plant B cannot afford. The overall reduction of 100 tons would still be reached but at a lower overall cost ($12,500) than under the command-and-control system.

The instrument of tradable permits has been applied to other emissions. The first emission-trading schemes date back to 1974, when the United States experimented with emissions trading as part of the Clean Air Act.

7.6 POLICY INSTRUMENTS

Policy makers can call upon on an array of mechanisms in support of environmental policy (Figure7.1. The main categories of policy instruments are regulation **(command-and-control),market-based (economic) instruments (MBIs), voluntary approaches, and education and information.** The approaches are not mutually exclusive: all rely to some extent on education and information provision, which is signified in Figure 7.1 by the central placement of this category. For example, voluntary approaches include self-regulation, while economic instruments might be underpinned by regulation.

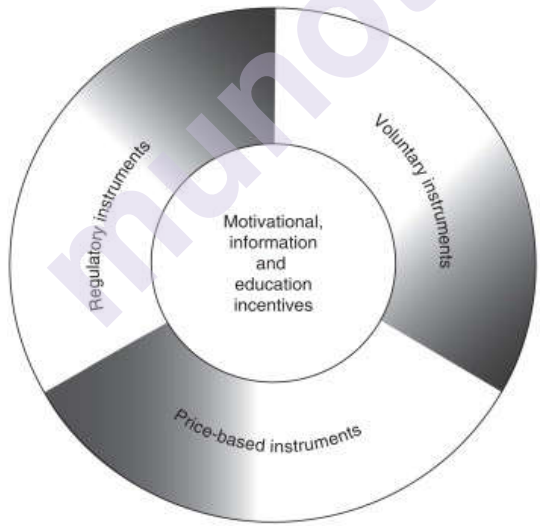

Figure7.1. Policy instruments.

In concert with the changing nature of environmental governance generally, the balance in the use of these instruments is changing from what was once a predominant reliance on regulatory methods to a much greater resort to market-based and voluntary approaches. Accordingly, greater responsibility is being transferred to the individual, either directly

through the market as an instrument of policy or through policy prescriptions that individualize the responsibility for the environment.

In most nations, environmental policy has historically relied on the use of public regulation, which is often associated with command-and-control instruments, such as zoning, discharge standards, licensing, bans or limits on inputs and outputs, and requirements in terms of technology and design. Despite their widespread use, regulatory measures are considered by some people to be inflexible, intrusive, and inefficient; in many cases, they have failed to change behaviour with respect to the environment. Accordingly, in recent years, there has been a trend in many Western nations toward self-regulation, in which private interests (such as farmers, companies, and individuals), rather than governments, regulate to protect the public good. Examples of private-interest regulatory mechanisms include industry codes of practice, environmental certification, eco-labelling programs and agreements between interest groups and industry. There is a growing interest in quality control codes and certification systems, particularly in manufacturing, agriculture, and food processing industries. Although there is no legal enforcement, governments can influence the design, implementation, and impact of private regulation in a variety of ways. Thus, governments are showing interest in a greater reliance on self-regulation and voluntary standards, together with a statutory duty of care for the environment, on the basis that everyone who could influence the risk of environmental harm should be required to take all reasonable and practical steps to prevent any foreseeable harm from their actions. This is an important shift in the approach to policy implementation.

An emphasis on the development of voluntary or partnership programs involving individuals and community groups undertaking local projects for environmental remediation have accompanied the progressive shift of responsibility to individuals, firms, and communities. The strategies of partnerships, self-help, and community empowerment have been used to encourage participation and to promote the idea that environmental problems are best addressed through communities working together and with government and industry. Advantages might include increased public participation in decision making, which is now sometimes associated with what is called ‘deliberative democracy’. A wide range of concerns counterbalances the positive rhetoric surrounding partnerships and civic environmentalism, however. These refer to the implications of imbalances of power in partnerships, volunteer burnout in community-based programs, an absence of strategic direction in terms of environmental outcomes, and a lack of adequate resources.

To overcome the limitations of both voluntary and regulatory approaches, there has been an increasing interest in, and acceptance of, the use of economic instruments in support of environmental policy objectives. These market-like mechanisms aim to internalize negative environmental externalities, for example, by creating markets in carbon, biodiversity, and salinity. Economic instruments provide financial incentives/disincentives that, in many cases, are likely to engender better responses to

environmental issues, while avoiding the complexities and prescriptive nature of legislation.

Although the enthusiasm for economic instruments is widespread, they have also been subject to critical assessment. There are equity issues and prospective operational problems arising from the definition of property rights and organizational capacity. A review of the use of economic instruments in the Organisation for Economic Co-operation and Development (OECD) nations revealed 'no black and white picture of their general success'.

The success of policy instruments relies on matching them to the particular ecological, political, and economic situation and to the capabilities of institutions and stakeholders. It is not necessarily a matter of developing new tools and instruments, but designing a 'mix' of policy instruments that is best suited to the circumstance. It has also been established that the attitudes and outlook of stakeholders (e.g., industry, individuals, and land managers) are fundamental considerations in bringing about changes in environmental practices. To succeed, new policy approaches require the cooperation of these stakeholders.

Thus, the effective and efficient implementation of policy and management strategies by government relies, in part, on an understanding of what stakeholders regard as the key issues that influence those decisions that in turn impact on the environment, how they are responding to these issues, their disposition toward various policy and management tools, and their past experience in working with government agencies.The main function of environmental policy is **to, through government action, minimize the environmental impact of businesses and society**.

A therapeutic approach in which efforts are directed either toward reducing external pressures (e.g., employment or financial problems) that contribute to emotional difficulties or toward modifying aspects of the individual's living or working space to improve functioning.

Policy makers who seek to improve environmental quality (or the management of natural resources) have a number of policy approaches that they can use. These include **command-and-control regulations, market-based instruments (such as taxes and cap-and-trade programs)**, and voluntary approaches.

7.7 THE COMMAND-AND-CONTROL APPROACH

The principle is to command people or firms not to do something by enacting a law that makes it illegal and by delegating authorities to enforce such law through the imposition of fines or penalty to violators.

7.7.1 Command-and-control approach and environment standards

Command-and-control approach (CAC) is one where political authorities mandate people, by enacting a law, to bring about a behavior and use an enforcement machinery to get people to obey the law. In environmental

policy, the CAC approach involves the setting of standards to protect or improve environmental quality. A standard is generally the tool used in the CAC approach.

It is a mandated level of performance enforced through a piece of legislation. A few examples are the limits set on the volume of timber that could be harvested, bans on the cutting of trees, and maximum levels legally allowed for pollution emissions. There are three types of environmental quality standards, namely, ambient, emission and technology.

7.7.2 Ambient standards.

These refer to "never-exceed" levels for some pollutants in a particular environment. The Philippine Clean Air Act, which repeals the National Pollution Control Act, for instance, establishes ambient air quality standards for source-specific air pollutants such as sulfur oxide and carbon monoxide from mobile and stationary sources. For water quality, meanwhile, the ambient standards refer to minimum levels needed to be maintained for dissolved oxygen, pH or acidity level, biochemical oxygen demand (BOD), and total coliform organisms, etc. Dropping beyond this minimum level would lead to a harmful situation. And while ambient standards cannot be directly enforced, legal measures could nonetheless be imposed on polluters to regulate their emission-producing activities.

7.7.3 Emission standards.

Emission or effluent standards are also "never-exceed" levels applied directly to the quantities of emissions from pollution sources per unit of time. For example, the Philippine Clean Air Act of 1999 allows maximum emission of specific pollutants from vehicles. The Act also allows the Department of Environment and Natural Resources (DENR) to designate each regional industrial center to allocate emission quotas within its jurisdiction. In effect, emission standards set a limit or constraint to the level of performance that has to be observed by the polluters, as highway speed limit does. Since emission standard only sets the maximum limit of emission, however, the polluters are left with the decision on how to achieve it. Setting emission standards does not necessarily mean meeting ambient standards. Even if emission standards are imposed on firms but no control on the number of polluting firms is established, then the aggregate environment quality in terms of ambient standards is not directly checked.

The recent phenomenon in Bolinao, Pangasinan illustrates this point as the unabated proliferation of fish pens and cages caused the accumulation of fish feeds and other wastes in the water. This then reduced the dissolved oxygen content, eventually resulting in fish kill.

7.7.4 Technology standards

These standards specify the technologies or practices, including design, engineering, input and output standards, that polluters must adopt or meet to protect the environment. In contrast to emission standards, technology

standards impose on polluters certain decisions and technologies to be used. This is some form of "technology forcing" for polluting industries to adopt technological change in order to meet environment standards.

7.8 CONCERNS ON ENVIRONMENT STANDARDS

Standards are popular because they appear simple and specific in targets. However, in reality, there are complications and other considerations that have to be addressed such as the level of standards, uniformity of standards, equity effects and enforcement. While standards under the CAC approach may appear to directly put restraints on pollution, it has a number of limitations, particularly in the incentive it offers polluters to comply with environment standards. CAC is like a "one-size-fits-all" approach (World Bank 1999) that does not categorically consider varying performance of polluters, thereby ignoring the efficiency principle. This constraint has thus encouraged the use of other policy alternatives for environmental management, one of which is the "polluter pays" principle.

This is an incentive-based strategy where taxes or charges are estimated according to the level of emission. The incentive system adopted by the Laguna Lake Development Authority (LLDA) in the 1990s illustrates how it restored the lake that has become a basin of industrial wastes from surrounding industries. The LLDA imposed a charge per unit of emission within the legally permissible standard and a higher unit charge for emissions above the standard. In two years' time, the scheme brought about an 88 percent reduction in BOD discharges from the pilot plants covered in the initial implementation (World Bank 1999).

7.9 VOLUNTARY APPROACHES FOR ENVIRONMENTAL POLICY: ENVIRONMENTAL EFFECTIVENESS, ECONOMIC EFFICIENCY AND USAGE IN POLICY MIXES

Voluntary actions by firms and households to improve environmental performance clearly should be welcomed − and there is a considerable literature indicating that firms can profit from taking such voluntary action. However, opinions differ concerning the usefulness for policy makers to rely on voluntary approaches to achieve environmental targets. Voluntary approaches include agreements on environmental performance negotiated with industry and public programs in which firms can volunteer to participate. Some see such approaches as offering a chance to address environmental problems in a flexible manner at a low cost, based on consensus building between the different stakeholders. Others believe that such approaches provide few environmental improvements beyond what would have occurred anyway, and that both administrative and abatement costs can be greater than with other instruments.

The report “Voluntary Approaches for Environmental Policy” provides an up-to-date discussion of the use of such approaches in meeting environmental policy goals. It builds on a number of case studies, and

focuses in particular on the environmental effectiveness, economic efficiency and the administrative costs related to these approaches − when they are used either in isolation or as part of "policy mixes" together with other types of policy instruments.

The report demonstrates that a large, and seemingly increasing, number of voluntary approaches is being used in environmental policy in OECD member countries, most often in combination with one or more other instruments. While recognizing that it would be imprudent to make overly generalized statements about the merits of applying voluntary approaches, a few conclusions can be drawn:

- While the environmental targets of most − but not all − voluntary approaches seem to have been met, there are only few cases where such approaches have been found to contribute to environmental improvements significantly different from what would have happened anyway.

- Hence, the environmental effectiveness of voluntary approaches is still questionable.

- This could indicate that a significant degree of "regulatory capture" has taken place.

But it remains unclear what would have been the − realistic − alternative to a given policy or policy combination. Would there in practice have been sufficient political willingness to give priority to reach ambitious environmental targets − if that, for instance, could jeopardize the (often modest) employment in the most affected (highly polluting) sectors?

The broadening use of voluntary approaches seems to reflect the fact that policymakers have tried to find an instrument through which one could avoid having to make such trade-offs. It is, however, unlikely that difficult trade-offs can be avoided if more ambitious environmental targets are to be met in the future.

- In most member countries, the entry into force of the Kyoto protocol will represent a new situation, where they face an economy-wide, legally binding, environmental target. If, under such a regime, some sectors are given a more lenient treatment, other sectors will have to abate more − or the country will have to buy more quotas in the international market.

- Voluntary approaches are generally designed to limit the impacts of environmental policies on the production costs of participating firms. However, when firms do not face an appropriate marginal incentive to abate pollution (from a tax, or from the value of a tradable emission permit), environmental policy largely fails to stimulate a reduction in demand for the products that cause environmental problems in their production.

- The economic efficiency of voluntary approaches is generally low − as they seldom incorporate mechanisms to equalize marginal abatement costs between all producers, inter alia because environmental targets tend to be set for individual firms or sectors, rather than at a national level.

- However, traditional "command and control" policies also rarely equalize abatement costs at the margin between different polluters, and voluntary approaches can offer a higher economic efficiency than such policies, by providing increased flexibility in how environmental improvements are to be accomplished.

- Voluntary approaches can sometimes be put in place more rapidly than alternative policy instruments, like new regulations or economic instruments. However, the likelihood of a voluntary approach providing any environmental improvements beyond "Business-as-Usual" depends strongly on their quality.

A "first best" approach would be to replace the "command and control" policies by economy-wide economic instruments − taxes or tradable permits − where technically and administratively possible.

A "second-best" option could be to improve the flexibility of pre-existing "command and-control" regulations, instead of a piece-meal approach that lets only a few companies attain environmental improvements in a more flexible manner.

The performance of many voluntary approaches would be improved if there were a real threat of other instruments being used if (appropriately set) targets are not met. However, if it is likely − or widely believed − that the alternative policy would entail significant negative social impacts, the credibility of such threats may not be great.

Various types of administrative and transaction costs vary greatly between different voluntary approaches. If too few resources are spent in their preparation, negotiation and enforcement, their environmental impacts are likely to be very modest.

Combining a voluntary approach with a tax or a tradable permit system can trigger quite significant additional administrative costs, and the environmental integrity of the other instrument can be weakened.

Based on the discussion in the report, some recommendations for policy formulation have been singled-out:

Consider carefully if current environmental targets − or the lack of such targets − represent a reasonable balance between the combined benefits of additional environmental improvements and the total costs of achieving such improvements.

• Consider also if the targets are set in such a way that they encompass as many as possible of the sources of a given problem.

If economic costs under current policies are allowed to be higher than what could have been possible, in order to limit social costs (e.g. concerning transitory unemployment and/or impacts on low-income households): consider carefully whether other policy instruments cannot better address such social concerns.

- If a voluntary approach is already applied: consider whether target fulfilment to date is satisfactory, and whether credible threats of the application of additional instruments would be appropriate − and possible to implement.

- If a new voluntary approach is being prepared: elaborate first a "Business-as-Usual scenario", describing likely developments in the years ahead if no policy-changes were to be made. Quantified targets should be set with reference to this scenario, in such a way that marginal abatement costs and marginal benefits of the environmental improvements balance reasonably well. Consider carefully whether well-prepared alternative policy instruments − that could serve as credible threats − can underpin the voluntary approach. Make sure to collect the information necessary for a later evaluation of the approach in question.

- Consider carefully various potential impacts of combining a voluntary approach with other policy instruments: ¾ Which are the likely consequences on environmental effectiveness, economic efficiency, administrative costs, sectoral competitiveness impacts, of the other policy instrument(s)? ¾ Which are the likely consequences of "adding" other instruments to the voluntary approach?

The report does not alter the finding of many previous analyses that economy-wide economic instruments in many cases can be a better policy option than voluntary approaches, both from the point of view of environmental effectiveness and economic efficiency. A broader application of economic instruments is, however, frequently hampered by − in particular − a fear of loss of international competitiveness of the most affected (and most polluting) sectors, which in turn could have negative impacts on employment in these sectors. Providing tax exemptions to the sectors in questions in return for "voluntary" abatement commitments can be one way to overcome "the competitiveness obstacle". However, the environmental and/or economic costs of applying this option could be high. Increased international co-operation to facilitate use of economic instruments would seem to be a better option.

Local incentives are the most effective approach to environmental policy. Local governments often have a more direct knowledge of factors that affect the environment, such as how much waste residents create or how much water and electricity they use.

Command-and-control **policies regulate behavior directly**, whereas market-based policies provide incentives for private decision-makers to change their behavior.

Regulatory approaches require government agencies to restrict or direct the activities of regulated parties using terms and conditions within statutory and regulatory instruments, operating permits, licenses, approvals or codes of practice. These may be specified for a whole sector or for an industrial process that is used across several sectors.

Regulatory approaches range widely. Some are very restrictive tools that provide little flexibility, with government dictating the behaviour for regulated parties to comply with environmental regulations. In contrast, innovative regulatory approaches allow parties more latitude in selecting the best means to comply with rules. Regulatory approaches are highly dependent on deterrents and, as a result, effective enforcement is essential to their success in achieving environmental goals.

7.10 ENVIRONMENTAL STANDARDS

Environmental standards are **administrative regulations or civil law rules implemented for the treatment and maintenance of the environment**. Environmental standards should preserve nature and the environment, protect against damage, and repair past damage caused by human activity.

Environmental standards are typically set by government and can include prohibition of specific activities, mandating the frequency and methods of monitoring, and requiring permits for the use of land or water. Standards differ depending on the type of environmental activity.

Environmental standards may be used produce quantifiable and enforceable laws that promote environmental protection. The basis for the standards is determined by scientific opinions from varying disciplines, the views of the general population, and social context. As a result, the process of determining and implementing the standards is complex and is usually set within legal, administrative or private contexts.

The human environment is distinct from the natural environment. The concept of the human environment considers that humans are permanently interlinked with their surroundings, which are not just the natural elements (air, water, and soil), but also culture, communication, co-operation, and institutions. Environmental standards should preserve nature and the environment, protect against damage, and repair past damage caused by human activity.

7.10.1 Development of Environmental Standards

Historically, the development of environmental standards was influenced by two competing ideologies: eco-centrism and anthropocentrism. Eco-centrism frames the environment as having an intrinsic value divorced from the human utility, while anthropocentrism frames the environment as only having value if it helps humanity survive. This has led to problems in establishing standards.

In recent decades, the popularity and awareness of environmentalism has increased with the threat of global warming becoming more alarming than ever since the IPCC released their report in 2018. The report asserts that based on scientific evidence "if human activities continue to at this rate it is predicted to increase in-between 1.5-2 °C over pre industrial levels in-between 2030 and 2052". Busby argues that Climate change will define this century and that it is no longer a faraway threat. In turn, the demand for protecting the environment has risen. Developments in science have been fundamental for the setting of environmental standards. Improved measurements and techniques have allowed scientists to better understand the impact of human-caused environmental damage on human health and the biodiversity, which composes the natural environment.

Therefore, environmental standards in modern times are set with the view that humans do have obligations toward the environment, but they can be justified in terms of obligations toward other humans. This means it is possible to value the environment without discarding anthropocentrism. Sometimes called prudential or enlightened anthropocentrism. This is evident as environmental standards often characterize the desired state (e.g. the pH of a lake should be between 6.5 and 7.5) or limit alterations (e.g., no more than 50% of the natural forest may be damaged). Statistical methods are used to determine the specific states and limits the enforceable environmental standard.

Penalties and other procedures for dealing with regions out of compliance with the standard may be part of the legislations.

7.10.2 Governmental Institutions setting Environmental Standards

Many different institutions set environmental standards.

United Nations (UN)

The UN, with 193 member states, is the largest intergovernmental organization. The environmental policy of the UN has a huge impact on the setting of international environmental standards. At the Earth summit in 1992, held in Rio, the member states acknowledged their negative impact on the environment for the first time. During this and the following Millennium Declaration, the first development goals for environmental issues were set.

Since then, the risk of the catastrophe caused by extreme weather has been enhanced by the overuse of natural resources and global warming. At the Paris Agreement in 2015, the UN determined 17 Goals for sustainable development. Besides the fight against global poverty, the main focus of the goals is the preservation of our planet. These goals set a baseline for global environmentalism.

The environmental areas of water, energy, oceans, ecosystems, sustainable production, consumer behaviour and climate protection were covered by the goals. The goals contained explanations on which mediums were required to reach them. Implementation and follow-up are controlled by

non-enforceable voluntary national reviews. The main control is done by statistical values, which are called *indicators*. These indicators deliver information if the goals are reached.

European Union

Within the Treaty on the Functioning of the European Union, the Union integrates a self-commitment towards the environment. In Title XX, Article 191.1, it is settled: "Union policy on the environment shall contribute to the pursuit of the following objectives: — preserving, protecting and improving the quality of the environment, — protecting human health, — prudent and rational utilization of natural resources, — promoting measures at international level to deal with regional or worldwide environmental; problems, and in particular combating climate change." All environmental actions are based on this article and lead to a suite of environmental laws. European environmental regulation covers air, biotechnological, chemical, climate change, environmental economics, health, industry and technology, land use, nature and biodiversity, noise, protection of the ozone layer, soil, sustainable development, waste, and water.

The European Environment Agency (EEA) consults the member states about environmental issues, including standards. The environmental standards set by European legislation include precise parametric concentrations of pollutants and also includes target environmental concentrations to be achieved by specific dates.

United States

In the United States, the development of standards is decentralized. More than a hundred different institutions, many of which are private, developed these standards. The method of handling environmental standards is a partly fragmented plural system, which is mainly affected by the market. Under the Trump Administration, Climate standards have increasingly become a site of conflict in the politics of global warming.

7.11 AMBIENT AIR QUALITY STANDARDS

The National Ambient Air Quality Standards (NAAQS) are set by the Environmental Protection Agency (EPA) to regulate pollutants in the air. The enforcement of these standards is designed to prevent further degradation of air quality.

States may set their own ambient standards, so long as they are lower than the national standard. The NAAQS regulates the six criteria for air pollutants: sulphur dioxide (SO_2), particulate matter (PM_{10}), carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), and lead (Pb). To ensure that the ambient standards are met, the EPA uses the Federal Reference Method (FRM) and Federal Equivalent Method (FEM) systems to measure the number of pollutants in the air and check that they are within the legal limits.

7.11.1 Air emission standards

Emission standards are national regulations managed by the EPA [that control the amount and concentration of pollutants that can be released into the atmosphere to maintain air quality, human health, and regulate the release of greenhouse gases such as carbon dioxide (CO_2), oxides of nitrogen and oxides of sulphur.

The standards are established in two phases to stay up-to-date, with final projections aiming to collectively save Americans $1.7 trillion in fuel costs and reduce the amount of greenhouse gas emissions (GHG) by 6 billion metric tons. Similar to the ambient standards, individuals states may also tighten regulations. For example, California set their own emissions standards through the California Air Resources Board (CARB), and these standards have been adopted by some other states. Emission standards also regulate the number of pollutants released by heavy industry and for electricity.

The technological standards set by the EPA do not necessarily enforce the use of specific technologies, but set minimum performance levels for different industries.https://en.wikipedia.org/wiki/Environmental_standard - cite_note-:0-28 The EPA often encourages technological improvement by setting standards that are not achievable with current technologies. These standards are always set based on the industry's top performers to promote the overall improvement of the industry as a whole.

7.12 IMPACT OF NON-GOVERNMENTAL ORGANISATIONS ON ENVIRONMENTAL STANDARDS

7.12.1 International Organization of Standardization

The International Organization of Standardization (ISO) develops a large number of voluntary standards. With 163 member states, it has a comprehensive outreach. The standards set by the ISO were often transmitted into national standards by different nations. About 363,000 companies and organizations worldwide have the ISO 14001 certificate, a standard for environmental management created to improve the environmental performance of an organization and legal aspects as well as reaching environmental aims. Most of the national and international environmental management standards include the ISO 14000 series. In light of the UN Sustainable Development Goals, ISO has identified several families of standards which help meet SDG 13 which is focused on Climate Action for global warming.

7.12.2 Greenpeace

Greenpeace is a popular non-governmental organization that deals with biodiversity and the environment. Their activities have had a great global impact on environmental issues. Greenpeace encourages public attention and enforces governments or companies to adapt and set environmental

standards through activities recording special environmental issues. Their main focus is on forests, the sea, climate change, and toxic chemicals. For example, the organization set a standard about toxic chemicals together with the textiles sector, creating the concept 2020, which plans to banish all toxic chemicals from textile production by 2020.

7.12.3 World Wildlife Fund

The World Wide Fund is an international non-governmental organization founded in 1961 that works in the field of wilderness preservation and the reduction of human impact on the environment.

7.12.4 Economy

Environmental standards in the economy are set through external motivation. First, companies need to fulfil the environmental law of the countries in which they operate. Moreover, environmental standards are based on voluntary self-commitment which means companies implement standards for their business. These standards should exceed the level of the requirements of governmental regulations. If companies set further-reaching standards, they try to fulfil the wishes of stakeholders.

At the process of setting environmental standards, three different stakeholders have the main influence. The first stakeholder, the *government*, is the strongest determinate, followed by the influence of the customers. Nowadays, there is an increasing number of people, who consider *environmental factors* during their purchasing decision. The third stakeholder who forces companies to set environmental standards is *industrial participants*. If companies are part of industrial networks, they are forced to fulfil the codes of conduct of these networks. This code of conduct is often set to improve the collective reputation of an industry. Another driving force of industry participants could be a reaction to a competitors action.

The environmental standards set by companies themselves can be divided into two dimensions: operational environmental policies and the message sent in advertising and public communications.

7.13 OPERATIONAL ENVIRONMENTAL POLICIES

This can be the environmental management, audits, controls, or technologies. In this dimension, the regulations tend to be closely connected with other function areas, e.g. lean production. Furthermore, it could be understood that multinational companies tend to set cross-country harmonized environmental government regulations and therefore reach a higher performance level of environmental standards.

It is often argued that companies focus on the second dimension: the message sent in advertising and public communications. To satisfy the stakeholders' requirement, companies were focused on the public impression of their environmental self-commitment standards. Often the real implementation does not play an important role.

A lot of companies settle the responsibility for the implementation of low-budget departments. The workers, who were in charge of the standards missing time and financial resources to guarantee a real implementation. Furthermore, within the implementation, goal conflicts arise. The biggest concern of companies is that environmental protection is more expansive compared to the gained beneficial effects. But, there are a lot of positive cost-benefit-calculation for environmental standards set by companies themselves. It is observed that companies often set environmental standards after a public crisis. Sometimes environmental standards were already set by companies to avoid public crises. As to whether environmental self-commitment standards are effective, is controversial.

7.14 TECHNOLOGY SPECIFICATIONS

Technology specifications prescribe a particular technology or equipment that a regulated party must use to control emissions/effluent levels. The requirement or standard is typically applied to all parties within a sector without freedom to choose alternate means of control. Specifications are most often used in pollution control technology.

Where are they used?

Explicit technology specifications in environmental regulation, for example through approvals, permits or Codes, are quite rare across most jurisdictions. This approach works best where there is a single applicable technology or where the need for certainty in environmental control is immediate, and administrative ease is desirable. When Alberta Environment sets Sulphur recovery levels, there may only be one commercially available technology. While the department's Sulphur recovery guideline does not specify a required technology, its use is implied and this represents a "de facto" technology specification. Approvals issued by the department may mention the technology for clarity purposes.

Tool performance:

Pros

- Provides a high level of certainty that the desired performance will be achieved, assuming the operation and maintenance of the technology is continued.
- Compliance is straightforward as it is focused on whether the specific technology or equipment is installed and operating to specifications.
- Treats all entities within a sector equally, when applied uniformly.
- Relatively simple for the department to administer. Emissions standards do not have to be set, and the regulator does not need to consider the adequacy of alternative technologies proposed by the regulated parties.

Cons

- • Specified technologies may not be adequate to achieve long-term outcomes.
- Regulated parties cannot pursue other control technologies or methods that might be less costly.
- Can fail to consider the different circumstance of each effected regulated party.
- Requires specific operating standards and monitoring to ensure the specified technology is being used and maintained appropriately.
- Discourages innovation amongst those firms that already are proactive and innovative in applying the best available technologies to enhance environmental performance.

7.15 QUESTIONS

1. Explain the meaning and importance of environmental policy.
2. Discuss various environmental policy instruments.
3. Explain command control approach of environmental policy.
4. Discuss in details the concept of environmental standards.
5. Explain how non-governmental organizations affect the environmental standards.

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8

ENVIRONMENTAL POLICY AND PRACTICES - II

Unit Structure

8.0 OBJECTIVES

- To understand the concept of Market-based instruments (MBIs) approach.
- To familiar students with the Rehabilitation & Resettlement Policy
- To enable the learners to grasp fully the theoretical rationale behind the Kyoto protocol & subsequent developments on Climate change.
- To explain the students the importance of Rio declaration.
- To understand the concept of Carbon Trading.

8.1 INTRODUCTION : MARKET BASED INSTRUMENTS (MBI's)

Governments need to choose policy instruments to implement their environmental policies and to achieve environmental goals. For that purpose, they may use traditional command-and-control approaches, but

they may also choose to use market-based instruments as a more efficient or more acceptable approach to meeting their objectives. In practice, it is not about making a choice between regulatory and market-based instruments, but rather finding a good mix between these two approaches.

Market-based instruments (MBIs) are **taxes, charges, levies, tradable permit schemes**, deposit refund systems, subsidies etc. The term "market-based environmental policy instruments" (MBIs) is used to describe a very wide range of policy instruments. Their common characteristic is the use of market power and competition to achieve environmental objectives.

Policy Design Circle

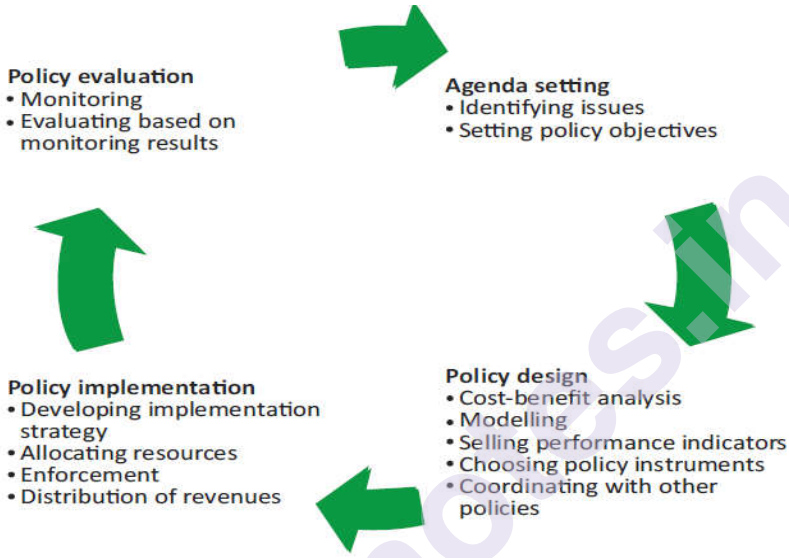


Figure 8.1

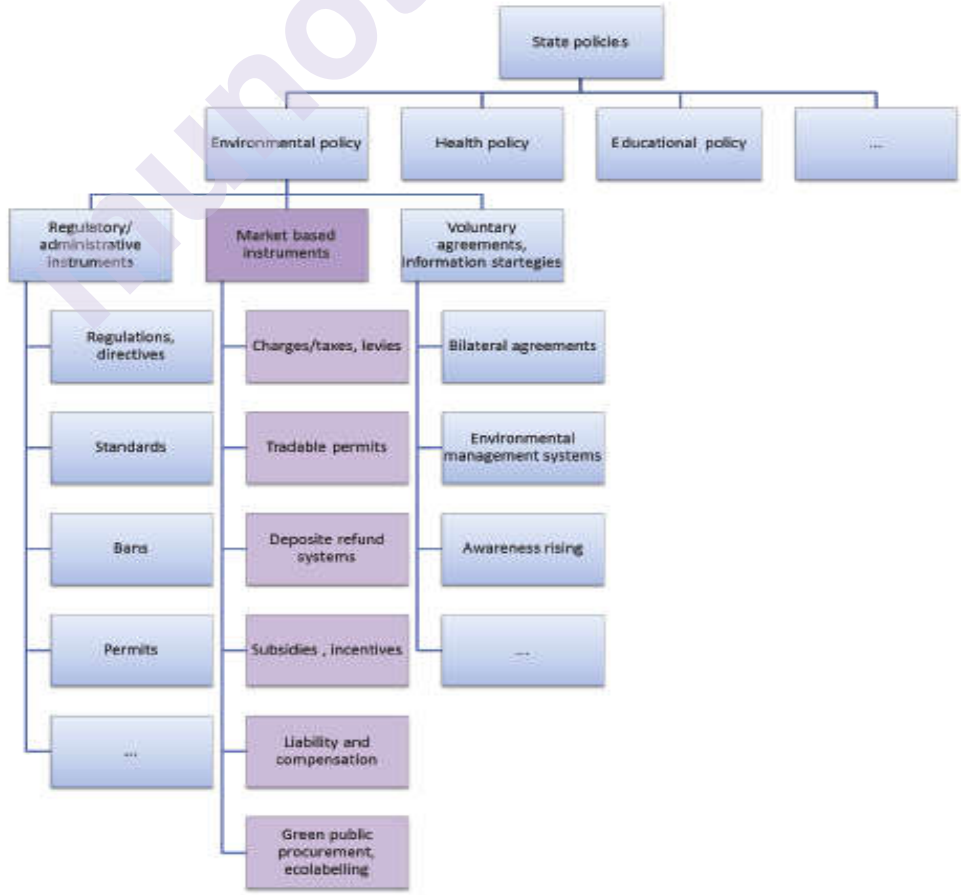
Governments can use a range of environmental policy instruments to implement their environmental policies and deliver their commitments to international environmental agreements. Environmental policy instruments can roughly be divided into three broad categories: 1. Regulatory/ administrative instruments (so called **"commandand-control").** These are regulations, directives, bans, permits, etc., which are prescriptive and provide the private sector with relatively little flexibility in achieving their goals. 2. Market-based instruments (MBIs) are taxes, charges, levies, tradable permit schemes, deposit refund systems, subsidies etc. These instruments can be used to provide producers and consumers with incentives to change their behaviour towards more efficient use of natural resources by reducing consumption, and to look for more effective ways of making environmental progress while giving them flexibility in how they do so. Market-based instruments can be implemented in a systematic manner, across an economy or region, across economic sectors, or by environmental medium (e.g. water)

8.1.1 VOLUNTARY AGREEMENTS AND INFORMATION STRATEGIES/ MORAL SUASION :

These are voluntary environmental measures independent of government requirement, such as bilateral agreements between the government and private firms and voluntary commitments made by firms, e.g. implementation of environmental management systems, publishing environmental reports. Voluntary changes in behaviour could be accomplished also via education, transfer of knowledge, training, persuasion, etc.

Market-based instruments (MBIs), also referred to as "market-based economic instruments" or "economic instruments" (EIs), are tools for governments to implement environmental policy. These tools "affect estimates of the costs and benefits of alternative actions open to economic agents" Or, to put it more simply, if a tool affects the cost or price of goods and services in the market, then it is a market-based economic instrument. This definition focuses on the economic signals and incentives the instrument provides. If it changes the cost or price of a good (e.g., plastic bag), service (e.g., waste collection), activity (e.g., waste dumping), input (e.g., materials), or output (e.g., pollution) then it is a market-based instrument.

Figure 8.2. Classification of Environmental Policy Instruments (Based on EEA 2005A)



8.1.2 HOW DO THEY WORK?

MBIs help to assign **"the right price**" to resources that are not otherwise appropriately valued in the market, such as water, clean air, ecosystem services, biodiversity, and marine resources. **"Getting the price right"** means that it properly reflects the resource cost or cost of the pollution impacts and reflects the principle of "**full-cost recovery**" or the "user pays principle". This provides producers and consumers with incentives to change their behaviour and look for more effective ways of making environmental progress, while giving them flexibility in how they do so. Some MBIs through raising prices also result in revenue raising. Price based instruments (taxes/charges, subsidies, deposit refund systems, feed-in-tariffs, etc.) are used to lever behavioural change by changing prices in existing markets.

Quantity based instruments (tradable permits/emissions trading schemes) influence behavioural change by specifying the 'amount' of new rights/obligations and allowing the market to set their price. Whether by influencing prices (through taxation or incentives), or setting absolute quantities (emissions trading), or quantities per unit of output (emission charges), MBIs implicitly acknowledge that firms differ from each other and therefore provide flexibility that can substantially reduce the costs of environmental improvements. In theory, if properly designed and implemented, market-based instruments will allow any desired level of pollution clean up to be realized at the lowest overall cost to society, by providing incentives for the greatest reductions in pollution by those firms that can achieve these reductions most cheaply.

8.1.3 MAIN PRINCIPLES IN USING MBIS

1. Environmental effectiveness

The most important point to underline is that any environmentally related MBI should cause change in consumption or production pattern which will lead to reduce environmental burden. If an instrument fails to do that, it should be considered whether to change or even abandon the instrument.

2. Economic efficiency

One of the advantages of MBIs is their effectiveness on every unit of pollution. Taxes encourage both static (abatement at the lowest-cost source) and dynamic (continuous reduction of pollution abatement costs and pollution levels) efficiency gains.

3. Equity / income distribution

Policy makers need to consider the impact of such taxes also on sensitive groups such as low-income households or pollution-intensive, trade-exposed businesses. Lower tax rates or exemptions are sometimes put into place to limit impacts on such groups. Generally it is advised not to make exemptions into tax system itself, but rather use other policy instrument to overcome the distributional problems.

4. Competitiveness

The aim of economic instruments (especially taxes) is to make activities with higher environmental impact less profitable in an economic sense. It means that, at the enterprise level, there are always companies that are better off than others – those who pollute less or are more efficient in their resource use. The competitiveness issue rises more sharply at a sector or national level, where taxes or tradable allowance schemes imposed may have a negative impact on international competitiveness (if the instrument is implemented only at local/national level).

5. Acceptance, stakeholder involvement.

The acceptance of environmental taxes is in good correlation with awareness about environmental problems in society. Opposition to environmental taxes may be caused by not enough information about the purpose of the tax, little trust of assurances in how the revenue is used, fear of loss of competitiveness or other reasons. Well-designed taxes are highly transparent in terms of their coverage and costs. It should be clear what is taxed, which polluters are exempt, and what the cost to polluters will be per unit of pollution generated.

An evaluation should take place to assess which groups are most powerful, and what their primary goal is. Allocation of rights in the baseline is also quite important: groups with existing rights, whether actual or implied, will often have more power/interest in fighting changes to existing policies. The factional analysis should also assess what options exist for buffering any social impacts that may occur from the policy reform, especially those that affect the poor.

8.1.4 HOW DO MBI S COMPARE WITH REGULATORY INSTRUMENTS?

As set out above, using MBIs to achieve environmental goals can be cost-efficient20. MBIs improve price signals so that producers and consumers can properly take them into account and are incentivised to reduce negative - and increase positive - environmental and other impacts. Regulatory instruments require detailed information on regulated industries and industrial technologies in order to set standards. Command-and-control tools often require sophisticated regulatory compliance staff. By comparison, with MBIs the government can avoid the need for detailed information if the market sets prices, for example for tradable permits. In some cases, MBIs can help substitute for weak institutions in circumstances where the parties who buy rights monitor cheating on a decentralized level - so long as sanctions can be taken against cheaters once detected. In short, compared to regulatory instruments, market-based instruments may offer the following advantages:

- They improve price signals, by giving a value to the external costs and benefits of economic activities, so that economic actors take them into account and change their behaviour to reduce negative – and increase positive - environmental and other impacts .

- They allow industries to have greater flexibility in meeting objectives and thus lower overall compliance costs.

Homogenous taxes encourage abatement at the lowest-cost source, helping to ensure that environmental goals are achieved at the lowest social cost ("static efficiency"). Different firms face different pollution abatement costs. By implementing a tax on emissions, for example, it will pay certain firms more than others to cut back on emissions. This lowest-cost solution is unlikely to be achieved if a uniform environmental standard was applied to every individual polluter.

In contrast to regulatory instruments, the use of MBIs gives polluters (firms) an incentive to go further and reduce pollution more than required by environmental authorities. In the longer term, polluters may pursue technological innovation to reduce further adverse impacts on the environment ("dynamic efficiency"). MBIs generate revenues which could be used for different reasons, such as providing support for innovation or reducing other taxes to support employment, i.e. when used in the context of environmental tax or fiscal reforms .

8.1.5 MAIN CONCERNS ABOUT USING MBIS

However, although there are many successful examples of using MBIs, there are studies indicating that MBIs are not always the best instruments for achieving change in behaviour. There are various reasons or situations where MBIs may not succeed and regulatory and other instruments might be more successful in achieving the objectives:

8.1.5.1 Emergency conditions.

When problems have severe implications, emergency conditions arise, and behaviour needs to stop immediately, direct bans may be more appropriate.

8.1.5.2 Excessive monitoring costs.

When there are a large number of very small transactions (e.g., emissions trades) monitoring costs may be very high so regulations may be a better fit.

8.1.5.3 Fragmented authorities.

Where authority to set and enforce regulations is highly fragmented across institutions, oversight of market-based instruments might become quite difficult.

8.1.5.4 Equity/distributional issues.

Increasing prices to cover their full resource cost will impact on consumer groups where they cannot switch to alternative goods and services, and this may be of concern where they are sensitive groups such as low-income households.

8.1.5.5 Illegal activities.

MBIs can encourage cost-avoiding damaging activities, such as illegal waste dumping.

8.1.5.6 Strong opposition.

Where political power and interest group factions remain strong, policy makers need to judge the most prudent course.

8.1.5.7 High level of dislocation.

Where large numbers of people will be displaced or unemployed as a result of MBIs, caution is required.

8.1.5.8 No ability to make transitional payments to affected sectors.

From an economic perspective, it is more efficient to remove broad-based subsidies and replace them with direct payments to the poor. Examples include transitional subsidies to water, energy, and foodstuffs for the poor segment of society. However, in corrupt societies, the transfer payments to the poor are unlikely to actually occur. Thus, monitoring and enforcement are essential to avoid widespread hardship or social unrest.

8.1.5.9 International competitiveness.

Taxes on industrial inputs increase the costs of production. If the domestic production competes with the foreign producers (without the tax) then it may harm the competitiveness of domestic firms. The advantages and disadvantages of the individual types of MBIs are addressed further below.

8.1.6 MAIN TYPES OF MBIS

MBIs can be classified in different ways, for example, according to their sector of implementation (e.g. transport, energy) or by environmental medium (e.g. water, air). Alternatively, the European Environmental Agency (EEA) has classified MBIs into five main types based on their aim and functioning:

1. Environmental taxes (also environmentally related taxes) that have been designed to change prices and thus the behaviour of producers and consumers, as well as raise revenues.

2. Environmental charges that have been designed to cover (in part or in full) the costs of environmental services and abatement measures such as waste water treatment and waste disposal.

3. Tradable permits that have been designed to achieve reductions in pollution (such as emissions of CO2) or use of resources (such as fish quotas) in the most effective way through the provision of market incentives to trade.

4. Environmental subsidies and incentives that have been designed to stimulate development of new technologies, to help create new markets for environmental goods and services including technologies, to encourage changes in consumer behaviour, and to temporarily support achieving higher levels of environmental protection by companies.

5. Liability and compensation schemes that aim at ensuring adequate compensation for any damages resulting from dangerous activities to the environment and provide for means of prevention and reinstatement.

8.2 ENVIRONMENTAL TAXES AND CHARGES

The most common MBIs in use are environmental (or environmentally related, green) taxes and charges. Taxes are generally considered to be unrequited payments to (usually) national or regional governments with no individual counterpart service received in exchange for the payment. Charges, on the other hand, are typically payments made in exchange for a service, with the charges usually levied in proportion to the quantum of service received, and so the terms 'user charges', or 'cost recovery charges' are often used in this context. Environmental taxes and charges can be based on emissions, inputs and outputs.

Environmental taxes include all environment-related taxes, excises and state fees, which are recorded as taxes in national accounts. The base of an environmental tax is a physical unit (or a proxy of it) of something that has a proven specific negative impact on the environment – pollutants or on goods, the use of which produces such pollutants. By seeking to reduce polluting behaviour, environmental taxes by definition are intended to alter production decisions and to have a disproportionate impact on polluters. Accordingly, environmental taxes can be either explicit (taxes directly on emissions) or implicit (taxes on inputs or related goods).

Economic theory suggests that direct taxes on polluting emissions will reduce environmental harm in the least costly manner, because they give polluters an incentive to reduce their pollution up to the point where further reduction would cost more than paying the tax, and to do so in the least costly way. It can provide incentives for innovation. A market-based tax places no cap on pollution allowed - the amount by which producers reduce their pollution depends on the chosen tax rate. Taxes present a good option to manage pollution from diffuse sources, where regulatory measures may be more complex to implement and enforce (e.g. taxes on fertilizers or car emissions). Taxes/charges raise revenues that may be used for other purposes, including environmental improvement schemes. This can increase the overall benefit from the tax and revenue policy package.

The acceptance of environmental taxes is in good correlation with awareness about environmental problems in society. Opposition to environmental taxes may be caused by not enough information about the purpose of the tax, little trust in assurances of how the revenue is used, fear of loss of competitiveness or other reasons. Well-designed taxes

should be highly transparent in terms of their coverage and costs. It should be clear what is taxed, which polluters are exempt, and what the cost to polluters will be per unit of pollution generated.

One instrument used in relation to natural resources is royalty. A royalty is a payment made by one party (e.g. private company) to another (e.g. the state) that owns a particular asset (mineral resources, oil) for the right to ongoing use of that asset. Royalty is based on either the volume or value of the production (often expressed as a percentage of the revenues obtained or a fixed price per unit sold).

Royalty is not considered to be an environmental policy instrument, because its aim is not to internalise the externalities, change the behaviour of producers or reduce the resource use. It is designed to compensate the owner for the asset's use. However, explicitly royalties may influence the use of natural resources.

8.2.1 MAIN CONCERNS RELATED TO ENVIRONMENTAL TAXES

Finding the proper level of taxation is critical to the effectiveness of the instrument because it is difficult to anticipate exactly how much pollution reduction will result from any given tax. Policy makers can be expected to fully explore the factors that are likely to determine the effectiveness of the tax, and consider the potential need to be flexible and ready to make changes in the design of the tax, should the circumstances change. For example increasing commodity prices could result in reducing the case for taxes to raise the price.

Taxes and charges provide clear cost signals, but are less effective in guaranteeing a given environmental outcome and hence ensuring that targets are met or that an immediate reduction is secured to address a crisis situation.

Taxes, such as carbon pricing, are a clear illustration of the risk for MBIs to bring competitive disadvantage and losing market shares against competitors that do not face a carbon price. Industries that are subject to a climate policy have the potential to move their production to countries without such taxation, reducing the employment opportunities and the economic output within the acting country. Opposition to increased environmental taxes often focuses on concerns that firms might relocate and/or people might lose their jobs.

The introduction of some taxes (e.g. carbon tax) can have a regressive impact, as low-income households tend to spend a higher share of their income on energy bills and energy intensive goods. In the end, however, the final distributional impact of carbon pricing depends on the government's allocation of the revenues raised or expenditures saved through the carbon pricing mechanisms.

Introducing a tax establishes a conflict between objectives: less pollution means less revenue. This means that evaluation of the tax needs to be

undertaken against its direct objectives but also in the context of the wider tax and spend policy as a whole, as part of environmental tax reform.

8.2.3 ENVIRONMENTAL SUBSIDIES

The OECD broadly defines a subsidy as "any measure that keeps prices for consumers below market levels, or for producers above market levels, or that reduces costs for consumers and producers". Subsidies can come in the form of:

- direct grants, transfers of funds that are clearly visible in some countries' budgets (i.e. on-budget subsidies);
- tax exemptions (which are generally less visible on government accounts, but can be calculated, so called off-budget);
- other types that are less evident as subsidies: for example accelerated depreciation of environmentally preferable capital assets; and less than full-cost recovery pricing with resources costs/the costs of externalities not borne by the producer and not covered by the price of their goods or services.

Beyond this there are other subsidies that are not always recognised as such: for instance, where prices for goods and services, such as water supply, do not reflect the full costs of provision (i.e. not full cost recovery pricing), or do not reflect the resource costs. A further important category is where there is no internalisation of externalities such as environmental damage (i.e. not following the polluter pays principle).

Subsidies have traditionally been used for economic or social reasons, for example to support ailing industries, to help develop vital infrastructure or to protect domestic producers from overseas competition. They can be seen as a way of protecting jobs, either generally or in specific regions, for example support for fishermen to protect coastal fishing communities. The use of subsidies for environmental purposes, however, is more recent, but they are nowadays widely used by government to achieve environmental objectives to encourage more environmentally beneficial behaviour (e.g. introduction of better technologies).

Some subsidies are environmentally harmful. These are the subsidies/tax exemptions etc. which confer an advantage on certain consumers, users or producers, in order to supplement their income or lower their costs, but in doing so, discriminate against sound environmental practice.

Subsidies are present in all sectors of the economy. The most common areas where subsidies exist include energy and transport.

8.2.3 MAIN CONCERNS RELATED TO SUBSIDIES

Some subsidies are inefficient use of government resources – notably where the original rationale for the subsidy is no longer applicable.

Some subsidies create environmental burdens – e.g. pollution and climate effect; excessive resource use; or other impacts such as on fisheries stock viability, biodiversity, etc.

Environmentally harmful subsidies (EHS) lead to inefficient working of the internal market, and overall impacts on competitiveness.

EHS can hinder innovation by locking in old technologies and locking out new ones and hence undermining the needed innovation developments for a competitive and environmentally sustainable economy.

Important targets will not be met or be difficult to meet without reforming subsidies – notably meeting CO2 reduction targets.

"Costs" of environmentally harmful subsidies. The scale of subsidies with potential negative impact on the environment, notably in the areas of fossil fuels, transport and water, are estimated to be worth a global total of USD 1 trillion. These subsidies lead to higher levels of waste, emissions, resource extraction, or negative impact on biodiversity.

8.2.4 LIABILITY AND COMPENSATION SCHEMES

Liability and compensation have not typically been regarded as market-based instruments. However, they do have some potentials to produce a number of economic impacts and to affect the market, and they can therefore be classed as economic or market-based instruments.

In the context of damage to the environment, the development and enforcement of liability legislation inherently recognise the rights of the public to environmental goods, specifically placing responsibility on the polluter for restoring the environment or compensating for environmental damage. Most commonly known examples of such damages include marine oil spills, nuclear damage, groundwater contamination and impairment of ecosystems and landscapes. In addition, countries such as Denmark and Germany, for example, have also enforced liability laws for non-genetically modified crops being contaminated by genetically modified organisms (GMO).

8.3 GREEN PUBLIC PROCUREMENT

Green public procurement (GPP) is "a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured".

Implementing green criteria in purchasing is one direct way for governments to influence the market to provide more environmentally friendly goods. GPP can avoid unnecessary purchases by involving a review of the need for the product or service and the range of solutions that best fit that need. Through setting required criteria for goods or services GPP can lead to direct environmental gains through the purchase of greener products (e.g. less CO2 emission by purchasing electricity from

renewable energy sources). It can also help create a critical mass of demand to support the development of a wider market for ecological products.

Possible savings by implementing GPP:

Three million tonnes of CO2 would be saved in the Netherlands alone if all Dutch public authorities applied the national Sustainable Public Procurement criteria, which include green criteria. Public sector energy consumption would be reduced by 10%. CO2 emissions would be cut by 15 million tonnes per year if the whole European Union adopted the same environmental criteria for lighting and office equipment as the City of Turku, Finland – reducing electricity consumption by 50%.

8.4 LABELLING SCHEMES

As set out in the introduction, lack of information may also lead to market failure. In these circumstances governments can take action to mandate or encourage the market to provide consumers with better information. For example, the government can create labelling schemes to provide information on products and their environmental and health impacts from their production and their use (e.g. organic farming labelling, eco-labels). Such labels can help consumers to choose more environmentally friendly products and services and can lead to consumption shift. Labelling schemes can cover different product/service groups and regions (have a look on examples in table 8.1).

Table 1. Examples of Labels

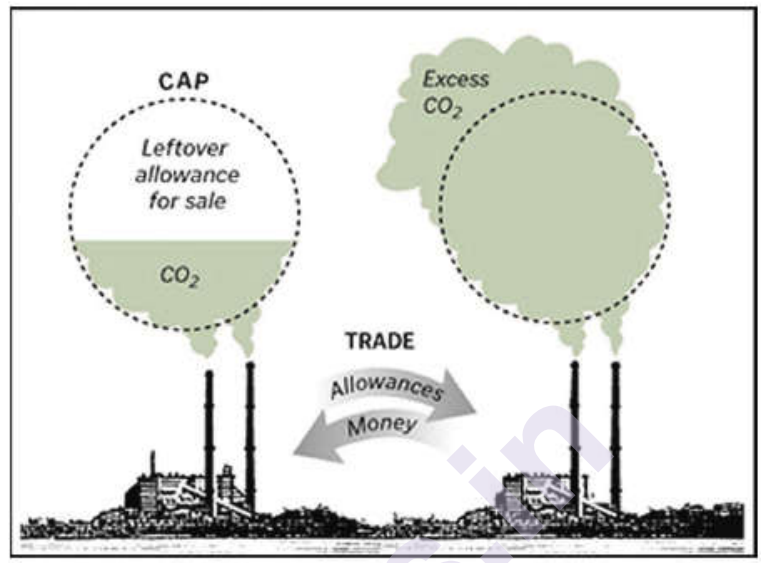
Name	European Union eco-label	Energy Star	Forest Stewardship Council	Indonesian eco-label
Country/ region	regional (European Union)	US, Australia, Canada, Japan, New Zealand, Taiwan, European Union	global	national
Visual	EU Ecolabel www.ecolabel.eu	energy ENERGY STAR	FSC	Ramah Lingkungan
Items covered	more than 30 product groups (e.g. chemicals, paper, electronics, coverings etc)	energy using products	forestry (mainly wood) products	forestry products, paper, furniture

8.5 TRADABLE PERMITS

Market-based tradable (also transferable) permits or cap-and trade schemes set a limit on access to a resource (the cap) and then allocate it among the users in the form of permits. Under a tradable permit system, an allowable overall level of pollution or use of resource is established and allocated among firms in the form of permits. Firms that keep their

emission levels or resource use below their allotted level may sell their surplus permits to other firms or use them to offset excess emissions in other parts of their business (figure 8.3)

Figure 8.3 Emissions Trading



Tradable permits have been designed to achieve reduction in pollution or use of resources in the most effective way through the provision of market incentives to trade. With tradable permits it is likely to achieve a maximum set level (a cap) at a lower cost than other means, and, importantly, may reduce below that level due to technological innovation.

The most common forms of tradable permits are: emissions trading on air pollutants (e.g. EU ETS), emissions trading on water quality (nutrients discharges to water courses), resource use allowances (e.g. fishing quotas, animal allowances), etc.

In theory, different tradable permit systems are analogous. However, there may be important differences in practice between, for example, pollution permits markets and fishing quota markets. For instance, controlling and forecasting emissions from a power plant is arguably easier than predicting both the level of catch on any trip and its composition. This is especially true in multi-species fisheries where fish populations cannot be directly targeted without incidental catch of other stocks.

Where regulators have a good sense of the point at which emissions causing health problems or ecosystems begin to fray, tradable permits are often the best choice. Caps can be set in advance, either based on:

- absolute values (e.g., tons of salmon that can be caught or emissions emitted) or
- relative values (e.g., percent of total allowable catch or emission).

- Another important aspect of tradable permits is whether they are auctioned or allocated via free allocation/ grandfathering. There are three main modes of allocating allowances:
- competitive auctioning
- free allocation proportionate to sources' past emission levels
- free allocation subjected to regular update based on activity levels.

Full auctioning is the most economically efficient approach as it generates budget revenues that can, for example, be used to offset other distortionary taxes and assist with transitional costs. However, some level of free allocation is common practice when trading systems have been introduced. This is generally done to lower direct financial cost and alleviate concerns about international competitiveness. Within the same system, more than one allocation mechanism can be applied, sometimes differentiated across sectors.

8.5.1 MAIN CONCERNS RELATED TO TRADABLE PERMITS

Emissions trading (ET) offers a dynamic incentive and can help ensure that a given target is met, if combined with appropriate allocation of emission allowances. The price of allowances is, however, uncertain and determined by the market. Therefore, the costs of pollution abatement are uncertain, and excessive costs could be occurred.

ET can lead to significant additional administrative tasks and burdens and greater needs for monitoring, verification and enforcement, the costs of which need to be taken into account in any consideration of whether ET schemes are the sensible solution.

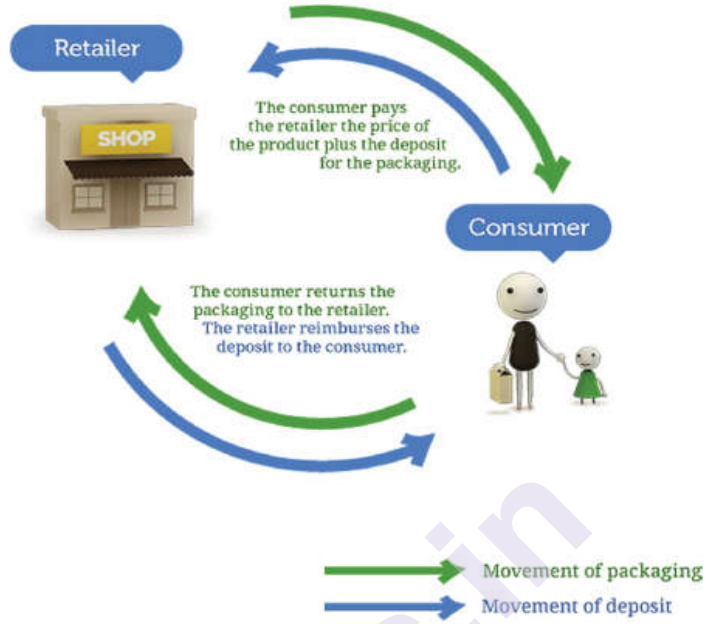
An argument against permits is that formalizing emission rights is effectively giving people a license to pollute, and this can be considered to be socially unacceptable. When using a transferable-permit system, it is very important to accurately measure the initial problem and also how it changes over time. This is because it can be expensive to make adjustments (either in terms of compensation or through undermining the property rights of the permits).

8.6 DEPOSIT REFUND SYSTEMS

A deposit-refund system (DRS), or advance deposit fee, is a surcharge on a product when purchased and a rebate when it is returned. Deposit-refund schemes require paying a deposit on the purchase of potentially polluting products, which is refunded when the products or their residues are returned for recycling or disposal (see figure 8.4). While most commonly used with beverage containers (packaging) it can be used on other materials including liquid and gaseous wastes. Deposit-refund systems are used on products such as batteries, tires, automotive oil, consumer electronics, shipping pallets etc.

Figure 8.4 Deposit Refund System for Packaging

(From Consumer's perspective)



Source: EestiPandipakend

Deposit-refund systems aim to give a financial incentive for consumers to return the product or the waste back to retailers or producers for reuse, recycling or disposal. Deposit-refund systems can be voluntary or mandated by legislation.

The deposit refund system can have particular design features to increase the incentive effect or adjust the cost burden. For example if the refund is lower than the deposit, the difference can be a "handling fee" which is passed to the recycler to make the recycling more economic (as in the Swedish return system for aluminium cans and PET bottles). If the deposit return is higher than the deposit this can increase the incentive to return the item and reduce consumer resistance to the scheme where there is a long period between paying the deposit and receiving the refund (as in the earlier deposit-refund scheme for car hulks in Sweden.

8.6.1 MAIN CONCERNS RELATED TO DEPOSIT REFUND SYSTEMS

Deposit-refund systems are considered to be more cost-effective than other methods of reducing waste disposal (such as regulations, subsidies), but the relatively high administrative costs of a deposit system could outweigh these cost savings. If the DRS is implemented in one region or country and the product is subject to export (e.g. beverages) then domestic producers might have a competitive disadvantage compared to foreign producers.

8.7 INSTRUMENTS MIXES

MBIs are seldom used individually and are often used as part of a package of a number of MBIs or they are combined with regulatory (command-and-control measures). The main reason for using an instrument mix is that in most cases environmental problems are of multi-aspect nature and no one single policy instrument can achieve the goals set alone. For example, in order to achieve the goal of reducing CO 2 emissions, governments may use explicit and implicit carbon pricing as well as create energy efficiency standards for housing and vehicles. Using complementary MBIs can also reinforce their incentive effects. For example, ETS can be complemented with energy taxation. Supplementing ETS with CO 2 taxes can help limit compliance-cost uncertainty by giving polluters the opportunity to pay the pre-determined tax instead of buying a tradable permit, the price of which can be rather volatile at times.

In most cases, policy mixes are not initially designed as such but rather individual instruments are created separately and over time, new instruments are added to address the inefficiencies of the existing policies. For example, explicit pricing mechanisms can be complemented by research and technology support policies to address knowledge and diffusion failures of specific emission reduction technologies, energy labelling to reduce information barriers, energy efficiency building codes to address split incentives between landlords and tenants, and active competition and regulations to limit market power.

8.8 ENVIRONMENTAL TAX / FISCAL REFORMS

Environmental (also called “ecological”, “green”) tax or fiscal reform is not an instrument by itself but rather a wider approach to change taxing or fiscal system in a way which is beneficial both for the environment and socio-economic development.

Environmental tax reform (ET R) is defined as “reform of the national tax system where there is a shift of the burden of taxes, for example from labour to environmentally damaging activities, such as unsustainable resource use or pollution”.

Under ETR, the tax burden is shifted from ‘good’ things such as income and employment and on to “bad” things such as pollution and resource use. Environmental fiscal reform extends beyond ET R by including subsidy reforms, which entail phasing out subsidies on environmentally harmful activities and products, such as fossil fuels or pesticides, and redirecting public spending towards more socially and environmentally beneficial activities.

There are at least four possible types of effects of ETR:

- it makes various goods or activities more expensive
- the direct or indirect distribution of this extra revenue
- job creation and eco-innovation

- effective ETR will also result in environmental benefits, for example by reducing pollution.

One of the challenges of ETR is ensuring that the costs and benefits are appropriately distributed across society, and do not negatively impact the poorest people. Instruments also need to balance the right mix of environmental and economic incentives. Ultimately, ETR mechanisms can only be implemented if they are acceptable to the public and policy makers.

Environmental tax reform in Germany Between 1999 and 2003 the German government followed a policy of ecological tax reform. It raised taxes on consumption of environmentally damaging fossil fuel energy in small foreseeable stages, through increased taxes on engine fuels, electricity, light fuel oil and gas. This created incentives for energy conservation, innovative energy-efficient technologies and the use of renewable energies. In this way, emissions of greenhouse gases and air pollutants have been reduced and oil dependence eased.

The tax revenue collected is mainly used for a direct reduction of non-wage labour costs by lowering employers' and employees' contributions to the pension fund. A smaller part is used as support for renewable energy and for the renovation of buildings for energy saving purposes; and tax reductions and exemptions are used to support energy-efficient power plants and public transport amongst other things.

The ecological tax reform thus helps to support and strengthen climate protection while labour becomes cheaper and more attractive.

Source:
https://sustainabledevelopment.un.org/index.php?page=view&type=99&nr=92&menu=1449

8.9 REHABILITATION AND RESETTLEMENT POLICY

Government of India has formulated the National Rehabilitation & Resettlement Policy, 2007. One of its aims is **to minimize large-scale displacement**, as far as possible. The Policy also provides comprehensive rehabilitation & resettlement benefits to the displaced families.

The objectives of the National Rehabilitation and Resettlement Policy are: **to minimise displacement and to promote**,' as far as possible, non-displacing or least-displacing alternatives; to ensure adequate rehabilitation package and expeditious' implementation of the rehabilitation process with the active participation .

Resettlement and Rehabilitation (R&R) Plan forms a part of the **Environmental Impact Assessment and Management Plan Reports** (EIA and EMP) and is assessed and approved by the Expert Appraisal Committee (EAC) of Ministry of Environment, Forest and

Climate Change (MoEF&CC) for according Environmental Clearance to the project.

The R&R Plan for project affected families for ongoing projects has been prepared based on National Policy for Rehabilitation and Resettlement, 2003 and as per National Rehabilitation and Resettlement Policy, 2007 (NRRP-2007). For new and upcoming projects the provisions of the R&R Plan would be according to the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 and its amendments which come from time to time. The R&R Plan is implemented in association with the concerned State Government, representatives from project affected families and other stakeholders in the area. Considering the plight of those who have sacrificed their resources for the larger benefit of the society, ways and means has to be explored and implemented to protect their rights in general and the rights of vulnerable sections in particular, as an attempt towards sustainable developments. In the process, NEEPCO explores various viable alternatives and select the one causing least displacement or adverse impacts. Therefore, a detailed socio-economic survey is conducted before formulation of R&R Plan for the project affected families (PAFs) so as to assess the socio-economic and socio-cultural set-up of the affected families and local people. In future, in addition to Socio-economic aspects, a separate chapter on socio-cultural aspects based on study on Ethnography of the area will be included. For effective implementation & monitoring of R&R Plan of a project, NEEPCO in consultation with the concerned State Government forms a Project R&R Committee headed by Administrator for R&R (rank of District Collector of the concerned State Government) and Head of the Project being the Member Secretary of the committee.

A broad R&R package being implemented by NEEPCO at its various projects comprises the following:-

Compensation :

- Compensation cost for land.

Physical Rehabilitation:

For project affected persons:

- Construction of residential houses.
- Construction of sanitary latrine.
- Construction of granary.
- Construction/grant of/for cattle /poultry sheds.
- Agricultural /horticultural land.
- Land development and protection measures against sediment flow.
- Transportation / displacement grant.

For village infrastructure:

- Development of grazing land.
- Site development for village land.
- Development of road.
- Providing power supply.
- Providing water supply.
- Construction of sanitation and sewerage facilities.
- Construction of school building.
- Construction of religious worship place.
- Construction of Community Hall.
- Construction of Panchayat Ghar.
- Construction of post office building.
- Grant for opening fair price shop.
- Construction of market.
- Construction of park and playground.
- Medical facilities- primary health centre.
- Veterinary services.
- Preservation of historical monuments.
- Cremation ground / grave yards.
- Preservation of biodiversity sites.

Economic rehabilitation:

Grant for:

- Agricultural activities.
- Horticultural activities.
- Dairying.
- Poultry rearing.
- Piggery.
- Goatery.
- Non-farm economic activities.

Training on:

- Cultivation and management of soil and water conservation in hills and hill slopes, in terraced lands, selection of crops and varieties as well as other cultural practices for better production.
- Management and upkeep of cross-bred cows.
- Management and upkeep of improved pigs.
- Management and upkeep of ducks.

- Management and upkeep of goatery.
- Weaving and designing.
- Handicrafts.
- Mushroom cultivation.

II) R&R Package Approved for some NEEPCO Projects

Important features of R&R Packages at various projects of NEEPCO are given below:

a) Kameng Hydro Electric Project (Arunachal Pradesh).

- Homestead land: Land for construction of house @ 0.02 ha per family.
- House to be constructed for 99 PAFs with a plinth area of 50 sq. m. per PAF.
- Granary of 7.5 sq. m. to be constructed for all 99 PAFs.
- Cattle/Poultry Shed of 40 sq. m. to be constructed for all 99 PAFs.
- 1.50 ha of Agricultural land and 1 ha of Horticultural land to each PAF.
- Land Development: 45 ha through Bench Terracing and 238.5 ha land development.
- Transportation/Displacement Grant of Rs.3500/- per PAF.
- Rehabilitation Grant of Rs.2,500/- per PAF for 12 months.
- Training Facilities: Training programmes in upkeep of cross breed cows, improved pigs, ducks, goatery, weaving and designing, handicrafts, mushroom cultivation.
- Economic Rehabilitation:
  - Rs.2,000/- per family for agricultural planting materials.
  - Rs.1,500/- per family for horticultural planting materials.
  - Rs.30,000/- per family for 25 families for 2 cross breed cows.
  - 10 layers for poultry rearing for each PAF @ Rs.75/- per layer.
- Basic amenities and infrastructural facilities in settlement site: Planning and development of R&R site for housing and other civic amenities such as approach road, drainage, water, electricity, sanitation etc. construction of community hall, sanitation and sewerage, religious worship house, post office, panchayat ghar, school, fair price shop, market, play-ground, veterinary services, free treatment and medicines to the oustees in the project.

The Rehabilitation and Resettlement Bill, 2007 provides **for benefits and compensation to people displaced by land acquisition purchases or any other involuntary displacement**.

8.10 THE REHABILITATION AND RESETTLEMENT BILL, 2007

Highlights of the Bill

- The Rehabilitation and Resettlement Bill, 2007 provides for benefits and compensation to people displaced by land acquisition purchases or any other involuntary displacement. The Bill creates project-specific, state and national authorities to formulate, implement, and monitor the rehabilitation and resettlement process.
- For large scale displacement, the government shall conduct a social impact assessment. It shall appoint an Administrator for Rehabilitation and Resettlement who is responsible for formulating, executing, and monitoring the rehabilitation and resettlement plan.
- The Bill outlines minimum benefits for displaced families and the criteria for eligibility. Benefits may include land, house, monetary compensation, skills training and preference for jobs.
- The Bill establishes the post of Ombudsman to address any grievances from the rehabilitation and resettlement process. Civil courts are barred from entertaining any suits related to this matter.

8.10.1 KEY ISSUES AND ANALYSIS

- Though the purpose of the Bill is to 'provide for the rehabilitation and resettlement' of affected persons, the Bill itself does not require that these persons be resettled.
- While the Statement of Objects and Reasons mentions minimising displacement, protecting livelihoods, and improving living standards, the language in the Bill does not make these clauses mandatory.
- The affected families eligible for benefits are identified as of the date of declaration of the affected area. This declaration is made when 400 or more families are affected en masse. It is not clear whether benefits apply in cases where fewer families are displaced.
- The National Rehabilitation Policy, 2007 requires residency for 3 years in the affected area for displacement benefits. The Bill requires 5 years.
- The Bill bars civil courts from entertaining any suits on issues under the authority of the Administrator, Commissioner, or Ombudsman. These authorities are effectively given the power of a judicial authority without judicial qualifications. There is also no mechanism for appeals.
- The Bill does not specify a clear timeframe for rehabilitation.

8.11 THE KYOTO PROTOCOL

The Kyoto Protocol was an international agreement that aimed to reduce carbon dioxide (CO2) emissions and the presence of greenhouse gases (GHG) in the atmosphere. The essential tenet of the Kyoto Protocol was that industrialized nations needed to lessen the amount of their CO2 emissions.

he protocol was adopted in Kyoto, Japan in 1997, when greenhouse gases were rapidly threatening our climate, life on the earth, and the planet. Today, the Kyoto Protocol lives on in other forms, and its issues are still being discussed.

- The Kyoto Protocol is an international agreement that called for industrialized nations to reduce their greenhouse gas emissions significantly.
- Other accords, like the Doha Amendment and the Paris Climate Agreement, have also tried to curb the global-warming crisis.
- Talks begun by the Kyoto Protocol continue in 2021 and are extremely complicated, involving politics, money, and lack of consensus.
- The U.S. withdrew from the agreement on the grounds that the mandate was unfair and would hurt the U.S. economy.
- The Paris Climate Agreement of 2015, which replaced the Kyoto Protocol, includes commitments from all major GHG-emitting countries to reduce their climate-altering pollution.

8.11.1 THE KYOTO PROTOCOL EXPLAINED

Background

The Kyoto Protocol mandated that industrialized nations cut their greenhouse gas emissions at a time when the threat of global warming was growing rapidly. The Protocol was linked to the United Nations Framework Convention on Climate Change (UNFCCC). It was adopted in Kyoto, Japan on December 11, 1997, and became international law on February 16, 2005.

Countries that ratified the Kyoto Protocol were assigned maximum carbon emission levels for specific periods and participated in carbon credit trading. If a country emitted more than its assigned limit, then it would be penalized by receiving a lower emissions limit in the following period.

Major Tenets

Developed, industrialized countries made a promise under the Kyoto Protocol to reduce their annual hydrocarbon emissions by an average of

5.2% by the year 2012. This number would represent about 29% of the world's total greenhouse gas emissions.

Targets depended on the individual country. As a result, each nation had a different target to meet by that year.

Members of the European Union (EU) pledged to cut emissions by 8%, while the U.S. and Canada promised to reduce their emissions by 7% and 6%, respectively, by 2012.

The amount of the Kyoto Protocol fund that was meant to aid developing countries in selecting non-greenhouse-emitting industrialized processes and technologies.

3 Kyoto Mechanisms

The Protocol **established market mechanisms** based on the trade of emissions permits. It allowed countries an additional means to meet their targets by way of three market-based mechanisms: International Emissions Trading, Clean Development Mechanism (CDM) and Joint Implementation (JI).

The mechanisms encouraged GHG mitigation in the most cost-effective ways, i.e. in the developing world. The idea was that as long as pollution is removed from the atmosphere, it does not matter where it is reduced, which stimulated green investment in developing countries and included the private sector to develop cleaner infrastructure and systems over older, dirtier technology.

An Adaptation Fund was established to finance adaptation projects and programmes in developing countries that are parties to the Protocol. In the first commitment period, the Fund was financed mainly with a share of proceeds from CDM project activities. For the second commitment period, international emissions trading and joint implementation would also provide the Fund with a 2% share of proceeds.

The International Emissions Trading mechanism allows countries that have emission units to spare – emissions permitted them but not "used"- to sell this excess capacity to countries that are over their targets.

The Clean Development Mechanism allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) to implement an emission-reduction project in developing countries. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one tonne of CO2, which can be counted towards meeting Kyoto targets.

Finally, the **Joint Implementation mechanism** allows a country with an emission reduction or limitation commitment under the Kyoto Protocol (Annex B Party) to earn emission reduction units (ERUs) from an emission-reduction or emission removal project in another Annex B Party, each equivalent to one tonne of CO2, which can be counted towards meeting its Kyoto target.

8.11.2 RESPONSIBILITIES OF DEVELOPED VERSUS DEVELOPING NATIONS

The Kyoto Protocol recognized that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity. As such, the protocol placed a heavier burden on developed nations than less-developed nations.

The Kyoto Protocol mandated that 37 industrialized nations plus the EU cut their GHG emissions. Developing nations were asked to comply voluntarily, and more than 100 developing countries, including China and India, were exempted from the Kyoto agreement altogether.

8.11.3 A PARTICULAR FUNCTION FOR DEVELOPING COUNTRIES

The protocol separated countries into two groups: Annex I contained developed nations, and Non-Annex I referred to developing countries. The protocol placed emission limitations on Annex I countries only. Non-Annex I nations participated by investing in projects designed to lower emissions in their countries.

For these projects, developing countries earned carbon credits, which they could trade or sell to developed countries, allowing the developed nations a higher level of maximum carbon emissions for that period. In effect, this function helped the developed countries to continue emitting GHG vigorously.

The United States' Involvement

The United States, which had ratified the original Kyoto agreement, dropped out of the protocol in 2001. The U.S. believed that the agreement was unfair because it called only for industrialized nations to limit emissions reductions, and it felt that doing so would hurt the U.S. economy.

The Kyoto Protocol Ended in 2012, Effectively Half-Baked

Global emissions were still on the rise by 2005, the year the Kyoto Protocol became international law—even though it was adopted in 1997. Things seemed to go well for many countries, including those in the EU. They planned to meet or exceed their targets under the agreement by 2011. But others continued to fall short.

The United States and China—two of the world's biggest emitters—produced enough greenhouse gases to mitigate any of the progress made by nations who met their targets. In fact, there was an increase of about 40% in emissions globally between 1990 and 2009.

The Doha Amendment Extended Kyoto Protocol to 2020

In December 2012, after the first commitment period of the Protocol ended, parties to the Kyoto Protocol met in Doha, Qatar, to adopt an amendment to the original Kyoto agreement. This so-called Doha Amendment added new emission-reduction targets for the second commitment period, 2012–2020, for participating countries.

The Doha Amendment had a short life. In 2015, at the sustainable development summit held in Paris, all UNFCCC participants signed yet another pact, the Paris Climate Agreement, which effectively replaced the Kyoto Protocol.

8.12 THE PARIS CLIMATE AGREEMENT

The Paris Climate Agreement is a landmark environmental pact that was adopted by nearly every nation in 2015 to address climate change and its negative effects. The agreement includes commitments from all major GHG-emitting countries to cut their climate-altering pollution and to strengthen those commitments over time.

Every five years, countries engage in the Global Stocktake, which is an assessment of their progress under the Paris Climate Agreement.

A major directive of the deal calls for reducing global GHG emissions to limit the earth's temperature increase in this century to 2 degrees (preferring a 1.5-degree increase) Celsius above preindustrial levels. The Paris Agreement also provides a way for developed nations to assist developing nations in their efforts to adapt climate control, and it creates a framework for monitoring and reporting countries' climate goals transparently.

The Kyoto Protocol Today

In 2016, when the Paris Climate Agreement went into force, the United States was one of the principal drivers of the agreement, and President Obama hailed it as "a tribute to American leadership."

As a candidate for president at that time, Donald Trump criticized the agreement as a bad deal for the American people and pledged to withdraw the United States if elected. In 2017, then-President Trump announced that the U.S. would withdraw from the Paris Climate Agreement, saying that it would undermine the U.S. economy.

The former president did not begin the formal withdrawal process until Nov. 4, 2019. The U.S. formally withdrew from the Paris Climate Agreement on Nov. 4, 2020, the day after the 2020 presidential election, in which Donald Trump lost his reelection bid to Joseph Biden.

On January 20, 2021, his first day in office, President Biden began the process of rejoining the Paris Climate Agreement, which officially took effect on Feb. 19, 2021.

A Complicated Stalemate

In 2021, the dialogue is still alive but has turned into a complex quagmire involving politics, money, lack of leadership, lack of consensus, and bureaucracy. Today, despite myriad plans and some actions, solutions to the problems of GHG emissions and global warming have not been implemented.

Almost all scientists who study the atmosphere now believe that global warming is primarily the result of human action. Logically then, what humans have caused by their behavior should be able to be remedied by humans changing their behavior. It is frustrating to many that cohesive action to deal with the human-made global climate crisis has yet to happen.

8.13 REMEMBER THE INTERNET

It is critical that we remain convinced that we can, in fact, resolve these issues so crucial to our survival. We humans have already solved huge problems in numerous fields via technical innovation that led to radically new solutions.

Interestingly, if anyone had suggested in 1958 that our own Defense Advanced Research Projects Agency (DARPA), which oversees the development of advanced technologies for use by the U.S. military, would lead the world in creating the Internet—a system that could "connect every person and thing with every other person and thing on the planet instantly and at zero cost"—they might have been laughed off the stage, or worse.

What Is the Primary Purpose of the Kyoto Protocol?

The Kyoto Protocol was an agreement among developed nations to reduce carbon dioxide (CO2) emissions and greenhouse gases (GHG).

Why Didn't the U.S. Sign the Kyoto Protocol?

The United States backed out of the Kyoto Protocol agreement in 2001 on the basis that it unfairly burdened developed nations. The treaty called only for developed nations to reduce emissions, which the U.S. believed would unfairly stifle its economy.[12]

What Special Problems Do Developing Nations Face With Such Treaties As the Kyoto Protocol?

Developing countries were not mandated to act under the agreement, and volunteering to reduce emissions under it would create large costs that they were either incapable of incurring or unwilling to incur.

What Sorts of Emissions Is the Kyoto Protocol Built to Curb?

The Kyoto Protocol was built to curb carbon dioxide (CO2) and greenhouse gas emissions.

Important Dates of the Kyoto Protocol

December 1-11, 1997 – The Conference of the Parties to the UNFCCC is held in Kyoto, Japan. Nearly 200 nations attend and adopt the first international treaty on managing and reducing greenhouse gases.

November 2, 1998 – In Buenos Aires 160 nations meet to work out details of the protocol and create the "Buenos Aires Action Plan."

July 23, 2001 – Negotiators from 178 countries meet in Germany and agree to adopt the protocol, without the participation of the US.

November 10, 2001 – Representatives from 160 countries meet in Marrakech, Morocco, to work out details of the protocol.

November 18, 2004 – The Russian Federation ratifies the protocol.

February 16, 2005 – The Kyoto Protocol comes into effect.

December 12, 2011 – Canada renounces the Kyoto Protocol, saying its goals are unworkable because the US and China never agreed to it, and says that a new pact is needed to address emissions.

December 2012 – The Kyoto Protocol is extended to 2020 during a conference in Doha, Qatar.

June 23, 2013 – Afghanistan adopts the Kyoto Protocol, becoming the 192nd signatory.

2015 – At the COP21 summit, held in Paris, all UNFCCC participants sign the Paris Agreement that effectively replaces the Kyoto Protocol. The parties agree to limit warming to 'well below' 2 degrees, and below 1.5 degrees above pre-industrial levels if possible.

8.14 RIO-SUMMIT

Rio-Summit produced conventions dealing with climate change, biodiversity, forestry and recommended a list of development practices called Agenda 21. It gave the **concept of sustainable development to be combined economic growth with ecological responsibility**.

The **United Nations Conference on Environment and Development** (UNCED), also known as the Rio de Janeiro Earth Summit, the Rio Summit, the Rio Conference, and the Earth Summit (Portuguese: ECO92), was a major United Nations conference held in Rio de Janeiro from June 3 to June 14, 1992.

First, there has been **a lack of domestic legislation to underpin the Rio principles and conventions**. Second, there was a lack of credible and independent international scrutiny to monitor delivery.

Rio+20 was one of the biggest international gatherings of 2012, and the largest event in the history of the United Nations. It **presented an opportunity to re-direct and re-energise political commitment to the**

three dimensions of sustainable development: economic growth, social improvement and environmental protection.

Agenda 21, the Rio Declaration on Environment and Development, **and the Statement of principles for the Sustainable Management of Forests** were adopted by more than 178 Governments at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil, 3 to 14 June 1992.

The **United Nations Conference on Environment and Development** (**UNCED**), also known as the **Rio de Janeiro Earth Summit**, the **Rio Summit**, the **Rio Conference**, and the **Earth Summit** (Portuguese: ECO92), was a major United Nations conference held in Rio de Janeiro from June 3 to June 14, 1992.

Earth Summit was created as a response for member states to cooperate together internationally on development issues after the Cold War. Due to issues relating to sustainability being too big for individual member states to handle, Earth Summit was held as a platform for other member states to collaborate. Since the creation, many others in the field of sustainability show a similar development to the issues discussed in these conferences, including non-governmental organizations (NGOs).

The issues addressed included:

- systematic scrutiny of patterns of production—particularly the production of toxic components, such as lead in gasoline, or poisonous waste including radioactive chemicals
- alternative sources of energy to replace the use of fossil fuels which delegates linked to global climate change
- new reliance on public transportation systems in order to reduce vehicle emissions, congestion in cities and the health problems caused by polluted air and smoke
- the growing usage and limited supply of water

An important achievement of the summit was an agreement on the Climate Change Convention which in turn led to the Kyoto Protocol and the Paris Agreement. Another agreement was to "not to carry out any activities on the lands of indigenous peoples that would cause environmental degradation or that would be culturally inappropriate".

The Convention on Biological Diversity was opened for signature at the Earth Summit, and made a start towards redefinition of measures that did not inherently encourage destruction of natural ecoregions and so-called uneconomic growth.

Although President George H.W. Bush signed the Earth Summit's Convention on Climate, his EPA Administrator William K. Reilly acknowledges that U.S. goals at the conference were difficult to negotiate

and the agency's international results were mixed, including the U.S. failure to sign the proposed Convention on Biological Diversity. https://en.wikipedia.org/wiki/Earth_Summit - cite_note-2

Twelve cities were also honoured by the Local Government Honours Award for innovative local environmental programs. These included Sudbury in Canada for its ambitious program to rehabilitate environmental damage from the local mining industry, Austin in the United States for its green building strategy, and Kitakyūshū in Japan for incorporating an international education and training component into its municipal pollution control program.

The Earth Summit resulted in the following documents:

- Rio Declaration on Environment and Development
- Agenda 21
- Forest Principles
- Moreover, important legally binding agreements (Rio Convention) were opened for signature:
- Convention on Biological Diversity
- Framework Convention on Climate Change (UNFCCC)
- United Nations Convention to Combat Desertification

In order to ensure compliance to the agreements at Rio (particularly the Rio Declaration on Environment and Development and Agenda 21), delegates to the Earth Summit established the Commission on Sustainable Development (CSD). In 2013, the CSD was replaced by the High-level Political Forum on Sustainable Development that meets every year as part of the ECOSOC meetings, and every fourth year as part of the General Assembly meetings.

Critics point out that many of the agreements made in Rio have not been realized regarding such fundamental issues as fighting poverty and cleaning up the environment.

Green Cross International was founded to build upon the work of the Summit.

The first edition of Water Quality Assessments, published by WHO/Chapman & Hall, was launched at the Rio Global Forum.

8.15 AGENDA 21

It is the declaration signed by world leaders in 1992 at the United Nations Conference on Environment and Development (UNCED), which took place at Rio de Janeiro, Brazil. It aims at achieving global sustainable development. It is an agenda that aims at fighting against environmental damage, poverty, disease through global co-operation on common interests, mutual needs and shared responsibilities. One major objective of

the Agenda 21 is that every local government should have its own local Agenda 21 to combat environmental degradation.

The 1992 Rio Declaration on Environment and Development defines the rights of the people to be involved in the development of their economies, and the responsibilities of human beings to safeguard the common environment. The declaration builds upon the basic ideas concerning the attitudes of individuals and nations towards the environment and development, first identified at the United Nations Conference on the Human Environment (1972).

The Rio Declaration states that long term economic progress is only ensured if it is linked with the protection of the environment. If this is to be achieved, then nations must establish a new global partnership involving governments, their people and the key sectors of society. Together human society must assemble international agreements that protect the global environment with responsible development.

8.16 PRINCIPLES TO THE RIO DECLARATION.

1. People are entitled to a healthy and productive life in harmony with nature.
2. Development today must not threaten the needs of present and future generations.
3. Nations have the right to exploit their own resources, but without causing environmental damage beyond their borders.
4. Environmental protection shall constitute an integral part of the development process.
5. Eradicating poverty and reducing disparities in living standards in different parts of the world are essential if we are to achieve sustainable development whilst meeting the needs of the majority of the people.
6. Environmental issues are best handled with the participation of all concerned citizens.
7. The polluter should, in principle, bear the cost of pollution.
8. Sustainable development requires better scientific understanding of the problems. Nations should share knowledge and technologies to achieve the goal of sustainability.

8.17 CARBON TRADING

Carbon trading is the process of buying and selling permits and credits that allow the permit holder to emit carbon dioxide. It has been a central pillar of the EU's efforts to slow climate change.

Carbon trade is the buying and selling of credits that permit a company or other entity to emit a certain amount of carbon dioxide. The carbon credits and the carbon trade are authorized by governments with the goal of gradually reducing overall carbon emissions and mitigating their contribution to climate change. Carbon trading is also referred to as carbon emissions trading.

- Carbon trade agreements allow for the sale of credits to emit carbon dioxide between nations as part of an international agreement aimed at gradually reducing total emissions.
- The carbon trade originated with the Kyoto Protocol, a United Nations treaty that set the goal of reducing global carbon emissions and mitigating climate change starting in 2005.
- Various countries and territories have started carbon trading programs—for example, in July 2021, China started a national emissions-trading program.
- Cap and trade, a variation on carbon trade, allows for the sale of emission credits between companies.
- These measures are aimed at reducing the effects of global warming but their effectiveness remains a matter of debate.
- Rules for a global carbon market were established at the Glasgow COP26 climate change conference in November 2021, enacting an agreement first laid out at the 2015 Paris Climate Agreement.

n July 2021, China started a long-awaited national emissions-trading program.[1] The program will initially involve 2,225 companies in the power sector and is designed to help the country reach its goal of achieving carbon neutrality by 2060. It will be the world's largest carbon market. That made the European Union Emissions Trading System the world's second-largest carbon trade market.[2] The EU's trading market is still considered the benchmark for carbon trading.

The carbon trade originated with the Kyoto Protocol, a United Nations treaty that set the goal of reducing global carbon emissions and mitigating climate change starting in 2005. At the time, the measure devised was intended to reduce overall carbon dioxide emissions to roughly 5% below 1990 levels by 2012. The Kyoto Protocol achieved mixed results and an extension to its terms has not yet been ratified.

The notion is to incentivize each nation to cut back on its carbon emissions in order to have leftover permits to sell. The bigger, wealthier nations effectively subsidize the efforts of poorer, higher-polluting nations by buying their credits. But over time, those wealthier nations reduce their emissions so that they don't need to buy as many on the market.

When countries use fossil fuels and produce carbon dioxide, they do not pay for the implications of burning those fossil fuels directly. There are some costs that they incur, like the price of the fuel itself, but there are other costs not included in the price of the fuel. These are known as externalities. In the case of fossil fuel usage, these externalities are often negative externalities, meaning that the consumption of the product has negative effects on third parties.

The world's biggest carbon trading system is the European Union Emissions Trading System (EU ETS). It is beset with problems and corruption and yet countries such as Brazil and China continue to pursue carbon trading as a way to tackle rising emissions.

How do carbon trading permits work?

The model used in all current carbon trading schemes is called 'cap and trade'. In a 'cap and trade' scheme, a government or intergovernmental body sets an overall legal limit on emissions (the cap) over a specific period of time, and grants a fixed number of permits to those releasing the emissions. A polluter must hold enough permits to cover the emissions it releases. Each permit in the existing carbon trading schemes is considered equivalent to one tonne of carbon dioxide equivalent (CO_2e). In the theoretical model, (but rarely in practice) permits are to be sold – usually by auction – so that from the outset, polluters are forced to put a price on their emissions, and are incentivised to reduce to a bare minimum the permits they seek.

8.17.1 What are offset credits?

Every current and planned carbon 'cap and trade' scheme involves offset credits in one form or another. Credits are a supplementary source of permissions to pollute that can be bought in from countries or industries outside the cap, usually in the developing world. Their purchase allows the emitter to exceed the emissions cap by paying someone else somewhere else to reduce their emissions instead. It is important to remember: offsets do not reduce emissions, they merely replace them.

This practice of carbon offsetting has now filtered through into the realm of private individuals, for example by paying extra money when you book a flight to offset your carbon footprint.

8.17.2 Does carbon trading work to reduce emisions?

Carbon trading is increasingly criticised, not least because carbon dioxide emissions in industrialised countries are not declining at the necessary rate to avert catastrophic climate change.

Fern and many scientists, economists and NGOs believe that carbon trading is a dangerous distraction from the need to end fossil fuel use and move to a low carbon future. We do not have time to wait for a high price on carbon: we must shift to a low carbon energy, agriculture, transport and industrial world now. The best way to do this is through direct regulation.

Fern's initial interest in carbon trading came about because trees were seen as a way of offsetting carbon cheaply, while simultaneously providing money to protect trees. *What is Biodiversity offsetting?* explains why you can never offset carbon by protecting or planting trees. There is also no evidence that carbon trading has lived up to the promise of providing money.

Despite the flaws inherent in pollution trading, the concept continues to appear in proposals to reduce environmental harm. For more information visit our campaign on biodiversity offsetting.

8.18 QUESTIONS

1. Explain fully the concept of Market Based Instruments.
2. Discuss the role of environmental faxes & Charges in Market Based Instruments.
3. Explain environmental subsidies as one of the important market Based Instrument.
4. Discuss the concept of liability instruments and tradable permit.
5. Examine the Rehabilitation and Resettlement Policy of the government in relation to environmental policy.

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