Module I

1

INTRODUCTION TO ENVIRONMENTAL ECONOMICS-I

Unit Structure:

1.0 UNIT OVERVIEW

This unit provides an introduction to the meaning and scope of environmental economics. The unit explains why the discipline is important; the linkages between the economy and the environment; the origins and significance of environmental economics; and the scope of the discipline. The unit then provides an overview of key economic issues and concepts that will be employed throughout the module.

1.1 UNIT OBJECTIVES

- To explain the nature and scope of environmental economics.
- To explain how the economy and the environment are linked and the uses made of the environment by the economy.
- To explain the significance of environmental economics.

Unit Learning Outcomes

By the end of this unit, students should:

- have gained a knowledge of the main interactions between the environment and the economy and the physical constraints that place limits on the interaction

- be familiar with the nature and scope of environmental economics and what is included in the discipline
- be familiar with significance of environmental economics.

1.2 ORIGINS OF ENVIRONMENTAL ECONOMICS

Environmental economics developed in its present form in the 1960s as a result of the intensification of pollution and the heightened awareness among the general public in Western countries about the environment and its importance to our existence.

Economists became aware that, for economic growth to be indefinitely sustainable, the economic system needs to take into account the uses of the environment that we have already mentioned, so that natural resources are not depleted and so that the environment is not overused as a waste sink. Environmental economists view the environment as a form of natural capital which performs life support, amenity, and other functions that cannot be supplied by man-made capital. This stock of natural capital includes natural resources plus ecological systems, land, biodiversity, and other attributes.

The growth of environmental economics in the 1970s was initially within the neoclassical paradigm. In general, this approach to the environment is concerned with issues of market failure, inappropriate resource allocation, and how to manage public goods. There was little concern for the underlying relationships between the economy and the environment. Concerns about the limits of this approach to environmental economics led some environmental economists to develop what is now referred to as ecological economics. Ecological economics views the relationship of the economy and the environment as central. Thus, any analysis places economic activity within the environment. This distinction is best illustrated with reference to debates concerning sustainable development and the difference between weak and strong sustainability. Ecological economics supports the notion of strong sustainability. This view of sustainability assumes that not all forms of capital (ie human and natural) are perfectly substitutable.

1.3 MEANING OF ENVIRONMENTAL ECONOMICS

According to Arun Balasubramanian, ―no longer is economics merely a science of production and distribution, it has to take into account the ecological repercussions of economic activities that could affect both production and distribution. It means that economics as a subject cannot exist in isolation, it cannot even be a mere study of how goods and services are produced, but at the same time it has to take into consideration the impacts of the use of resources on the environment. The impacts may be in the form of externality, pollution, exhaustion, etc. Any study on the economic content of production, distribution, development, etc., cannot be completed without touching upon theenvironmental aspects like externality, pollution, damage, exhaustion, depletion etc.

Environmental economics can therefore be defined as that ―part of economics whichdeals with interrelationship between environment and economic development and studied the ways and means by which the former is not impaired nor the latter impeded It isthus a branch of economics which discusses about the impacts of interaction betweenmen and nature and finds human solutions to maintain harmony between men and nature.Environmental economics teaches us how to promote economic growth of nations withleast environmental damage. Classical and neoclassical school of thoughtsunderestimated the environmental issues of production and consumption, since theyconsidered these issues merely as social issues. When the environmental goods get transferred into economic goods, the problems of environmental damage crop up, andtherefore the need to interact with economic principles.

1.4 NATURE OF ENVIRONMENTAL ECONOMICS

1. **Positive and Normative aspects:**
   Environmental economics is an application of scientific theories and general application of welfare economics. When we study the cause and effect relationship, it covers the positive aspect. For example, the laws of thermodynamics are equally applicable to economic process.
   If the problem is related to policy measures, then it is considered as normative aspect. Therefore, environmental economics is a normative science because it prescribes the goals of environmental policy.

2. **A Study of Micro and Macro Aspects:**
   We generally observe crowded market places, industrial units, and even residential areas in a city like, Delhi. We do not get enough fresh air at these places. Its solution lies in micro level planning. On the other-hand, when the pollution problem is related to the economy as a whole such as rise in temperature, then it is related to macro aspect of environmental planning.

   Environmental economics draws more from microeconomics than from macroeconomics. It focuses primarily on how and why people make decisions that have consequences for the natural environment. It is concerned also with how economic institutions and policies can be changed to bring these environmental impacts more into balance with human desires and the needs of the ecosystem.

3. **As Static and Dynamic:**
   Environmental economics deals with economic and managerial aspects of pollution and natural resources. It interacts between human beings and their physical surroundings. It studies the impact of pollution on human beings and suggests national utilization of resources in a proper way so that there may be an increase in social welfare or minimization of social costs.

   Environmental economics is also concerned, with the natural environment, but not exclusively so. For example, man-made and

cultural or social environments may also be a part of the nature of environmental economics

4. **Environmental Pollution as an Economic Problem:**
Environmental pollution is an economic problem because it requires us to make choices and to resolve conflicts of interests. It is an economic problem because the means by which pollution can be reduced are themselves resources using. Further, it also reduces the value of some resources that society has at its disposal. Economic growth can affect environmental quality under different situations. Environmental quality can increase with economic growth. Thus increased incomes, for example, provide the resources for public services.

5. **As a Social Science:**
Environmental economics deals with economic and managerial aspects of pollution and natural resources. It interacts between human beings and their physical surroundings. It studies the impact of pollution on human beings and suggests rational utilization of resources in a proper way so that there may be an increase in social welfare or minimization of social costs.

1.5 SCOPE OF ENVIRONMENTAL ECONOMICS

Environmental economics is considered both a positive and a normative science. Therefore, it has wide scope.

1. Economy-environment analysis:

Environmental economics is primarily concerned with the impact of economic activities on environment and its implications for the individual firm, industry and the economy as a whole. Economists have formulated economy-environment models to explain the various economic activities and their external effects. For example, the Material Balance Model and the Leontief Abatement Model explain these externalities.

2. Eco-development:

The main objective of environmental economics is to maintain a balance between economic development and environmental quality. In order to achieve it, environmental economists have to explore the various socio-economic possibilities to reduce pollution and uplift the standard of living of the people. This objective gained momentum after the publication of the Report on Limits to Growth

3. Welfare approach:
Environmental economics has emerged as a discipline to tackle environmental problems from an economic welfare framework. The welfare framework covers scarce resources and market failures due to property rights and ethical aspects of different problems of pollution. Thus it suggests the best possible means to tackle the environmental problems.

4. Dynamic and stock-flow analysis:

The mainstream economics is largely confined to the static problems of market behaviour. But environmental management issues are about resources and are dynamic in nature. Moreover, resources have a stock and they have a rate of depletion and replenishment such as oil, minerals, and forests. Thus there is the inevitable stock-flow dimension to environmental issues.

5. Environmental values:

Environmental issues are about resources. The neo-classical economists have analysed the use of various resources like fisheries, forests, fossil fuels and water in a rational manner and with environmental values. In fact, environmental values are economic values. It is important for the society to conserve its limited resources in the interest of economic efficiency and welfare.

6. Clean Technology:

Presently environmental pollution is caused by misuse of existing technology and failure to develop better one. Environmental economists are in favour of appropriate and clean technologies which provide the most rational use of natural resources and energy and to protect the environment.

7. Conservation Policy:

The longstanding foundation of environmental economics lies in conservation economics which tends to emphasise the impact of economic activities on demand for productive resources and energy resources. It suggests the optimal strategy in the utilization of natural resources in a rational manner.

8. Multi-disciplinary base:

Environmental economics is inherently a multi-disciplinary subject. It consists of an integration of many varied disciplines such as biology, ecology, physical sciences, ethics and main stream economics. Therefore, it has wide scope

1.6 SIGNIFICANCE OF ENVIRONMENTAL ECONOMICS

1. Environmental economics will help you understand some important and controversial issues – such as climate change policy, nuclear power, recycling policy, and traffic congestion charging. This is an exciting field of economics to study and very much at the heart of many public debates and controversies.

2. Environmental economics is primarily concerned with the impact of economic activities on environment and its implications for the individual firm, industry and the economy as a whole. Economists have

formulated economy-environment models to explain the various economic activities and their external effects.

3. The main significance of environmental economics is to maintain a balance between economic development and environmental quality. In order to achieve it, environmental economists are exploring the various socio-economic possibilities to reduce pollution and uplift the standard of living of the people.

4. Environmental economics aims to tackle environmental problems from an economic welfare framework. The welfare framework covers scarce resources and market failures due to property rights and ethical aspects of different problems of pollution. Thus it suggests the best possible means to tackle the environmental problems.

5. Environmental issues are about resources. The neo-classical economists have analyzed the use of various resources like fisheries, forests, fossil fuels and water in a rational manner and with environmental values. In fact, environmental values are economic values. It is important for the society to conserve its limited resources in the interest of economic efficiency and welfare.

6. Presently environmental pollution is caused by misuse of existing technology and failure to develop better one. Environmental economists are in favor of appropriate and clean technologies which provide the most proper use of economic resources, energy and protecting the environment. Environmental economics is inherently a multi-disciplinary subject. It consists of an integration of many varied disciplines such as biology, ecology, physical sciences, ethics and mainstream economics. Research under this theme may include:

- Healthcare & Development
- Efficiency in the Healthcare Industry

1.7 ECONOMY AND THE ENVIRONMENT

Man cannot exist in isolation. Man‘s life is interconnected with various other living and non-living things. His life also depends on social, political, economic, ethical, philosophical and other aspects of social system. In fact, the life of human beings is shaped by his living environment. What exactly is living environment? Environment means ―all the conditions, circumstances, and influences surrounding and affecting the development of an organism or group of organisms. It also means that the complex of physical, chemical and biotic factors that act upon an organism or an ecological community and ultimately determine its form and survival.

Environment, environmentalists, environmentalism etc., are the common words used in our ordinary life in recent years. Environmentalists are those who love and care for environment, who realize that any damage to the environment will affect the life of living things. Environmental

concern of environmentalists and fundamental environmentalists are different. The former upholds and tries to popularize the need for environmental education. But the latter embraces environment in its virgin form and any intervention in the ecological balance of the environment mars the very survival of living things. Therefore, fundamental environmentalists are always treated as anti developmentalists. But the works of such persons are always appreciated by the people at large.

The words Ecology and Economics stem from the same Greek root Oikos' which means habitation. Ecology is the study of the relationship or interdependence between living organisms and their environment. Hence in Greek root, Ecology deals with the household and nature', while Economics deal with the _household of man'. An ecological balance exists in the society in which all the living things live harmoniously. But the problem is that man in his aspiration for better living has upset the ecological balance thereby endangering nature as well as himself. Quite often we find that there is a conflict between Economy' and Ecology'. Ecology studies harmony between nature and man, whereas Economics spells out the disharmony between man and nature. The disharmony arises as a result of the incompatibility of the basic ecological principle of stability as a precondition for the sustainability of ecological system and the economic principles of business profitability.

Environmental economics attempts to study the inter relationship between economic and environment. Economic as a subject cannot exist in isolation, it cannot even be a mere study of how good and services are produced, but at the same time it has to take into consideration the impacts of the use of resources on the environment. The impact may be in the form of externality, pollution, exhaustion, etc. Any study on the economic content of production, distribution, development, etc., cannot be completed without touching upon the environmental aspects like externality, pollution, damage, exhaustion, depletion etc. environmental economics can therefore be defined as that part of economics which deals with interrelationship between environment and economic development and studies the ways and means by which the former is not impaired nor the letter impeded. Environmental economics teaches us how to promote economic growth of nations with least environmental damage. When the environmental goods get transferred into economic goods, the problems of environmental damage crop up and therefore the need to interact with economic principles.

One must begin by recognizing the threefold connection between the environment,human society and its economy.

First, the environment provides the economy with raw materials which are transformed into consumer products through the production process. These raw materials include energy, which is itself a consumer product as well as an intermediate that drives this transformation.

Second, the environment provides services which are used directly by consumers. These may be critical life-support services such as the oxygen

in the air that we breath or the water that we drink. They may be aesthetic or recreational services that we may derive pleasure from, such as rambling in the forest or boating on the river.

Finally, there is a less recognized but vital service that the environment provides to the economy. It act as a receptacle or a sink for all the waste products that are the result of the process of production and consumption. The environment is not a passive sink, it act upon the waste products to clean up the environment and recycle the waste into material that can be used again.

These inter linkages are given in the following diagram:

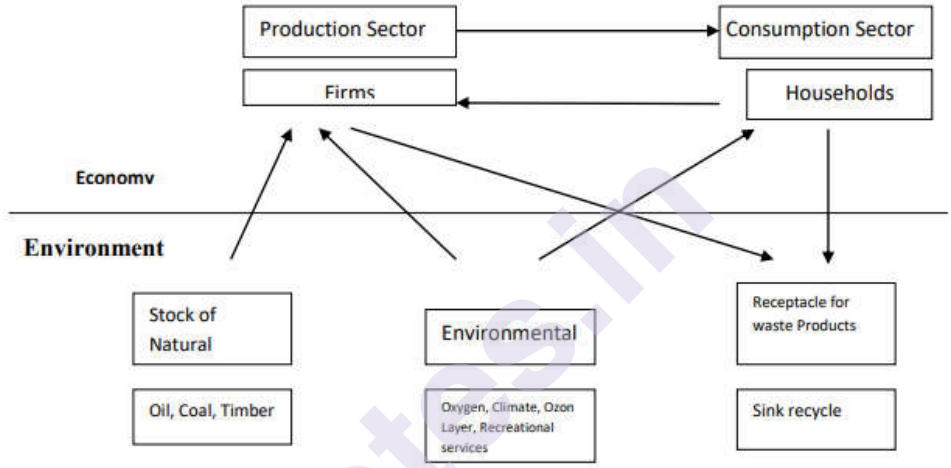

Fig: 1.1 interdependence of economics and environment.

All problems relating to the degradation of the environment relates somehow to an interference that occurs in this relationship, that hinders the delivery of these good and services that are provided directly or indirectly by the environment to the economy. It may involve the slowing down or a complete break down of the natural clean up process. It is this interference or obstacle that lies at the root of all environmental problems.

Let us take a simple example, if a factory produces some good, it also produces smoke. The amount of good it produces is decided by the economy. This in turn decides the amount of smoke that will be belched out and the damage to human health it will cause. If your neighbour plays his music system too loudly, your mental peace is disturbed.

Thus all problems of environmental pollution or degradation occur as a by product of our activities related to production or consumption. It is therefore, important to understand the economic forces that derive production and consumption such as the formation of market prices and the optimal allocation of inputs.

1.8 SUMMARY

A dominant figure in the early advocacy was Allen Kneese who, along with John Krutilla, was widely regarded as one of the fathers of

environmental economics.Environmental economics is the study of agent's decisions that haveenvironmental consequences and how to affect these decisions to achieveenvironmental quality goals.Environmental economics will help you understand some important and controversial issues – such as climate change policy, nuclear power, recycling policy, and traffic congestion charging. This is an exciting field of economics to study, and very much at the heart of many public debates and controversies.

Environmental economics is primarily concerned with the impact of economic activities on environment and its implications for the individual firm, industry and the economy as a whole. Economists have formulated economy-environment models to explain the various economic activities and their external effects.

1.9 EXERCISE QUESTIONS

1. What is Environmental Economics? Explain its nature.
2. Discuss the Scope of Environmental Economics.
3. How the study of Environmental Economics is Significant?
4. Discuss the various inter-linkages between economy and environment.
5. Write a note on – Origin of Environmental Economics

1.10 SUGGESTED READINGS

1. Hanley N, J.F. Shogern and Ben White, Environmental Economics in Theory and Practice,Macmillan, 1997.

2. Kolstad,C.D., Environmental Economics, Oxford University Press, New Delhi, 1999.

3. Sankar,U. (Ed), Environmental Economics, Oxford University Press, New Delhi, 2001.

4. Bhattacharya, R.N. (Ed), Environmental Economics – An Indian Perspective, Oxford University Press, New Delhi, 2001

2

INTRODUCTION TO ENVIRONMENTAL ECONOMICS –II

Unit Structure:

2.0 UNIT OVERVIEW

This unit provides an explanation of Kuznets Curve with its causes and criticism. The unit explains Common Resources; Tragedy of Common; and externalities and Property rights. The unit then provides an overview of how property rights affect externalities and market failure.

2.1 UNIT OBJECTIVE

- To explain the EnvironmentalKuznet Curve.
- To explain Common Resources and Tragedy of Common
- To understand externalities and property rights.

Unit Learning Outcomes

By the end of this unit, students should:

• have gained a knowledge of the Environmental Kuznet Curve.

• be familiar Common Resources and Tragedy of Common

• be familiar with externalities and property rights.

2.2 ENVIRONMENTAL KUZNETS CURVE

The Environmental Kuznets curve relationship between environment and development takes its inspirations from the income distribution theory developed by Simon Kuznets in 1955. In his study, Kuznets found an inverted U-shaped relationship between the indicators of income inequality and the level development as measured by per capita income.

The income inequality increases along the path of economic development in the early phase, declares in the later phase.

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.

Definition: The environmental Kuznets curve suggests that economic development initially leads to a deterioration in the environment, but after a certain level of economic growth, a society begins to improve its relationship with the environment and levels of environmental degradation reduces.

From a very simplistic viewpoint, it can suggest that economic growth is good for the environment.

However, critics argue there is no guarantee that economic growth will lead to an improved environment – in fact, the opposite is often the case. At the least, it requires a very targeted policy and attitudes to make sure that economic growth is compatible with an improving environment.

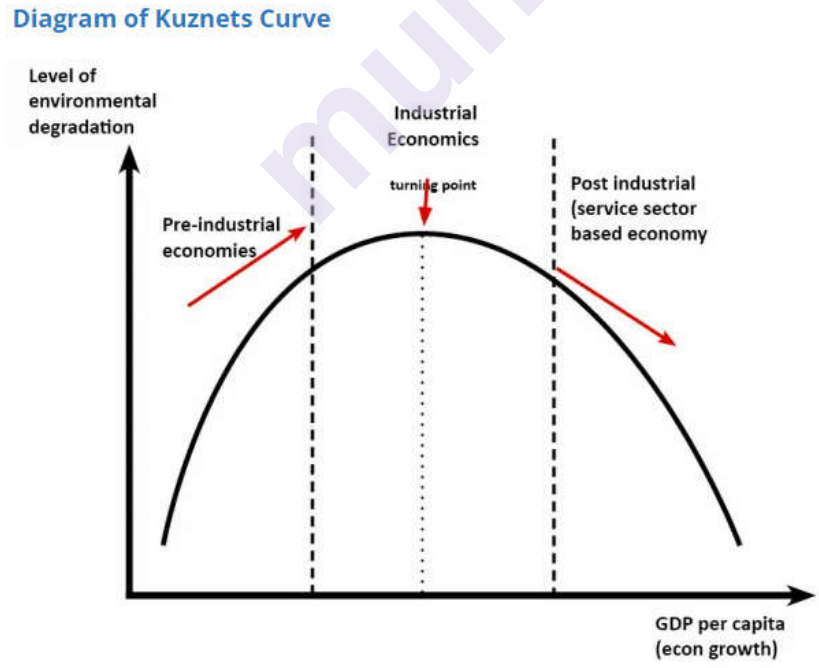

Fig 2.1 Environmental Kuznet Curve

2.2.1 Causes of Environmental Kuznets curve:

1. **Empirical evidence of declining pollution levels with economic growth.** Studies found that higher economic growth in the US led to increased use of cars, but at the same time – due to regulation, levels of air pollution.

2. **Spare income with growth.** With higher rates of economic growth, people have more discretionary income after paying for basic necessities; therefore, they are more amenable to paying higher prices in return for better environmental standards.

3. **Focus on living standards as opposed to real GDP.** Traditional economic theory concentrates on increasing real GDP and rates of economic growth. But there is a growing awareness the link between economic growth and living standards can be weak. Focusing on living standards can become politically popular.

4. **Improved technology.** The primary driving force behind long-term economic growth is improved technology and higher productivity. With higher productivity, we can see higher output, with less raw materials used. For example, since the 1950s, the technology of car use has significantly improved fuel efficiency. In the 1950s, many cars had very low miles per gallon. In recent years, car manufacturers have made strides in reducing fuel consumption and have started to develop hybrid technology.

5. **Solar and renewable energy.** A good example of how improved technology has reduced potential for environmental damage is the progress in solar technology. In recent years, the cost of solar energy has significantly fallen – raising the prospect of clean technology.

6. **De-industrialisation.** Initially, economic development leads to shifting from farming to manufacturing. This leads to greater environmental degradation. However, increased productivity and rising real incomes see a third shift from industrial to the service sector. An economy like the UK has seen industrialisation shrink as a share of the economy. The service sector usually has a lower environmental impact than manufacturing.

7. **Role of government regulation.** Economic growth and development usually see a growth in the size of government as a share of GDP. The government are able to implement taxes and regulations in an attempt to solve environmental externalities which harm health and living standards.

8. **Diminishing marginal utility of income.** Rising income has a diminishing marginal utility. The benefit from your first £10,000 annual income is very high. But, if income rises from £90,000-

£100,000 the gain is very limited in comparison. Having a very high salary is of little consolation if you live with environmental degradation (e.g. congestion, pollution and ill health). Therefore a rational person who is seeing rising incomes will begin to place greater stress on improving other aspects of living standards.

2.2.2 Criticisms of Kuznets Environmental Curve:

1. **Empirical evidence is mixed.** There is no guarantee that economic growth will see a decline in pollutants.

2. **Pollution is not simply a function of income**, but many factors. For example, the effectiveness of government regulation, the development of the economy, population levels.

3. **Global pollution.** Many developed economies have seen a reduction in industry and growth in the service sector, but they are still importing goods from developing countries. In that sense, they are exporting environmental degradation. Pollution may reduce in the UK, US, but countries who export to these countries are seeing higher levels of environmental degradation. Oneexample is with regard to deforestation. Higher-income countries tend to stopthe process of deforestation, but at the same time, they still import meat and furniture from countries who are creating farmland out of forests.

4. **Growth leads to greater resource use.** Some economists argue that there is a degree of reduced environmental degradation post-industrialisation. But, if the economy continues to expand, then inevitably some resources will continue to be used in greater measure. There is no guarantee that long-term levels of environmental degradation will continue to fall.

5. **Countries with the highest GDP have highest levels of CO2 emission.** For example, US has CO2 emissions of 17.564 tonnes per capita. Ethiopia has by comparison 0.075 tonnes per capita. China's CO2 emissions have increased from 1,500 million tonnes in 1981 to 8,000 million tonnes in 2009.

6. **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.

7. **Suri and Chapman urged that met 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.

2.2.3 Conclusion:

The link between levels of income and environmental degradation is quite weak. It is possible economic growth will be compatible with an improved environment, but it requires a very deliberate set of policies and willingness to produce energy and goods in most environmentally friendly way.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 the environment and invest more in environmental protection. This leads to decline in environmental degradation.

2.3 COMMON RESOURCES

Common resource means a good or service shared by a well-defined community. 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 CPRs, 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. We shall discuss briefly about these common property resources.

2.3.1 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.

2.3.2 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.

2.3.3 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.

2.4 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 behaviour 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'.

2.5 EXTERNALITIES AND PROPERTY RIGHTS

2.5.1 Externalities:

Externalities occur in an economy when the production or consumption of a specific good or service impacts a third party that is not directly related to the production or consumption of that good or service.

Almost all externalities are considered to be technical externalities. Technical externalities have an impact on the consumption and production opportunities of unrelated third parties, but the price of consumption does not include the externalities. This exclusion creates a gap between the gain or loss of private individuals and the aggregate gain or loss of society as a whole.

The action of an individual or organization often results in positive private gains but detracts from the overall economy. Many economists consider technical externalities to be market deficiencies, and this is the reason people advocate for government intervention to curb negative externalities through taxation and regulation.

Externalities were once the responsibility of local governments and those affected by them. So, for instance, municipalities were responsible for paying for the effects of pollution from a factory in the area while the residents were responsible for their healthcare costs as a result of the pollution. After the late 1990s, governments enacted legislation imposing the cost of externalities on the producer. This legislation increased costs, which many corporations passed on to the consumer, making their goods and services more expensive.

2.5.2 Positive and Negative Externalities:

Most externalities are negative. Pollution is a well-known negative externality. A corporation may decide to cut costs and increase profits by implementing new operations that are more harmful to the environment. The corporation realizes costs in the form of expanding operations but also generates returns that are higher than the costs.

However, the externality also increases the aggregate cost to the economy and society making it a negative externality. Externalities are negative when the social costs outweigh the private costs.

Some externalities are positive. Positive externalities occur when there is a positive gain on both the private level and social level. Research and development (R&D) conducted by a company can be a positive externality. R&D increases the private profits of a company but also has the added benefit of increasing the general level of knowledge within a society.

Similarly, the emphasis on education is also a positive externality. Investment in education leads to a smarter and more intelligent workforce. Companies benefit from hiring employees who are educated because they are knowledgeable. This benefits employers because a better-educated workforce requires less investment in employee training and development costs.

2.5.3 Property rights:

The purpose of the property rights approach is to build on and merge with the standard theory of production and exchange in order to obtain an expanded scope of its validity. It argues that the purpose of trade and production is to exchange bundles of rights to do things with goods that are exchanged. Thus the value of the goods traded increases and the terms of trade improve with increases in the degree of property rights in those goods. It follows that the scope and content of property rights over resources affects the way people behave in a world of scarcity.

Since the same resource cannot simultaneously be used to satisfy competing demands, conflicts of interests have to be resolved. Thus the structure of property rights in a society at some point in time becomes crucial. There is evidence that the allocation of resources is constrained in specific ways by prevailing property rights assignments. What are owned are rights to use resources and not the resource itself. The strength with which rights are owned can be defined by the extent to which an owner's decision about how a resource will be used determines its use.

Property rights are an instrument of society and they derive their significance from the fact that they help individuals form reasonable expectations of their dealings with others. These expectations find expression in a society's laws, customs, and mores. Property rights specify how people may be benefited and harmed and therefore who must pay whom to modify the actions taken by individuals. Thus property rights have a close relationship with externalities. An externality occurs whenever the activities of one economic agent influences others in ways that are not taken into account by market transactions. Internalizing refers to a process whereby these effects have to be considered by all the individuals involved in the action. This could be done by a change in the ownership of rights. The concept of property rights can therefore help internalize externalities. However, such a process involves costs that have to be taken into account. Not only is it important to have a structure of property rights, it is equally important to ensure that these rights are enforced. This is where the legal system comes in. One of the purposes of the legal system is to establish the clear delimitation of rights, on the basis of which the transfer of rights can take place through the market. It should be possible for one user to buy out the rights of the other users to obtain exclusive usage. The use of a piece of land simultaneously for growing wheat and as a parking lot would produce chaos. To avoid this situation it would be important to create property rights to allow exclusive use of the land.

The advantage of establishing exclusive rights to use a resource when that use does not harm others is easily understood. However, the situation changes when actions may harm others directly. Consider the example of a doctor and a confectioner having shops next to each other. The confectioner's machine disturbs the doctor in her work. The doctor takes the matter to court and the confectioner is made to stop using his machine. This example brings out the reciprocal nature of the relationship that tends to be ignored while using Pigou's approach. The traditional (Pigouvian) approach has tended to obscure the nature of the choice that has to be made. The question is commonly thought of as one in which A inflicts harm on B and the issue is what should be done to restrain A. This is not entirely correct, however. What we are dealing with is a problem of a reciprocal nature: in the process of avoiding harm to B, we harm A. The real question then is: should A be allowed to harm B or should B be allowed to harm A? The problem is how to avoid more serious harm. Another example is straying cattle destroying crops on neighbouring land. If it is inevitable that some cattle will stray, then an increase in the supply of meat can only be obtained at the expense of a decline in the supply of crops. The nature of the choice is not very clear: do we prefer meat or do we prefer crops? It is impossible to know the correct answer without knowing the value of what is obtained and the corresponding opportunity cost.

It has been argued that the failure of economists to arrive at correct conclusions about the treatment of harmful effects cannot be ascribed to a few slips in analysis. The failure stems from basic defects in the current approach to problems of welfare economics. What we need is a change in approach. Pigou's analysis in terms of divergences between private and social products concentrates attention on particular deficiencies in the system and tends to nourish the belief that any measure that will remove the deficiency is desirable. This diverts attention from those other changes in the system that are inevitably associated with the corrective measure, changes that may well produce more harm than the original deficiency. Instead, it would be desirable to use an opportunity-cost approach when dealing with the question of economic policy and to compare the total product yielded by alternative social arrangements. These views were developed by Coase and form the basis of what is known as the Coase Theorem.

Once the legal rights of the parties have been established, it is possible to negotiate and modify those arrangements. In the example of the doctor and the confectioner described above, we can have two cases: (1) the property right is given to the doctor and the confectioner stops producing candies, or (2) the property right is given to the confectioner and the doctor can strike a bargain by which the confectioner waives his right.

There are costs associated with any market activity per se. Such costs are termed transactions costs and in some market transactions such costs can be significant. In a world with zero transactions costs, private negotiations or market transactions will always lead to an efficient outcome as long as property rights are well defined and this outcome will be independent of

who owns the right. The exact definition of legal rules has only distributional consequences. In reality, however, transaction costs are not zero. When there are costs associated with striking bargains, we have to compare those costs with the potential allocation gains from striking a bargain. Only in situations where those gains exceed the necessary bargaining costs will Coase-type results hold.

When bargaining costs are high, externalities will distort the allocation of resources and the assignment of property rights can have a major effect on that allocation. If, for example, major industries are given the right to spew noxious fumes into the atmosphere, an efficient allocation is unlikely to emerge since the costs of bringing together into an effective bargaining unit all the individuals harmed by such fumes are probably quite high. Nevertheless, development of the Coase Theorem and later research based on it has had a significant impact on the way economists think of the relationship between externalities, property rights, and the efficient allocation of resources.

The concept of property rights can be extended to various fields. One could think of the problem faced by a financially weak, independent inventor when selling a valuable but easily imitated invention for which no property rights exist. Most independent inventors cannot successfully create an organization to take commercial advantage of their invention, so they have to rely on another party. This involves a production contract, a licensing arrangement, or the outright sale of the invention. Thus the inventor's ability to make profits of capture rents depends on the market value of the invention, property rights, and the information of the inventor. When the inventor can rely on patents or other mechanism to protect her intellectual property rights, then theory suggests that the inventor can appropriate a substantial fraction of the value of the invention. But if property rights are weak and non-existent, then the inventor's ability to capture rents are limited. Also, reliance on laws concerning theft of ideas does not work since buyers employ strategies to avoid legal challenges. Finally, some forms of intellectual property rights—such as new product concepts and management ideas—are inherently difficult to protect.

2.6 HOW DO PROPERTY RIGHTS AFFECT EXTERNALITIES AND MARKET FAILURE?

An externality, in economics, is in one sense a side effect caused to an outside party in a business deal. The externality may have a positive or a negative effect on that party. Property rights are often at the heart of externalities.

A legal system that protects private property rights is often the most efficient at correctly distributing costs and benefits to all parties, as long as there is a measurable economic impact to each of them.

If those rights are not clear, market failure can occur. Market failure, in this case, means that a transaction can have consequences to third parties that are not captured in the values in the transaction. In the absence of

private property rights, there is no path to a solution that leads to an efficient use of the resources.

2.6.1 Property Rights Are a Bargaining Chip:

An externality can occur whenever an economic activity, or planned activity, imposes a cost or benefit on another party. It is called a positive externality if the activity imposes a net benefit and a negative externality if it imposes a net cost.

In many if not most cases, the outside party's power to seek redress for a negative externality lies in property rights.

For example, say many of your neighbors decide to bike to work rather than drive.

2.6.2 Good and Bad Effects:

Those bike-riding commuters create a net benefit by reducing the amount of traffic you have to deal with. They also reduce the air pollution in your immediate area and lower the demand, and therefore the price, of gasoline. You may even experience a reduced chance of being injured in an auto accident.

But suppose your neighbors ride their bicycles through your front yard and damage your landscaping. This is a clear-cut case of externalities negatively affecting your property rights.

The issue to be negotiated is the reassignment of those costs to the producer of the external effect rather than to you.

On a more serious scale, pollution is a classic negative externality. If you live next to a factory with a smokestack, you may experience net costs in the form of health complications, lower property value, and a dirty house. Your rights as a property owner allow you to seek a resolution to the issue.

2.6.3 Using Property Rights to Transfer Costs and Benefits

The simplest solution to externalities is to convince the recipient of external benefits or the producer of external costs to pay fairly for them.

Just as in a buyer-seller dynamic, the two parties can negotiate the market value of the external impact and come to an agreement. When they cannot agree, the producers of the problem may be forced to stop their cost-imposing activities until they come to terms.

2.6.4 A Market Failure

When property rights are not clearly defined or adequately protected, market failure can occur. That is, no solution that meets the needs of all parties involved can be achieved.

Traffic congestion might be an example of an externality without a solution. Since no business owns the roads, there is no incentive to charge higher rates during peak times or discounts during nonpeak hours. The individual drivers on the roads have no distinct property rights. The result is an inefficient allocation of highway travel.

2.6.5 Pareto Optimality and Externalities

Among economists, discussions about externality often focus on the concept of the Pareto optimal solution, or Pareto efficiency. This theory states that it is sometimes impossible to arrive at a resolution that makes someone better off without also making someone else worse off.

Pareto optimality represents an ideal that is probably impossible. That is, that an exchange of goods or services could occur in which every single person who is directly or indirectly affected by it is perfectly satisfied.

2.7 SUMMARY

The environmental Kuznets curve suggests that economic development initially leads to a deterioration in the environment, but after a certain level of economic growth, a society begins to improve its relationship with the environment and levels of environmental degradation reduces.

An externality can occur whenever an economic activity, or planned activity, imposes a cost or benefit on another party. It is called a positive externality if the activity imposes a net benefit and a negative externality if it imposes a net cost.

More generally, the stronger the set of property rights, the stronger the incentive to work, save, and invest, and the more effective the operation of the economy. The more effectively an economy operates, the more growth it will produce for any set of resources.

2.8 EXERCISE QUESTIONS

1. Explain the Environmental Kuznets Curve with diagramme.
2. What do you mean by common resources? Explain it.
3. Discuss the concept of Tragedy of Common in the context of environmental economics.
4. State and illustrate the Externalities and Property Rights in context of Environmental Economics.
5. How do Property rights affect Externalities and Market Failure?
6. Write a note on ‘Positive and Negative Externalities’

2.9 SUGGESTED READING

1. Hanley N, J.F. Shogern and Ben White, Environmental Economics in Theory and Practice,Macmillan, 1997.

2. Kolstad,C.D., Environmental Economics, Oxford University Press, New Delhi, 1999.

3. Sankar,U. (Ed), Environmental Economics, Oxford University Press, New Delhi, 2001.

4. Bhattacharya, R.N. (Ed), Environmental Economics – An Indian Perspective, Oxford University Press, New Delhi, 2001

❖❖❖❖

3

INTRODUCTION TO ENVIRONMENTAL ECONOMICS -III

Unit Structure:

3.0 UNIT OVERVIEW

This unit provides an explanation of Coase Theorem and its criticism. The unit explains Rio Declaration. The unit then provides explanation on Rio Declaration and agenda 21 programme of action for sustainable development.

3.1 UNIT OBJECTIVE

- To explain the Coase Theorem and its criticism.
- To explain Rio Declaration
- To understand Rio Declaration and agenda 21 programme of action for sustainable development

Unit Learning Outcomes

By the end of this unit, students should:

• have gained a knowledge of the Coase Theorm.

• be familiar Rio Declaration

• be familiar with Rio Declaration and Agenda 21 for sustainability.

3.2 COASE THEOREM

Introduction: According to Coase, any effort to internalize environmental externalities requires an effective scheme for assigning property rights. Coase also believed that by assigning property rights to at least one of the parties involved (either polluter or the pollutee) there would be no effect on the final outcome of the environmental problem. The Coase theorem developed by economist Ronald Coase in 1960. The advantages of this theory is that the pollution problem can be solved by an arbitrary assignment of property rights. Optimal level of pollution can be attained through voluntary negotiations of private parties (polluter and pollutee). If the state is acting as a regulator, enforceable ownership rights have to be assigned so that it can act as private enterprise.

Illustration: To illustrate the essence of this theory, let us follow the example given below. The two familiar firms to be taken to explain this theory are the paper mill and the fish hatchery. River flowing nearby these firm are a common good. The fish hatchery believes that and as per the legal rights, the river can be used for its activities. The paper mill is not permitted to discharge the effluents into this river. In the figure, this situation is represented by the origin O, where the amount of waste released into this river from the paper mill is zero.

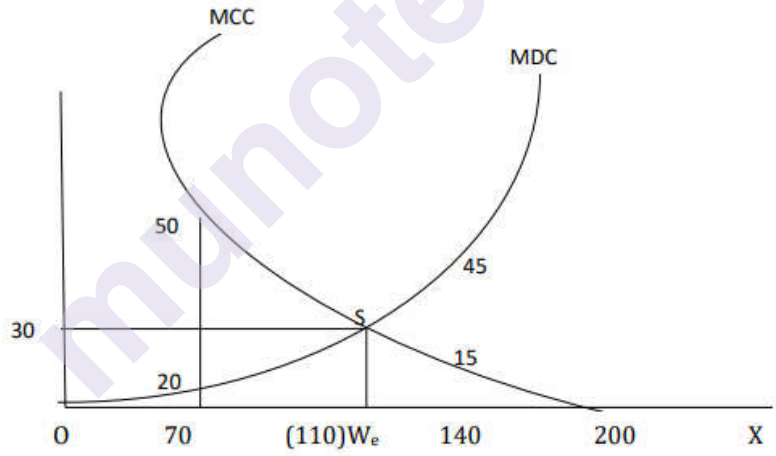

Fig 3.1 Coase Theorm

The figure explains that if the paper mill is not permitted to dispose of the wastes, it has to find an alternative method of disposal of 200 units of waste. But this system cannot sustain for a long period. When the waste discharged by the firm is less than We (110 units). The Marginal Cost of Cleaning (MCC) of the Mill is higher than the Marginal Damage Cost (MDC) to the hatchery. As shown in the figure, for the 70th unit of waste emitted into the river, the MDC to hatchery is Rs. 20. The MCC of mill is Rs. 50. The Rs. 50 is for cleaning up of 130 units (200-70=130) of wastes. To discharge 70 units of wastes, the mill is prepared to pay Rs. 20 to compensate for the damage caused to hatchery, because the alternative cost for waste disposal of 70 units is Rs. 50. This proposal is advantageous

to the paper mill. Though both the parties, the paper mill and the fish hatchery, enjoy some advantages, they can think of a better bargain. These two firms will be in a position to engage in a mutually beneficial transaction provided that it is at the point where the MCC>MDC. Further the negotiation ends when the MCC=MDC. This is the condition for the optimum level of pollution. In figure this is attained at We or 110 units of waste emission.

Coase theorem goes beyond the mere attainment of optimally. It also states that this optimal outcome is completely independent of the two parties who have the rights to the river. To illustrate this, let us imagine that the paper mill has exclusive legal rights to the use of the river. Under this circumstance, the mill can dispose of the entire wastes to the river. The figure shows that the paper mill can discharge a total of 200 units. But for each units between 110 and 200 units of wastes discharged, the MDC is greater than MCC. It means that the mill's MCC for abating pollution is lower than MDC which the mill needs to meet. This situation will call for the two firms. The paper mill and the hatchery to engage in a mutually beneficial transaction. When the waste is 140 units, the control cost which the mill needs to pay to the hatchery is Rs. 15 per unit, whereas the mill itself needs to spend Rs. 45 to avoid the 1 unit of waste emission. Thus when the emission level is at 140 units, the MDC is greater than MCC. The hatchery will take initiative to offer any amount higher than Rs. 15 to avoid higher levels of pollution emission to the river. Thus, the hatchery moves on the MCC curve and finally, it settles at S where MDC=MCC. Thus the optional level of pollution is again reached at We or 110 units where MDC=MCC.

The theory based on several assumptions:

a. Every firm has perfect information

b. Consumer and producers are price takers

c. Producers maximize the profit and consumers maximize the utility

d. There are no income or wealth effects e. There are no transaction costs.

Critical evaluation:

The following major limitations of this theory are:

1. Wealth effect is assumed to be non-existent. But in reality we all of us know that there are wealth effects which are subject to environmental factors.

2. Complete set of property rights is necessary to obtain optimum allocation of resources. Coase says that for achieving efficiency it does not matter how these rights are distributed. The question who will assign property rights to public goods is still a hard nut to crack. Arbitrary valuation cannot be considered as the relatively better option.

3. The transaction costs will be much higher when the parties involved in the negotiation process are many.

4. Coase theorem appears to be indifferent from the polluter pay principal which states that it is the polluter who has to meet the environmental damage cost. The extent of optimality in the polluter pay principle is analysed in the Pigovian fee.

3.3 RIO DECLARATION

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.

The primary objective of the Rio 'Earth Summit' was to produce a broad agenda and a new blueprint for international action on environmental and development issues that would help guide international cooperation and development policy in the twenty-first century.

Agenda 21 highlights the need to eradicate poverty. One of the major problems facing poorer nations is their lack of resources and ability to live sustainably. Developed nations have taken on the responsibilities of assisting poorer nations to reduce their environmental impacts and achieve sustainable development.

Earth Summit 1992 produced the Rio Declaration on Environment and Development, the Statement of Forest Principles, and Agenda 21. The Earth Summit also led to the establishment of the Convention on Biological Diversity, and the United Nations Framework Convention on Climate Change (UNFCCC).

3.4 RIO DECLARATION AND AGENDA 21 PROGRAMME OF ACTION FOR SUSTAINABLE DEVELOPMENT

Agenda 21 sought to provide a comprehensive blueprint of action to be taken globally, nationally and locally by organizations of the UN, governments, and major groups. The Rio Declaration established 27 principles intended to guide sustainable development around the world. Following are the 27 Principles of Rio Declaration.In 1992 the

Rio Declaration was adopted and contained in part Principle 10 stating that: "Environmental issues are best handled with participation of all concerned citizens, at the relevant level.

Principle 1

Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.

Principle 2

States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

Principle 3

The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations.

Principle 4

In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.

Principle 5

All States and all people shall cooperate in the essential task of eradicating poverty as an indispensable requirement for sustainable development, in order to decrease the disparities in standards of living and better meet the needs of the majority of the people of the world.

Principle 6

The special situation and needs of developing countries, particularly the least developed and those most environmentally vulnerable, shall be given special priority. International actions in the field of environment and development should also address the interests and needs of all countries.

Principle 7

States shall cooperate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem. In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.

Principle 8

To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies.

Principle 9

States should cooperate to strengthen endogenous capacity-building for sustainable development by improving scientific understanding through exchanges of scientific and technological knowledge, and by enhancing the development, adaptation, diffusion and transfer of technologies, including new and innovative technologies.

Principle 10

Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.

Principle 11

States shall enact effective environmental legislation. Environmental standards, management objectives and priorities should reflect the environmental and developmental context to which they apply. Standards applied by some countries may be inappropriate and of unwarranted economic and social cost to other countries, in particular developing countries.

Principle 12

States should cooperate to promote a supportive and open international economic system that would lead to economic growth and sustainable development in all countries, to better address the problems of environmental degradation. Trade policy measures for environmental purposes should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade. Unilateral actions to deal with environmental challenges outside the jurisdiction of the importing country should be avoided. Environmental measures addressing transboundary or global environmental problems should, as far as possible, be based on an international consensus.

Principle 13

States shall develop national law regarding liability and compensation for the victims of pollution and other environmental damage. States shall also cooperate in an expeditious and more determined manner to develop further international law regarding liability and compensation for adverse effects of environmental damage caused by activities within their jurisdiction or control to areas beyond their jurisdiction.

Principle 14

States should effectively cooperate to discourage or prevent the relocation and transfer to other States of any activities and substances that cause severe environmental degradation or are found to be harmful to human health.

Principle 15

In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Principle 16

National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.

Principle 17

Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.

Principle 18

States shall immediately notify other States of any natural disasters or other emergencies that are likely to produce sudden harmful effects on the environment of those States. Every effort shall be made by the international community to help States so afflicted.

Principle 19

States shall provide prior and timely notification and relevant information to potentially affected States on activities that may have a significant adverse transboundary environmental effect and shall consult with those States at an early stage and in good faith.

Principle 20

Women have a vital role in environmental management and development. Their full participation is therefore essential to achieve sustainable development.

Principle 21

The creativity, ideals and courage of the youth of the world should be mobilized to forge a global partnership in order to achieve sustainable development and ensure a better future for all.

Principle 22

Indigenous people and their communities and other local communities have a vital role in environmental management and development because of their knowledge and traditional practices. States should recognize and duly support their identity, culture and interests and enable their effective participation in the achievement of sustainable development.

Principle 23

The environment and natural resources of people under oppression, domination and occupation shall be protected.

Principle 24

Warfare is inherently destructive of sustainable development. States shall therefore respect international law providing protection for the environment in times of armed conflict and cooperate in its further development, as necessary.

Principle 25

Peace, development and environmental protection are interdependent and indivisible.

Principle 26

States shall resolve all their environmental disputes peacefully and by appropriate means in accordance with the Charter of the United Nations.

Principle 27

States and people shall cooperate in good faith and in a spirit of partnership in the fulfilment of the principles embodied in this Declaration and in the further development of international law in the field of sustainable development.

3.5 SUMMARY

The Coase Theorem is a legal and economic theory developed by economist Ronald Coase regarding property rights, which states that where there are complete competitive markets with no transaction costs

and an efficient set of inputs and outputs, an optimal decision will be selected.There are limitations to the Coase theorem. If there are multiple polluters, or more than one party affected by the pollution, the assignment of property rights actually can determine the level of pollution. Take, for example, a plant that expels waste into a river.

The Rio Declaration on Environment and Development (RD) is a document that defines principles for the relationship of states to each other and the relationship between states and their citizens in the field of environment and development.

The Rio de Janeiro conference highlighted how different social, economic and environmental factors are interdependent and evolve together, and how success in one sector requires action in other sectors to be sustained over time.In 1992 the Rio Declaration was adopted and contained in part Principle 10 stating that: "Environmental issues are best handled with participation of all concerned citizens, at the relevant level.Rio-Summit produced conventions dealing with climate change, biodiversity, and 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.

3.6 EXERCISE QUESTIONS

1. State and illustrate Coase Theorm.
2. Explain assumptions and criticism of Coase Theorm.
3. Discuss Rio Declaration and its significance.
4. Explain Rio Declaration and agenda 21 programme of action for sustainable development.
5. Write a note on Principles of Rio Declaration.
6. Write short note on sustainable Development.

3.7 SUGGESTED READING

1. Jeoren C.J.M. Bergh, Handbook of enviornmrntal and Resource Economics, 2002.
2. Steven Hacket., Environmental and Natural Resources Economics-Theory, Policy and the sustainable society, Oxford University Press, New Delhi, 1999.
3. Sankar,U. (Ed), Environmental Economics, Oxford University Press, New Delhi, 2001.
4. Bhattacharya, R.N. (Ed), Environmental Economics – An Indian Perspective, Oxford University Press,New Delhi, 2001

❖❖❖❖

Module II

4

THE DESIGN AND IMPLEMENTATION OF ENVIRONMENTAL POLICY

Unit Structure:

4.0 OBJECTIVES

- To study the Criteria for evaluating environmental policies
- To study various Tools of Environmental Policy
- To study the concept of Environmental Standards and its types
- To study the relevance of Pigovian taxes
- To study the concept of effluent fees
- To understand the meaning of quotas in environmental policies
- To understand the concept of tradable permits
- To study the comparison between taxes and quotas
- To study various Environmental Policy: Regulation and Implementation

4.1 INTRODUCTION

Generally, state pass laws and regulations to protect environment from environmental degradation. It also sets certain criteria for evaluating environmental policies. The laws and regulations takes the form of

command and control regulation (standards, targets), environmental pricing practices (taxes, fees, permits etc.). In this chapter we will learn how environmental policies are designed and implemented by the government.

4.2 CRITERIA FOR EVALUATING ENVIRONMENTAL POLICIES

There are many environmental policies in practice all over the world. Each policy has its own different characteristics, advantages and disadvantages. Each policy has certain expectations about the behavior of the administrators and the polluters. These policies however succeed in some aspects and failed in other aspects. Following criteria should be considered while framing an effective environmental policy.

1. Efficiency: Administration in implementing various policies is said to be efficient when it gives maximum benefits to the society or when it adds into the well-being of the society compare to the social cost. In case of environmental policies related to pollution control, it implies to maintain a balance between abatement costs and damages. It brings us to the equilibrium point where marginal abatement costs and marginal damages are equal.

Environmental policies can be Centralized and Decentralized. In a centralized policy a central agency or the regulatory agency is in charge to attain efficiency. It takes such steps to move to the point where marginal abatement costs equals the marginal damages. It is possible only when the regulatory agency is having full knowledge of the marginal abatement costs and marginal damages. In a decentralized policy approach, the interactions of many individual decision makers reveal the information about the marginal abatement costs and marginal damages. The assessment of these individual decision makers adjust to the situation towards the point where marginal abatement costs equals the marginal damages.

2. Cost effectiveness: Cost effectiveness criterion of environmental policy implies that the cost incurred to achieve environmental improvement should bring about a greater amount of environmental improvement at the least possible cost. In simple words the costs incurred for environmental improvement should be less than the benefits enjoyed by the society due to environmental improvement.

The resources employed to environmental quality improvement must be used in such a manner so that it will have a huge impact. It is especially important in LDCs or Developing Countries where resources are limited and therefore these countries cannot afford to implement the policies which are not cost effective.

3. Fairness: Fairness criterion for evaluating environmental policies is justifiable on the principle of equity. There should be equal distribution of

benefits among the members of the society. It is explained with the help of following example.

Suppose there are several alternative air-pollution control policies available to the government for a particular region. The implementation of one such policy is depend upon the evaluation of cost and benefits of these alternatives.

				Distribution of Net benefits	
Air pollution control program	Total cost	Total benefits	Net benefits	Region X	Region Y
A	50	100	50	25	25
B	50	100	50	30	20
C	50	140	90	20	70
D	50	140	90	40	50

The above table shows the four alternative air pollution control programs that can be adopted by the government i.e. A, B, C, and D. there are two regions X and Y where region A represents lower income group people and region Y represents high income group people. It is seen from the above table that net benefits of Program A and B are same. But the distribution of net benefit in region X is more than region Y i.e. distribution in low income region is more. So we may prefer Program B which justifies the principle of equity or fairness. In case of Program B and C again we may prefer B because the distribution of net benefits is more towards region Y representing high income group and therefore it is unequal or unfair. In case of Program B and D, we can see that net benefits are more in both the regions X and Y as compare to program B. So we prefer D to B since region X is better of compare to the benefits it is getting if program B is adopted.

4. Incentives for technological improvements: The decision of the private parties, consumers actually determine the extent of environmental impact. If the incentives are given to these parties then it will reduce the environmental damage extensively. So whether the policy is providing incentive to adopt technological improvements to reduce environmental impact is one of the important criteria. It is inevitable to invent and innovate new technology which helps to reduce the environmental impact in the long run. Technological improvements or innovations through R & D programs shifts the marginal abatement cost function downward.

The invention and innovation of new technology is a long term and complex process. It requires that resources to be devoted to invention and

development in the first place. Then the issues of copyright, patent and related infrastructure arise. Since the huge amount of monetary investment and time is required, the public sector has to take initiative to develop R & D in this area. Incentive to adopt new technology will give boost to the R & D process of new technology.

5. Enforceability: Mere making a law to restrict or regulate something is not enough. Policy makers have to take regulatory measures to enforce it. In case of many stringent laws people do not accept or obey them voluntarily. So enforceability of law is inevitable. Therefore enforceability is an important criteria for effective environmental policy. There are two main steps in enforceability of a policy

i) Monitoring: In monitoring, the performance of the polluters is measured in accordance with the relevant laws. The main objective of monitoring is to make polluters aware that they are abide by the law. Monitoring of pollution behavior is a complicated procedure. Polluters try to evade this monitoring by adopting many ways. Technology can help to ease the process of monitoring.

ii) Sanctioning: In simple words sanctioning means penalties or fine imposed for violation of law. When monitoring process noticed that a polluter is violating a prescribed law, the policy makers refer his case to the court of law for levy of penalty or law. It may cause a burden on the judiciary system which is often costly and time consuming.

6. Moral consideration: Ethical consideration or moral consideration is another criteria for evaluating environmental policies. Different people have different kind of opinion to look at a policy. But a person's ethical approach or moral consideration helps to decide right or wrong choices for the various environmental policies. Welfare of majority should be given the priority. For e.g., if industrially developed countries are responsible for more environmental pollution is a fact then they should bear a major burden in rectifying the environmental degradation situation is a general opinion.

In this way, these six types of criteria are useful in evaluating environmental policies in different circumstances.

4.3 ENVIRONMENTAL STANDARDS

Environmental standards are direct regulation type of Command-and-Control Technique. It aimed at avoiding adverse health effects that may cause due to exposure to high pollution levels, protecting environmental quality or attaining sustainable development. The environmental standards are based upon guidelines such as maximum permissible concentration which guarantees protection of human health and environmental quality.

Environmental Standards are framed in the form of policy instruments which belong to the group of physical instruments for environmental policy. It includes environment studies, environmental planning, environmental impact studies, life cycle analysis and a set of

environmental accounting techniques. There are three types of environmental standards:

1. Ambient Standards
2. Emission Standards
3. Technology Standards

1. Ambient Standards:

Ambient standards set maximum allowable levels of a pollutant in the ambient environment. It can offer a simple method of establishing priorities on the basis of concentration limits. Ambient standards are set up on the basis of desired environmental quality objectives and the cost that society is willing to accept to meet those objectives. Ambient standards can be set at different levels for different locations. Ambient standard for a pollutant considers the health effects of different levels of exposure and also to protect natural ecosystems. For e.g. an ambient standard for dissolved oxygen in a particular water body may be set as 3 parts per million. This means that it is lowest allowable limit set of this pollutant in the water body. To ensure this, we must control the operation of the sources of this pollutant by adopting several measures.

2. Emissions Standards

Emissions standards set maximum allowable amounts of a pollutant discharge by a plant or other source. In other words, emission standards are the levels applied directly to the quantity of emission coming from the pollutants. A wide variety of bases are applied while setting an emission standards. For e.g.

- Emission rate (k.g. per hour)
- Emission concentration (part per million oxygen in water bodies)
- Percentage removal of pollutant

Emissions standards can be established by estimating the discharges that are compatible with ensuring that receiving areas around the plant meet the ambient standards defined for that particular pollutant. It requires considerable information on both the sources of pollution and the ambient environment and it varies from area to area. Emission standards are the types of performance standards because it considers the end result which polluter must achieve.

3. Technology Standards

There are some standards which actually does not specify any limit or the end result but it regulates the adoption of a specific technology, technique or practice by the polluters. For e.g. technology use in cars, electric equipments etc. Authorities set certain technology standards which are supposed to be followed by the potential polluters.

4.4 PIGOVIAN TAXES

The British economist Arthur C. Pigou developed the concept of externality in early 1900. He advocated that Pigouvian tax is a tax imposed on those economic activities which generate negative externalities, which are borne by the parties not related to it. The market becomes inefficient since the costs which arises from negative externalities are not reflected in the final cost of a product or service. The main objective of Pigouvian tax to remove market inefficiencies by increasing the marginal private cost by the amount generated by the negative externality. In that case the final cost i.e. original cost plus tax will reflect the full social cost of the economic activity. So the main purpose of Pigouvian tax is to discourage those activities which imposes a cost of production on to the unrelated persons in the society such as environmental pollution. This externality or external damage need to be corrected.

Pigouvian tax is imposed by the government on any activity which creates socially harmful externality. It is intended to tax the producer of the products or services who are responsible to create adverse side effects for society. And the amount of this tax is generally equivalent to the harm it causes to the society in the form of negative externality.

Pigouvian taxes are prevalent in the society in the form of tax on carbon emission, use of plastic bags etc. which creates negative externality. The implemented taxes are a measure to redistribute those costs back to the producer and/or user that generate the negative externality.

4.4.1 Working of Pigouvian tax

A negative externality attained market equilibrium under free market economy when the social marginal benefit (SMB) is equal to the personal marginal cost (PMC) which should be lower than the social marginal cost due to additional costs created by the negative economic activities. It creates the problem of market inefficiency or market failure. When Pigouvian taxes are imposed, the supply of negative economic activities will decrease. This in turn will decrease the quantity demanded of these products due to increase in the price. In this way market equilibrium will become socially efficient when social marginal cost will become equal to the private marginal cost. It is explained in the following diagram.

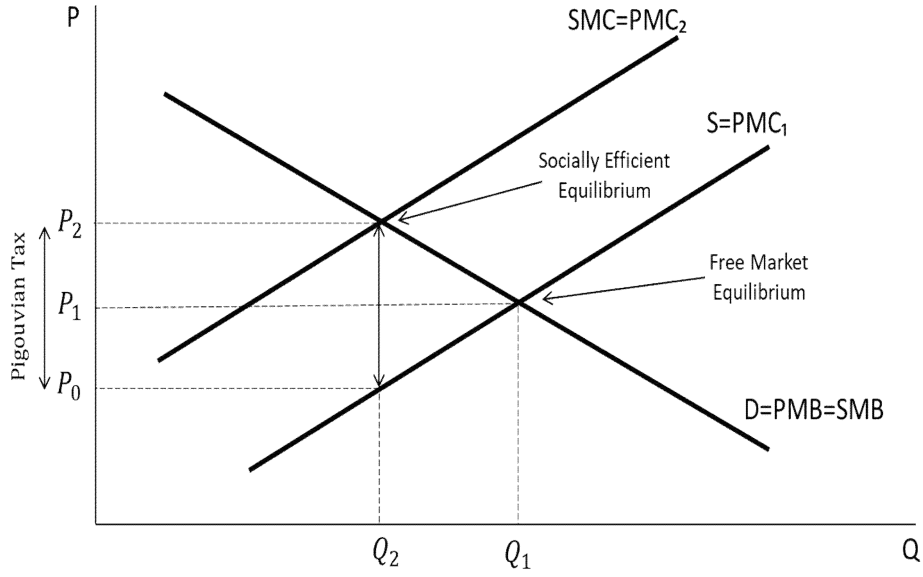

Fig -4.1

In the above diagram, in the absence of Pigouvian taxes a negative externality attains market equilibrium under free market conditions where demand curve D=PMB=SMB intersect supply curve $S=PMC_1$ at equilibrium point E_1. At this point price is OP_1 and quantity demanded is OQ_1. When Pigouvian tax is imposed equal to the amount of costs associated with the negative externality i.e. P_0P_2, prices will increase to OP_2 which in turn will decrease the demand from OQ_1 to OQ_2. A new equilibrium will be attained at E_2 where a new supply curve intersects the demand curve. In this way, the market equilibrium will become socially efficient because $SMC=PMC_2$.

4.4.2 Advantages of Pigouvian taxes:

1. Promotes market efficiency- it promotes market efficiency by imposing additional taxes to encounter negative externalities.

2. Discourages harmful activities- it discourages production and consumption of harmful activities that lead to negative externality because they are heavily taxed after imposition of Pigouvian taxes.

3. Increases revenue of the government- it helps to generate additional revenue to the government. This additional revenue government can use to subsidized and finance various programs and policies to ruled out the effects of negative externalities.

4.4.3 Disadvantages of Pigouvian taxes:

1. Difficult to measure- Pigouvian taxes are equal to the cost generated by negative externalities. The exact amount of which is difficult to measure in real world.

2. Political interference- Pigouvian taxes are generally imposed on the products which are harmful to the society at large such as tobacco, liquor etc. The producers of these products are the main sources of funds to the political parties. Since these parties favour these lobbyists it becomes difficult for the government to impose additional taxes.
3. Regressive taxes- Sometimes these taxes are regressive in nature when they are impose more burdensome to the lower income groups than higher income groups.

4.5 EFFLUENT FEES

As a country's economy develops rapidly with rapidly expanding industrial economy, the demand for the use of water increases. Discharge of effluents or industrial waste by these growing industries into the water bodies is the main cause of water pollution. Water being a natural resource is scarce if not used effectively. Water pollution adds to this problem of scarcity furthermore. So effective water management is required which takes care of not only the quantity but also the quality of available water.

To justify the principle of polluter pays, effluent charges or fees are an instrument of pollution control, imposing a financial or economic costs on the polluter or producer who discharges effluents or wastes into the water bodies causing water pollution. These charges or fees are also called as pollution charges. The main objective of these fees is to manipulate the economic behavior of the polluters. They can reduce the burden of these fees by

- By ceasing the production
- By bringing change in the technology of their production units which causes less pollution.

The amount collected by these effluent fees can be used by the government to improve the quality of water. The charges would be limited in total amount to a sum (and that sum would be earmarked in advance) sufficient to build and maintain those treatment facilities which in each particular receiving water body are necessary to achieve the quality of water inherent in the legislatively established classification for that particular water body.

Two different types of incentives would be given to the producers. These units can scrutinize their waste disposal program carefully and make any technological change which would reduce that charge by an amount greater than the cost of the change. Secondly in the long run, there will be a locational incentive. The units which need any quality water and the units whose discharge of effluent is large will tend to locate nearby to those stream basins with low water quality standards. Whereas for the units which require high quality water or whose effluent discharge quantity is small will be located to stream basins having a high water quality standard.

To conclude, following elements should be considered for a desirable effluent fees:

- Effluent fees should justify and reflect the environmental cost of water pollution caused by effluents
- Effluent fees should bear some relation to Marginal abatement cost borne by the producer so that the producer will be motivated to reduce pollution

- Enough revenue should be generated for the maintenance and treatment of water bodies

- Enough economic incentive in the form of offsetting of pollution charges to be given to the producer who releases clean effluent into the water bodies.

4.6 TRADABLE PERMITS

Tradable permits aim to reduce pollution emissions. There are two ways to issue these permits;

i) To auction it to the highest bidder; or
ii) To give it to the existing polluters in proportion to their baseline emissions.

The permit owners then free to buy or sell to anybody i.e. to other polluters who wants to participate in this market.

The tradable pollution permits are also called as cap and trade scheme. This system offers flexibility to the polluters to attain the environmental goal. It offers a legal right to the companies to pollute or to emit a certain amount during a fixed time span. A firm who pollutes less can sell its leftover permit to pollute to another firm whose emission is more. Selling of its right to pollute to another firm provides an incentive to develop innovative solutions.

The basic purpose of the tradable permit is to raise revenue by selling the permits and to reduce pollution over a period of time. If a firm fails to abide by the permissible limit then it has to buy this from other firms or from the government. The price of this permit in the market is therefore determine by the demand for and supply of these permits. In the long run the government can reduce the size of tradable permits and by selling it at a higher rate can induce the firms to innovate or adopt the measures which reduces the pollution or emission and thereby to reduce the cost of this pollution. The overall impact will be of reducing of the pollution by the firms.

When a firm creates or emits carbon during its production, then it creates negative externality. In this case social marginal cost of production is more than the private marginal cost. Tradable permits is a method to try and reduce output to a more socially desirable level. The price of the tradable permits is set to cover the social marginal cost.

Problems of tradable pollution permits:

There are certain problems of pollution permits listed below:

i) It is difficult to determine the quantity of tradable permits. The government can be give more or less quantity of permits depending upon their policies.

ii) It is difficult to measure the level of the pollution by the firms. There is a possibility that the firms can hide the true level or shift their production base to some other countries to avoid the surplus cost of the permit. In a globalized economy, the multinational companies often adopt this method to reduce cost.

iii) The administrating cost are likely to incur which cannot be ignored while implementing the scheme.

iv) In case of global pollution permits, countries who emits more than their permissible limit are required to buy it from other countries with excess permit limit. More often it happens with the industrially advanced rich developed countries who buy the permit from the less developed countries. So the aim to reduce pollution is achieved if such tactics are adopted.

v) There are some schemes such as offsetting schemes. In case of carbon emission beyond permissible limit if a firm agrees to plant trees to offset or compensate the pollution level, then such a permit is to be given to the firm. But once these firms get permit whether they really planted the trees or not is the questionable in many cases.

vi) Many a times political interference defeat the aim of the tradable permits and offers more quantity of permits to the firms.

4.7 QUOTAS (COMMAND AND CONTROL INSTRUMENTS)

Quotas or Command and control instruments prescribes certain rules and standards to comply with by using sanctions. This instrument assign a specific amount of emission to the polluters. So the polluters are allowed a specific amount of emission which helps to reduce pollution. For this at times they have to install specific type of equipment to reduce emission. Kyoto Protocol sets a binding targets for 39 industrially advanced countries and the European Union to reduce Green House gases (GHGs) emission.

How Quota system works?

In simple words quota means setting up of a limit or permission for a certain amount of a targeted thing. It is often used in Environmental legislation where policy makers intends to impose restrictions to ensure environmental sustainability. Based on a specific formula, these quotas / permits sanctioned to each individual or firm participant. These permits can be distributed by using several options

i) They can be given to the current users / polluter firms
ii) Buying and selling in the market freely determined by the forces of demand and supply
iii) Auctioning off them so that it is to be given to the highest bidder.

In each of these cases the permits are transferable in nature.

4.8 CHOICE BETWEEN TAXES AND QUOTAS

Taxes and Quotas both have their pros and cons:

1. Taxes are the direct payment in monetary terms made by the firms to government for emission of pollutants. Whereas Quotas are the quantitative limits imposed on the emission of pollutants. In case of taxes since there is a direct payment in proportion to the emission, the pinching is more. So the polluters try to optimize the cost of tax payment by reducing the emission. In this way taxes are effective than the quotas.

2. Measurement of taxes in proportion to the emission is difficult. They are generally measured as equal to the cost of negative externality. To measure taxes are therefore difficult in real world. As against this quotas are easy to determine based on a specific formula in real world.

3. Taxes have a direct positive impact on reduction of pollution when due to its heavy payment polluters try to reduce the emission. In case of quotas and permits since they are transferable in nature it does not have any direct impact on reducing the emission of pollutants.

To conclude, imposition of only tax or only quotas is not effective. Many a times hybrid policies of both these instruments in required. The choice between taxes and quotas is to be determined on the basis of negative externalities and distribution of cost. The success or the failure of these instruments are mainly depend on the policy implementation and objectives to a large extent.

4.9 ENVIRONMENTAL POLICY: REGULATION AND IMPLEMENTATION

Environmental damage due to global warming, ozone layer depletion, disposal of toxic chemical and nuclear waste at vulnerable places, loss of forests and degradation of soil will adversely affect the survival of present and future generations. May countries have therefore implemented

stringent environmental control mechanisms in the form of policies and laws.

Environmental policy implementation in India:

A) Constitutional provisions:

The provision for the rights and responsibilities of the citizens of India for environment protection have been made in the Constitution of India. Due recognition is given in the Constitution to the forest and wildlife and the tribal depend on the forest in the Constitution. Directive Principles to the States are given in the Part IV of it, wherein liability imposed on the States to protect the forest and wild life of the country. Part IV A of the Constitution mentioned fundamental duties of the citizens to protect and improve natural environment including forests, lakes, rivers and wild life.

B) Major legislations for environmental protection:

1. Environment (Protection) Act, 1986:

The Act was enacted in 1986. The main objective of the act is to provide for the protection and improvement of the environment. The Central Government empowered under this act to make provision to protect and improve environment quality, control and reduce pollution from all sources. Some important provision of the act are as follows:

- Rules are laid down for setting standards of emission or discharge of environmental pollutants
- Rules for Hazardous Waste (Managing and Handling), 1989 to control generation, collection, treatment, import, storage, and handling of hazardous waste.
- Rules for the Manufacture, Use, Import, Export and Storage of hazardous Micro-organisms / Genetically Engineered Organisms / cells were introduces in 1989. The objective is to protect the environment, nature and health in connection with the application of gene technology.

2. Water (Prevention and Control of Pollution) Act, 1974

The Act regulates quality of water under the Ministry of Environment, Forest and Climate change (MoEFCC), through State Pollution Control Boards (SPCBs) and Central Pollution Control Board (CPCB). It established water quality control stations all over the country at different places. The act not only provides for the prevention and control of water pollution but also takes care of maintaining or restoring of wholesome water in the country.

3. Air (Prevention and Control of Pollution) Act, 1981

Though this act was enacted in 1981, it was amended in 1987. It provides prevention, control and abatement of air pollution in India. It prescribed various functions for the Central Pollution Control Board and State Pollution Control Board as follows:

- To advise the Central government in matters related to the prevention, control of air pollution
- To execute a plan for a nation-wide programme for the prevention and control of air pollution
- CPCB to provide assistance and guidance to the SPCBs.
- To carry out investigate and research related activities to prevent and control of air pollution
- Collection, compilation and publication of data related to air pollution
- Prescribe standards for the air quality

4. Forest Conservation Act, 1980

This act was enacted to protect and conserve forestland. The prior approval of the Central government is required if any forestland is intended to be used for any other purpose or diverted for any non-forestry purpose. Such approval is granted only on the condition that compensatory plantation/afforestation are raised equivalent or double the area of forest land used for other purposes.

5. Wildlife (Protection) Act, 1972

This act provides protection to the wildlife such as wild animals, birds and plants to maintain ecological and environmental balance in the country. The act provides for the setting up of protected areas such as national parks, zoos, wildlife sanctuaries etc.

6. National Environmental Tribunal Act, 1995

This Act was especially passed to award compensation for damages to persons, property, and the environment arising from any activity involving hazardous substances. Following are the three major objectives of the Green Tribunal Act:

- Speedy disposal of the cases and the previously pending cases relating to environment protection and conservation of forests and other natural resources by the Tribunal.
- Enforcement of all the legal rights relating to the environment
- Providing compensation and relief to the affected people for the damage of property.

7. National Environment Appellate Authority Act, 1997

The act was passed to facilitate public hearing into the environment impact assessment to ensure greater transparency. It hears appeals related to cases of areas where restrictions are imposed on the operations, production processes of the industries.

8. National Green Tribunal (NGT) Act, 2010

This act deals with the multi-disciplinary issues related to the environment such as protection and conservation of forests and other natural resources. It is a fast track court for the speedy or expeditious disposal of cases. It not bound by the procedures laid down by Code of Civil Procedure, 1908 but guided by the principle of natural justice. New Delhi is the Principal Place of Sitting of the Tribunal and Bhopal, Pune, Kolkata and Chennai shall be the other 4 place of sitting of the Tribunal.

4.10 SUMMARY

1. There are many environmental policies in practice all over the world. Each policy has its own different characteristics, advantages and disadvantages.

2. Environmental standards are direct regulation type of Command-and-Control Technique. It aimed at avoiding adverse health effects that may cause due to exposure to high pollution levels, protecting environmental quality or attaining sustainable development.

3. Pigouvian tax is a tax imposed on those economic activities which generate negative externalities, which are borne by the parties not related to it. The main objective of Pigouvian tax to remove market inefficiencies by increasing the marginal private cost by the amount generated by the negative externality.

4. Discharge of effluents or industrial waste by the growing industries into the water bodies is the main cause of water pollution. Effective water management is required which takes care of not only the quantity but also the quality of available water. To justify the principle of polluter pays, effluent charges or fees are an instrument of pollution control, imposing a financial or economic costs on the polluter or producer who discharges effluents or wastes into the water bodies causing water pollution. These charges or fees are also called as pollution charges.

5. The tradable pollution permits are also called as cap and trade scheme. This system offers flexibility to the polluters to attain the environmental goal. It offers a legal right to the companies to pollute or to emit a certain amount during a fixed time span.

6. Quotas or Command and control instruments prescribes certain rules and standards to comply with by using sanctions. This instrument assign a specific amount of emission to the polluters. So the polluters are allowed a specific amount of emission which helps to reduce pollution.

7. Imposition of only tax or only quotas is not effective. Many a times hybrid policies of both these instruments in required. The choice between taxes and quotas is to be determined on the basis of negative externalities and distribution of cost.

8. Environmental damage due to global warming, ozone layer depletion, disposal of toxic chemical and nuclear waste at vulnerable places, loss of forests and degradation of soil will adversely affect the survival of present and future generations. May countries have therefore implemented stringent environmental control mechanisms in the form of policies and laws.

4.11 QUESTIONS

1. Briefly explain the criteria for evaluating environmental policies.
2. Discuss the concept and types of environmental standards.
3. Critically analyze the concept of Pigouvian taxes.
4. Write a note on Effluent charges.
5. Explain in detail the concept of Tradable permit.
6. Explain the meaning of quotas in environmental policy.
7. Differentiate between taxes and quotas.
8. Discuss briefly environmental policies implementation in India.

❖❖❖❖

Module III

5

MEASURING BENEFITS OF ENVIRONMENTAL IMPROVEMENTS

Unit Structure:

5.0 OBJECTIVES

- To study the concept of Economic value of Environment
- To understand the meaning of Use and Non-use values of environmental goods and services
- To study the Measurement methods of environmental value such as Market based and Non-market based methods
- To understand Contingent Valuation Method
- To study Travel Cost Method
- To study Hedonic Price Method

5.1 INTRODUCTION

As a country progresses and economic development takes place, it leads to the adverse impact on the environment. For the survival of all the living organisms it is essential to create a balance between the economic growth and environmental pollution. The government policies to protect and preserve the environment brings about the economic costs. To assess and implement any such environmental policy requires economic valuation of these likely environmental damages. In this unit, we will study the methods of measurement of this economic valuation of environmental damages.

5.2 ECONOMIC VALUE OF ENVIRONMENT

Traditionally, environmental valuation has been considered in the context of non-market valuation. The objective of this valuation is to obtain a measurement of the benefit to the welfare of individuals and the society or cost to incur due to environmental degradation by the individuals and the society in monetary terms. The ultimate goal is not just to measure the benefit or cost in money terms but help the policy makers in their policy initiatives regarding allocation of resources, imposition of taxes, various compensation schemes such as subsidies.

To measure the benefits and costs in monetary terms environmental valuation therefore considers the use of environmental goods, improving the conditions of environmental goods and damage, if any, and remedial measures to correct environmental damage. For e.g. national parks, they are not just the places of tourism but the benefits goes beyond that. They provide natural amenities and recreation facilities.

Economists have developed tools to measure environmental values. For this it estimates individual's willingness to pay to benefit from environmental goods. The costs due to environmental damage are measured by the loss suffered by the individuals who benefited from the damaged good and deciding the appropriate compensation for losing the benefit (willingness to accept).

5.2.1 The Total Economic Value (TEV) Framework:

The total economic value (TEV) framework assumed that individuals can hold multiple values for ecosystems. It also considers that a marginal change in the ecosystem services can give rise to changes in multiple values that can be held by the same individual. The TEV framework simply implies that all values that an individual holds for a change should be counted.

In simple terms, Total Economic Value (TEV) combines all the different values, which are grouped according to the service provided by the environmental good. It distinguishes between use value and non-use value. The use values are based on the actual use of the resource. The non-use values are not related to its present use. The use value includes the direct use value i.e. the value derived from the direct use and exploitation of the environmental good. Non-use values are composed of the existence value i.e. the value that individuals give to environmental goods for their mere existence and the bequest value i.e. the value estimated by individuals when considering the use of goods in the future.

Within the TEV framework an individual can consider both use and nonuse values for the services of an ecosystem. For e.g. consider an oil spill on a popular coastal beach. This can result in the forgone recreational trips to the beach. This is a lost use value. In addition to this loss it could also damage the ecosystem in ways that the beach users would never observe. It might kill marine life that live off the beach. The loss by those who do not visit the beach would be a loss of nonuse value. So the TEV

framework investigates the potential loss in use and in nonuse values of beach users and non-users of the beach.

5.2.2 Use Values: are generally grouped according to whether they are direct or indirect. The direct use value refers to both consumptive and nonconsumptive uses. It involves some form of direct physical interaction with the resources and services of the eco-system. Examples of Consumptive uses are harvesting fish and wild resources. Examples of nonconsumptive direct uses are use of water for transportation and recreational activities such as swimming can diminish the quality of aquatic ecosystems through pollution and other external effects.

The livelihoods of people staying in areas nearby aquatic ecosystems may be affected due to certain ecological functions for e.g. storm or flood protection, water purification, habitat functions. The values derived from these services are considered as indirect. They are derived from the support and protection of activities that have directly measurable values e.g., property and land values, drinking supplies, commercial fishing. Activities such as reading a book or magazine article about ecosystems, or watching a nature program, are also considered as indirect use values.

5.2.3 Nonuse Values: refers to all values people hold that are not associated with the use of an ecosystem good or service. Nonuse values need not arise from a direct service provided by an ecosystem. If people may benefit from the knowledge that an ecosystem simply exists unfettered by human activity (e.g., Crater Lake) is considered as a non-use value. Other examples of nonuse values are bequest and cultural or heritage values.

5.3 MEASUREMENT METHODS OF ENVIRONMENTAL VALUE

There are several approaches to derive environmental value i.e. to find out the monetary value of environmental damage, cost bored by individual and society and the benefits enjoyed by individuals and society. These approaches are based on:

- Market or quasi market prices
- Arbitrary monetary values set by legislation also called as judicial value
- Expert opinion or judgment value
- Non market valuation methods

In this unit we will discuss market prices and non-market prices approach.

In market based approach economic value of environmental goods and services are estimated on the basis of benefit and cost of those goods and services. In case of market value or productivity approach, change in productivity technique is applied. Whereas Human capital or foregone

earnings approach, the change in income technique is applied. In these techniques, value of production of a particular good or service is imputed according to the benefits derived from that particular economic activity. In the productivity change technique, change in an environmental attribute leads to changes in the output of the marketed good. For e.g., water pollution leads to decrease in the quality of water which can have an adverse impact on marine life and fish stock in terms of quantity and quality. Due to air pollution output of roundwood and berries provided by forests decreases.

Human Capital Approach or foregone earnings approach: It is a special case of the productivity change method applied the workforce or human beings. The value of preventing a fatality at a given time is equal to the future productive loss evaluated as the discounted sum of the earnings that the individual would have otherwise earned. Since it considers only the productive aspect of the individual, it underestimates the value of life compared with estimates derived from WTP approaches.

Non market valuation methods: In simple words, non-market value is the monetary value of the non-marketed environmental goods and services. The value of these goods and services are not tradable or determined by the market forces of demand and supply for e.g. air, water. Though the valuation of these goods and services is not easy to determine but it is essential to determine their monetary value so as to protect them from any kind of degradation or pollution.

- Valuation of these non-market environmental goods and services arises from the preferences of the individuals and the society.
- Different valuation methods are used to estimate benefits or cost to the individuals and the society.

Valuation of these non-market environmental goods and services is required for the following reasons:

- It helps the policy makers to take decisions regarding implementation of various environmental protection policies based on the gains or the losses that people experiences due to these goods and services.
- Most of these non-market goods are the public goods which are non-rival and non-excludable in consumption. Valuation prevents operation of inefficient allocation of these services.
- It helps in the litigations arises due to the harmful use of these non-marketed goods and services.

5.4 CONTINGENT VALUATION METHOD

Contingent Valuation Method relied on analytic survey technique or hypothetical situations to determine monetary value of environmental goods and services. This method needs information about the individual's willingness to pay for the use/consumption of non-marketed goods and

services and also one's willingness to accept the compensation caused due to the loss or damage of the non-marketed environmental goods and services. The information regarding willingness to pay and willingness to accept is in the direct form i.e. it collects information directly from the benefited or deprived individuals. This method is more effective when individuals are well aware or have an adequate information about the non-marketed environmental goods and services. In connection with this following approaches are need to be discussed:

A) Trade-off Game Method:

This method of contingent valuation techniques is relied on the creation of a hypothetical market for some good or service. In this game the respondent individuals are directly asked to give a single bid or offer which is equal to their willingness to pay or willingness to accept compensation for the environmental good or service. In another form of repeating bid game the individuals are given a variety of bids (offer prices) and asked them to decide the price for paying and receiving for the non-marketed environmental good.

(B) Costless-Choice Method:

In this method monetary valuation is not involved. People are given choice to select from the given hypothetical bundle of goods to determine their implied or indirect valuation of environmental good or service. This approach is more useful where barter and subsistence production takes place.

(C) Delphi Method:

The Delphi Method is also known as Expert Opinion method. In this survey method, opinion of the experts have been taken into consideration. By using their expertise in respective field, experts place values on a non-marketed good or service through a repetitive process where feedback among the group is considered between each step of repetition. This approach is useful in the valuation of specialized good or service. This is really a specialized survey technique because a sufficiently large sample of experts is presented individually with a list of events and their opinion regarding the valuation of each event.

Advantages of Contingent Valuation Method:

- ✓ Contingent valuation is flexible in nature. It can estimate the economic value of goods and services that are easily identified and consumed in discrete units for e.g., user days of recreation, when other means to measures cannot be applied.
- ✓ Contingent Valuation is the most frequently accepted method for estimating total economic value (TEV). It includes all types of non-use, passive use values, use values and also existence values , option values , bequest values .

- ✓ The nature and results of Contingent Valuation studies are easy to analyze and describe with the help of survey analysts. Monetary values can be presented in terms of a mean or median value per capita, per household, and also an aggregate value for the affected population.

Limitations of Contingent Valuation Method:

- ➢ Though the contingent valuation method has been used for the past few decades, but whether it satisfactorily measures people's willingness to pay for environmental quality is questionable.

- ➢ Contingent Valuation Method assumed that people are the good judges of the non-marketed goods and able to convert their choice for the goods in monetary terms and willingness to pay for the same. However it is fact that not all the people are able value the non-marketed environmental goods in monetary terms. Therefore the value estimation based on their choice for goods may not be a true value.

- ➢ The Contingent Valuation Method is based on the survey analysis. It is possible that the answers given by the people are misspelled or misinterpreted by the surveyor. In that case the analysis will be biased in nature. It is also possible that instead of valuing the good people are just expressing their opinion or feelings for the goods. For example, people may express their willingness to pay just to contribute to the social cause and not because of the good itself which may not be important to them. Or some people may value the good but are not willing to pay for it.

- ➢ It is possible that people may not stick to the question asked in the survey and value the good but they may associate the question with several other aspects and value the environmental good. In that case there answers may not be helpful for the survey which is intended for a specific reason. For e.g. if people are asked for their willingness to pay for reduce air pollution or improved quality of air then they may associate it with the health risk aspect with the air pollution and value the good, which may not be correct.

- ➢ There is high risk in case of getting answers for the hypothetical questions from the people. In such cases, it is possible that people may not take the questions seriously and value the good i.e. value will be either underrated or overrated. For e.g. if people think that their opinion really matters for decision making and they are likely to pay for the same in the future then they may intentionally underrate the value or express their willingness to pay and vice vis.

- ➢ The contingent valuation method ask people to value non-marketed environmental good in monetary terms i.e. their willingness to pay and willingness to accept in monetary terms. It is human psychology that people are always ready to accept more than they pay for some goods. So the answers from people are based on their psychology or feeling and not based on the true value of the good. Policy decisions can be based on these kind of answers.

- It is possible that people may not understand the question properly if asked in different manner at different times. For e.g. if people asked to value a one tenth part of a particular lake first and then they asked to value the whole or entire lake then people might think lake as a one good irrespective of its size and value the lake which might not be the true value.

- There may be differences of the opinion among people about the willingness to pay for the environmental good. For e.g. increase in vehicle tax, some may think increase is not rational and protest against it whereas some may think this increase as a donation or contribution to the society and express their willingness to pay in terms of the value for the good.

- In case of a single and repetitive bid it may happen that the bid or offer price is kept at low in initial bid and then based on the responses received from the people it can be increased or decreased subsequently. In such a situation the impact of the first or initial bid or offer price is more and it affects the final bidding or willingness to pay by the people.

- People may give answers strategically which does not reflect the true valuation of the non-marketed environmental good. For e.g. decision to reserve a part of river for fishing activity. It is likely to happen that people interested in fishing are willing to pay more because of their enthusiasm but in reality they may undervalue it and willing to pay less. This biased behavior of people can be determine for true valuation of environmental good.

- It is likely that people may have to value the good with little information available to them. When people are not fully aware about the good then this information bias may lead to overvaluation or undervaluation of the environmental good.

- Contingent valuation method is expensive and time consuming because of the extensive survey work and analysis.

5.5 THE REVEALED PREFERENCE METHOD

The demand for environmental goods can be revealed by examining the purchases of related goods in the private market place. A number of revealed preference methods such as travel- cost method, hedonic price method are discussed below.

5.5.1. Travel Cost Method

It is a widely used substitute market approach. To derive a demand curve for a specific recreational site, it relies on the information on time and travel costs. The curve derived is then used to estimate the consumers' surplus or value of the site to all users. For e.g. valuation of recreational benefits of public parks and sites.

In this method the demand for a recreational site or a public park i.e. number of visits per year to a park is intended to determine as a function of variables like price, visitors' income, and socio-economic characteristics. The price is nothing but the sum of entry fees to the site, cost of travel, and opportunity cost of time spent by the visitors. Then demand curve is derived which provides an estimate of the value of the park.

The Clawson- Knetsch-Hotelling method is the most common estimation technique used for a specific site. This method uses cost benefit analysis technique to collect information on travel costs borne by the visitors to generate a final demand curve for a recreation site. It is most appropriate for those sites where cost of travel is a major component of total visit costs. These places or sites are generally located outside or faraway places of the cities.

According to Clawson and Knetsch-Hotelling method, outdoor or outstation recreation activities fulfil individual's physical, social or psychological needs. It is necessarily a kind of package deal which involves costs related to anticipation, travel to the site, activities on the site, the return travel from the site and finally recollection.

The travel-cost method is explained in the following figure. Suppose there is a zoo in a city. The entry fee is OP which is fixed per visit as shown in the figure. Initial recreational demand for the zoo is shown by the demand curve BD_o and the environmental quantity level is E_0.

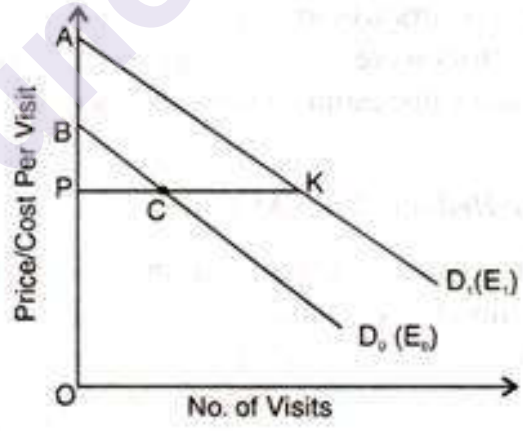

Fig – 5.1

Now suppose there is an improvement in environmental quality of zoo, which will shift the demand curve to the outward side to AD_1 and environmental quality level to E_1. This will increase the number of visits from PC to PK level. The gain in consumers' surplus is measured equal to the area PAK. So the net gain in consumers' surplus after improvement in environmental quality of the lake is measured as

Area PAK – Area PBC = Area ABCK.

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

Advantages of Travel Cost Method

- ✓ The travel cost method uses the conventional technique to estimate values based on market prices as used by the economists. So the values estimated are closed to reality.
- ✓ This method is based on actual behavior of the people and not on any hypothetical situation where they have been asked to perceive a situation and their willingness pay.
- ✓ This method is relatively cheaper and easy to apply.
- ✓ Since this method based on actual behavior of people the on-site survey is required and therefore the sample size of such on-site survey is also large. Large sample size enables to estimate more accurately.
- ✓ The results derived from such survey is relatively easy to interpret, analyze and implement.

Limitations of Travel cost Method

- ➢ Wide variations in tastes and preferences of visitors and availability of substitutes at various distances from the site, may distort demand estimates.
- ➢ The travel-cost method is of limited value if congestion is a problem. In case of small changes which affects recreational quality may be difficult to evaluate by using this method.
- ➢ This method assumes that recreational quality remains constant over the range from zero use to full present use at the current admission fee, which is highly hypothetical.
- ➢ This method is not capable of producing any total economic value estimate where it cannot estimate non-use items such as existence value. For e.g. non-visitors to the recreation sites. Since it uses only visitors i.e. use value of recreation sites, there may be an underestimation of site value.

5.6 HEDONIC PRICE METHOD

The hedonic pricing method is helpful to estimate economic value or quantitative value of ecosystem or environmental services that directly affect market prices. The hedonic price method relies on the hypothesis that while paying the prices for the goods individuals consider both environmental and non-environmental characteristics of goods. It is commonly applied to variations/changes in the housing prices which reflect the value of local environmental attributes. It requires a strong degree of statistical expertise and model specification. It is also helpful to estimate economic benefits or costs of the following:

- environmental quality , which includes air pollution, water pollution, noise pollution
- environmental amenities, includes aesthetic views or proximity to recreational sites

The real estate market is the most common example of hedonic price method. For e.g. the price of a building or a plot of land is determined by the characteristics of both internal factors like its size, appearance, features like solar panels or state-of-the-art faucet fixtures, and condition, and its surrounding environment i.e. external factors such as a high / low crime rate in the neighborhood, accessibility to schools and a downtown area, the level of water and air pollution, or the value of other homes close by.

Therefore, the hedonic price approach intends to identify difference in the valuation of a property due to environmental differences between various properties and individuals willingness to pay for an improvement in the environmental quality that they experience and the social value of improvement.

Let us discuss this with an example. Suppose the price of a house is determined by a number of factors like structural characteristics such as number of rooms, parking lots, plot size etc. and the environmental characteristics of that area. Here we need to estimate the economic value an individual is willing to pay considering all these environmental factors and non-environmental factors. With this information we will derive a hedonic price function.

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

Here Pi = house price

S = structural characteristics of the house

Si = type of construction, house size and number of rooms

N = neighbourhood characteristics of house

Ni = accessibility to work, crime rate, quality of schools etc.

Z = air quality (only environment variable affecting property value)

if the linear relation exists, then the equation becomes

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

and $y_a > 0$.

A positive relation between air quality and property price is represented in the following Figure. It indicates that house price increases with the improvement in the air quality.

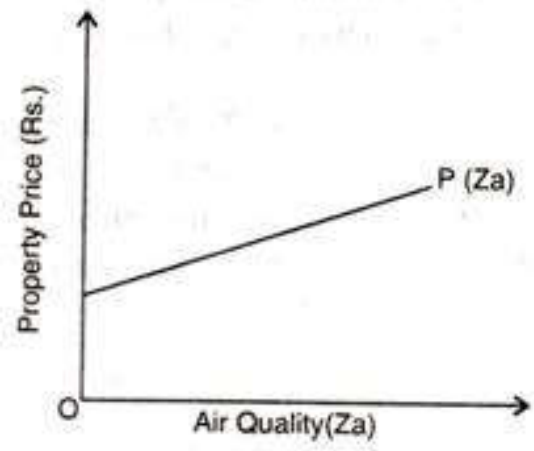

Fig 5.2

The following Figure represents that the implicit marginal purchase price of Z_a (air quality) varies or changes according to the ambient level (Z_a) prior to the marginal change.

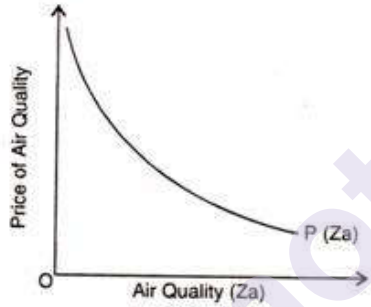

Fig 5.3

In this way, the hedonic method offers a useful way of estimating the change in amenity benefits.

Advantages of the Hedonic Price Method

- ✓ This method can be used to estimate values on actual prices is the main advantage of it.
- ✓ Since property market is highly volatile it is quick in responding to the information based on this method.
- ✓ Hedonic price method relies on the information received from property records which are accurate and therefore reliable.
- ✓ The primary data i.e. sales and characteristics of property and the secondary data required for the analysis in this method is easily and readily available.

Limitations of the Hedonic Price Method

- ➢ This method is widely relevant to properties but it is of no relevance when dealing with many types of public goods such as defence, air pollution and endangered species, etc.

- The hedonic price method may be used to estimate the present environmental benefits provided to local residents by an area. It cannot reliably predict the benefits which will be generated by future improvements which will have the effect of shifting the existing function. So the analysis and the hedonic price function will be of no use in future time.
- Analysis based on expectations regarding future environmental quality may bias present purchases away from that level which is dictated by present characteristic levels.

5.7 SUMMARY

1. The government policies to protect and preserve the environment brings about the economic costs. To assess and implement any such environmental policy requires economic valuation of these likely environmental damages.

2. Economists have developed tools to measure environmental values. For this it estimates individual's willingness to pay to benefit from environmental goods. The costs due to environmental damage are measured by the loss suffered by the individuals who benefited from the damaged good and deciding the appropriate compensation for losing the benefit (willingness to accept).

3. Total Economic Value (TEV) combines all the different values, which are grouped according to the service provided by the environmental good. It distinguishes between use value and non-use value. The use values are based on the actual use of the resource. The non-use values are not related to its present use.

4. There are several approaches to derive environmental value i.e. to find out the monetary value of environmental damage, cost bored by individual and society and the benefits enjoyed by individuals and society. These approaches are based on:

- Market or quasi market prices
- Arbitrary monetary values set by legislation also called as judicial value
- Expert opinion or judgment value
- Non market valuation methods

5. Contingent Valuation Method relied on analytic survey technique or hypothetical situations to determine monetary value of environmental goods and services. This method needs information about the individual's willingness to pay for the use/consumption of non-marketed goods and services and also one's willingness to accept the compensation caused due to the loss or damage of the non-marketed environmental goods and services.

6. In travel cost method the demand for a recreational site or a public park i.e. number of visits per year to a park is intended to determine as a function of variables like price, visitors' income, and socio-economic characteristics. The price is nothing but the sum of entry fees to the site, cost of travel, and opportunity cost of time spent by the visitors. Then demand curve is derived which provides an estimate of the value of the park.

7. The hedonic price method relies on the hypothesis that while paying the prices for the goods individuals consider both environmental and non-environmental characteristics of goods. It is commonly applied to variations/changes in the housing prices which reflect the value of local environmental attributes.

5.8 QUESTIONS

1. Explain the meaning of the term Economic value of environment.

2. Differentiate between use and non-use values.

3. Explain briefly market based and non-market based measurement methods of environmental value.

4. Briefly explain Contingent Valuation method.

5. Discuss in detail the Travel Cost Method of environmental value.

6. Explain Hedonic Price Method as one of the method of non-market based method of environmental value.

❖❖❖❖

Module IV

6

GLOBAL ENVIRONMENTAL ISSUES-I

Unit Structure:

6.0 UNIT OVERVIEW

This unit provides an explanation to Trade and Environment. The unit explains Trans Boundary Environmental Problems. The unit then provides an overview of Global warming, its causes and Challenges.

6.1 UNIT OBJECTIVES

• To explain the explanation to Trade and Environment.

• To familiar with Trans-Boundary Environmental Problems

• To explain the overview of Global warming, its causes and Challenges.

6.2 TRADE AND ENVIRONMENT

Trade refers to the voluntary exchange of goods or services between economic actors. Since transactions are consensual, trade is generally considered to benefit both parties. In finance, trading refers to the purchase and sale of securities or other assets.It has been widely recognized that globalization and that global trade plays an increasingly important role in determining relative economic growth among countries. International trade has grown considerably in recent decades. World integration is thus being accelerated through international trade in goods,

services, resources and capital. trade not only help to optimize the utilization of global resources but it can benefit all participating countries as well.This realization has caused the General Agreement on the Tariffs and Trade (GATT) to evolve into the World Trade Organization (WTO). In addition, free trade zones have been expanding. More European countries now belong to the European Union (EU), and the United States, Canada, and Mexico have created the North American Free Trade Area (NAFTA)

This growth in trade has influenced the quality of the environment in exporting and importing countries. The notion that free trade among countries leads to welfare maximization becomes questionable, when environmental degradation lowers that welfare. While comparative advantage implies that a country might specialize in the production of a pollution intensive commodity, such pollution would cause the environmental quality of the country to deteriorate. In this case there is a trade-off between gains from trade and environmental deterioration in country, compared to a country producing non-polluting goods, since income will increase only if gains from trade overcompensate welfare losses from environmental damage. Stricter environmental policies in the first country would thus affect its comparative advantage and consequently its economic growth.

Such interactions between trade and the environment haveproduced an increasingly greater need for a careful and balanced assessment of the issues involved and the challenges they pose to policy makers.Today the above issues linking environment and trade have expanded broadly. Such issues are as follows.

(1) effects of environmental policies or regulations on comparative advantage, specialization, industrial redeployment, trade patterns and terms of trade;

(2) effects of trade on environmental quality and welfare, and the use of trade policies for environmental purposes;

(3) use of environmental policy measures as strategic trade instruments to protect industries and stimulate growth

(4) coordination of the sometimes conflicting objectives of trade policy and environmental policy; and

(5) control of trans boundary pollution, including trade in wastes.

In addition, expanded trade tends to increase the scale of production for the world as a whole, meaning that the total volume of pollution and environmental damage is likely to increase. Trade also necessarily involves energy use for transportation, with resulting air pollution and other environmental impacts.The terms of trade have two distinct effects in the country. One is a net wealth effect that leads to an increase in the aggregate demand for goods and services. The other, terms of trade effect, are that an improving terms of trade means that the rate of return of

producing the nontrade commodity rises.Obligations are set out to foster good environmental governance, mandate the effective enforcement of environmental laws and regulations, and ensure that countries do not compromise their environmental laws to attract trade or investment.

6.3 OVERVIEW OF TRANS-BOUNDARY ENVIRONMENTAL PROBLEMS

Trans Boundary means crossing the border between two or more countries or areas and affecting both or all areas. A trans boundary problem is an environmental problem that is trans boundary in scale. In other words, it is an environmental problem originating in, or contributed by, one country and affecting (or impacting) another.

1. **Transboundary Pollution Issue:**Pollution can be transported across hundreds and even thousands of kilometers. The incredible distances that pollution can spread means that it is not contained within the boundaries of any single nation. This is why it is called 'Transboundary Pollution'.Air pollution, water pollution, and land pollution are three major forms of environmental pollution. Pollution can also refer to excessive human activity, such as light and noise pollution, or to specific pollutants such as plastic or radioactive material. Marine pollution is an excellent example of a Transboundary pollution problem that involves many nation-states and unlimited point sources of pollution. Marine pollution can be the result of on-shore industrial processes that use the ocean as a waste disposal site.

2. **Transboundary Water Conflict:** Transboundary water conflict' is defined as verbal, economic, or militarily hostile actions between stakeholders over internationally shared water resources. Within this group of actions, 'violent transboundary water conflict' is reserved to describe militarily hostile actions.The problems of Transboundary pollution include issues like the acidification of soils and lakes through acid rain, transboundary air pollution (known variably as smog, haze, or smoke), and downstream river or ocean pollution due to upstream activities.Transboundary cooperation allows countries to advance sound and sustainable regional and national infrastructures for storing, regulating, and exploiting their water resources.

3. **Trans boundary aquifers :**An aquifer is a body of saturated rock through which water can easily move. Aquifers must be both permeable and porous and include such rock types as sandstone, conglomerate, fractured limestone and unconsolidated sand and gravel. trans boundary aquifers (TBAs) are aquifers that underlie more than one country or political region.Transboundary aquifers are found in the subsurface space, in which water occurring in the rock pores is found in almost all types of rock formations. Management of TBA resources is therefore dependent on cooperation between countries and it is important that they are well understood to ensure they are exploited in a sustainable way.

4. **Trans boundary River issues:**Approximately 60 percent of the world's fresh water supply is located in 276 Transboundary rivers, such as the Nile, Rhine, Danube, Indus, Columbia, and Mekong basins. These Transboundary rivers cover 45 percent of the earth's land surface and provide a home for 40 percent of the world's population. Some notable examples are - The Jordan River, whose sources run from upstream Lebanon and Syria to downstream Israel and Jordan, The Nile, running from upstream Ethiopia through Sudan to downstream Egypt, The Ganges, running from upstream India to downstream Bangladesh.Brahmaputra (Transboundary River) Rises from Bhagirath Glacier, Manasarovar in Himalayas and flows for a total length of 2900 km. It passes through China, India and Bangladesh before emptying in the Ganges river in Ganges Delta.

5. **Transboundry Wetland Issues:**Human activities cause wetland degradation and loss by changing water quality, quantity, and flow rates; increasing pollutant inputs; and changing species composition as a result of disturbance and the introduction of nonnative species.Transboundary sites are created when two or more parties in the Convention cooperate across international boundaries to protect shared wetland areas.Wetlands are threatened by reclamation and degradation through drainage and landfill, pollution (discharge of domestic and industrial effluents, disposal of solid wastes), hydrological alteration (water withdrawal and changes in inflow and outflow), over-exploitation of natural resources etc.Wetlands destruction has increased flood and drought damage, nutrient runoff and water pollution, and shoreline erosion, and triggered a decline in wildlife populations.

6. **Trans border Crime issue:**Trans border crime: "trans-border crime" represent a number of illegal and notorious activities carried out by individuals and groups across national and international borders, either for financial or economic benefits and also socio- political cum religious considerations.e.g. drug trafficking, weapons trafficking, terrorism, corruption, money laundering, human trafficking, cybercrime, environmental crime, and smuggling of cultural artifacts.

7. **Cross-border migration** :Cross-border migration poses security challenges for the modern nation-state, as the influx of populations exert massive pressures on a country's resources and governance ecosystems. The undocumented migrants, for their part, not only struggle for their livelihood but often face fundamental crises of identity and belonging like India's eastern borders. Very often the undocumented migrants are perceived to be 'illegal outsiders' and 'encroachers'. They are faced with economic and identity crises which, multiplied manifold, accumulate to a serious humanitarian emergency.

8. Trans boundary Natural resources issues: Transboundary or shared natural resources are resources that cross the political boundaries of two more States.Studies on community based natural resource management have shown that there is need to incorporate local communities in natural resource management.

6.4 MEANING OF GLOBAL WARMING

Meaning: global warming, the phenomenon of increasing average air temperatures near the surface of Earth over the past one to two centuries. Climate scientists have since the mid-20th century gathered detailed observations of various weather phenomena (such as temperatures, precipitation, and storms) and of related influences on climate (such as ocean currents and the atmosphere's chemical composition). These data indicate that Earth's climate has changed over almost every conceivable timescale since the beginning of geologic time and that human activities since at least the beginning of the Industrial Revolution have a growing influence over the pace and extent of present-day climate change.

It is also known as the 'Greenhouse Effect,' which is one of the major causes affecting global warming. Though the current state of global warming is considered quite controversial, authentic researches have provided pertinent data to support the same. Widespread adoption and implementation of necessary solutions are essential to restrain these emissions and curtail the intensified effects of climate change. Now, we shall move forward to a detailed discussion on the causes and effects of global warming.

6.5 CAUSE OF GLOBAL WARMING

1. **Higher Levels of Deforestation:** Deforestation affects the release of aerosols and other chemical compounds that affect clouds and changes in wind patterns, causing a flux in precipitation levels. In basic terms, Trees and plants are responsible for being the primary source of oxygen. By taking the carbon dioxide in, they release oxygen in the air, thereby maintaining a state of ecological balance, causing lesser air pollution. Planned human activities like continued forest loss for industrial and commercial motives drive the increase in carbon dioxide concentrations. As we know, Carbon dioxide is one of the leading heat-trapping gases, mainly responsible for average warming and environmental imbalance over the past few decades.

2. **Transportation and Use of Vehicles:** In this fast-paced world, people often use vehicles even for covering short distances. Gaseous emissions from cars and vehicles often drive temperature rise by trapping energy, which translates into heat. Such activities come under 'anthropogenic forcing,' i.e., human-influenced forces on the climate system. Continued transportation around congested areas contributes to air pollution, which eventually leads to increased global warming.

According to IPCC reports, the transportation sector's contribution has grown by more than 50% since 1992 and continues to be one of the leading causes of global warming.

3. **Emissions from Industries and Power Plants:** According to a report stated in 2018, some of the significant global anthropogenic greenhouse gas emissions are almost equal to 52 billion tonnes of Carbon dioxide. Out of which 72% is released from industries and power plants. With the advent of industrialization, the rising usage of electricity and heat, global warming has increased to a great extent. The release of pollutants from these sources has a significant impact on the environment and disturbs the delicate balance of nature.

4. **Agriculture and Land Surface Changes:** Frequent practices of agriculture take up almost 50% of the world's habitable land. Short term agricultural cultivation affects nearly 24% of the permanent land-use change. These activities also add up to the rise in temperature and GHG emissions from the land surface. The changes in land surface disturb the natural process of carbon storage and affect the reflection and absorption of sunlight heat. Soil erosion, Deforestation, and chemical fertilizers application lead to increased runoff that carries pollutants into water resources and eventually to the oceans.

5. **Combustion of Fossil Fuels, Overpopulation:** Most of the heat-trapping emissions from burning coal, gas, and oil from industries and cars, along with widespread Deforestation and rising levels of black carbon pollution or 'soot' in the form of aerosols affecting Earth's albedo come under this type. Also, the primary gas causing Global warming is Carbon dioxide, which is influenced by rising overpopulation.

6. **Volcanic Eruptions**: They constitute one of the significant natural causes affecting global warming because of the increased release of gases and smoke from the eruptions.

7. **Natural Forest Fires**: When significant scale vegetation burns, leading to forest blaze, there is a release of stored carbon and a rise in greenhouse gas emissions. These emissions further trap solar energy leading to Global warming.

8. **Solar Activities:** Changes in solar irradiance in wavelengths and other variations such as solar flares or sunspots, if larger enough, could have an unprecedented impact over global warming and atmospheric temperatures.

9. **Melting Permafrost and Glaciers:** Towards the north and south poles of the planet, considerably large amounts of carbon are frozen in the form of permafrost. Disturbances such as solar activities, forest fires, volcanic eruptions can lead to the sudden release of GHGs and carbon

sequestration into the atmosphere, giving way to ecological imbalances.

6.6 CHALLENGES OF GLOBAL WARMING

1. Rise in Temperature Leading to Ice Melt: Melting glaciers and snow melts will cause severe water shortages and droughts with higher frequencies giving way to heatwaves and extreme weather conditions in the mid-latitudes. Thinning ice of the northern seas will make the atmospheric conditions vulnerable to control.

2. Ecological Risks: Global warming has contributed to the extension of drier climatic zones such as deserts in the subtropics. Mostly ecosystems and animal life will be affected by higher carbon dioxide levels and global temperatures leading to climate change, which will result in the extinction of many species and reduced ecological diversity.

3. The Threat to Marine Life: Global warming can lead to the destruction of marine and coral life underwater. Higher content of carbon dioxide in the water inflicts damage to valuable natural resources.

4. Loss of Settlements: Global warming can also lead to Inundation from sea level rise, which can further threaten infrastructure and establishments of human settlements. This severely leads to a decrease in the human population. Droughts, temperature rise, loss of glacial rivers puts the state of agriculture on ain the rampage.

5. Health Factors: There are various indirect effects such as malnutrition inflicted by crop failures. Scanty rainfall leading to desertification can also cause several diseases due to global warming.

6.7 SUMMARY

Such interactions between trade and the environment have produced an increasingly greater need for a careful and balanced assessment of the issues involved and the challenges they pose to policy makers.

Trans Boundary means crossing the border between two or more countries or areas and affecting both or all areas. A trans boundary problem is an environmental problem that is trans boundary in scale.

Global warming, the phenomenon of increasing average air temperatures near the surface of Earth over the past one to two centuries. It has its causes and challenges.

6.8 EXERCISE QUESTIONS

1. Explain the Interrelation between Trade and Environment.
2. What are the Transboundary environmental issues?
3. What is Global Warming? Explain its causes.
4. Discuss the Challenges of Global Warming.
5. Write a note on – Transboundary Pollution issues.

6.9 SUGGESTED READINGS

1.Hanley N, J.F. Shogern and Ben White, Environmental Economics in Theory and Practice,Macmillan, 1997.

2. Kolstad,C.D., Environmental Economics, Oxford University Press, New Delhi, 1999.

3. Sankar,U. (Ed), Environmental Economics, Oxford University Press, New Delhi, 2001.

4. Bhattacharya, R.N. (Ed), Environmental Economics – An Indian Perspective, Oxford University Press, New Delhi, 2001

7

GLOBAL ENVIRONMENTAL ISSUES- II

Unit Structure:

7.0 UNIT OVERVIEW

This unit provides an explanation to Trade and Environment. The unit explains Trans Boundary Environmental Problems. The unit then provides an overview of Global warming, its causes and Challenges.

7.1 UNIT OBJECTIVES

• To explain the explanation to Trade and Environment.

• To familiar with Trans-Boundary Environmental Problems

• To explain the overview of Global warming, its causes and Challenges.

7.2 URBANISATION

Urbanization is the process through which cities grow, and higher and higher percentages of the population comes to live in the city. Urbanisation is a form of social transformation from traditional rural societies to modern, industrial and urban communities. It is long term continuous process. It is progressive concentration of population in urban unit. The period after 1941, witnessed rapid growth of four metropolitan cities in India, which were Kolkata, Delhi, Mumbai, and Chennai. The nation's economy saw a rise due to industrial revolution and the invention of new technologies increased the standard of living of people living in urban areas.

Urbanization is the movement of people from rural to urban regions, expanding cities and towns. It is the process through which cities grow as higher percentages of the population come to live in the city.

Urbanization involves a complex set of economic, demographic, social, cultural, technological, and environmental processes that increase the proportion of the population of a territory that lives in towns and cities.

7.3 CAUSES OF URBANISATION

Various reasons have led to the growth of cities. They are as follows:

1. Industrialization:

Industrialization is a major cause of urbanization. It has expanded the employment opportunities. Rural people have migrated to cities on account of better employment opportunities.

2. Social factors:

Many social factors such as attraction of cities, better standard of living, better educational facilities, need for status also induce people to migrate to cities.

3. Employment opportunities:

In rural sector people have to depend mainly on agriculture for their livelihood. But Indian agriculture is depending on monsoon. In drought situations or natural calamities, rural people have to migrate to cities.

4. Modernization:

Urban areas are characterized by sophisticated technology better infrastructure, communication, medical facilities, etc. People feel that they can lead a comfortable life in cities and migrate to cities.

5. Rural urban transformation:

It is an interesting aspect that not only cities are growing in number but rural community is adopting urban culture, no longer rural communities are retaining their unique rural culture. Rural people are following the material culture of urban people. Urban rural transformation can be observed in the following areas.

7.4 CHALLENGES OF URBANISATION

1. Overcrowding:

Overcrowding is a situation whereby a huge number of people live in a small space. This form of congestion in urban areas is consistent because of overpopulation and it is an aspect that increases day by day as more people and immigrants move into cities and towns in search of a better life. Most people from rural or undeveloped areas always have the urge of migrating into the city that normally leads to congestion of people within a small area.

2. Development of Slums:

The cost of living in urban areas is very high. When this is combined with random and unexpected growth as well as unemployment, there is the spread of unlawful resident settlements represented by slums and squatters. The growth of slums and squatters in urban areas is even further exacerbated by fast-paced industrialization, lack of developed land for housing, a large influx of rural immigrants to the cities in search of a better life, and the elevated prices of land beyond the reach of the urban poor.

3. Water and Sanitation Problems:

Because of overpopulation and rapid population increase in most urban centers, it is common to find there are inadequate sewage facilities. Municipalities and local governments are faced with serious resource crisis in the management of sewage facilities. As a result, sanitation becomes poor and sewages flow chaotically, and they are drained into neighboring streams, rivers, lakes, or seas.

Eventually, communicable diseases such as typhoid, dysentery, plague, and diarrhea spread very fast leading to suffering and even deaths. Overcrowding also highly contributes to water scarcity as supply falls short of demand.

4. Poor Health and Spread of Diseases:

The social, economic and living conditions in congested urban areas affects access and utilization of public health care services. Slum areas in particular experience poor sanitation and insufficient water supply which generally make slum populations susceptible to communicable diseases. Environmental problems such as urban pollution also cause many health problems namely allergies, asthma, infertility, food poisoning, cancer and even premature deaths.

5. Traffic Congestion:

When more people move to towns and cities, one of the major challenges posed is in the transport system. More people means an increased number of vehicles which leads to traffic congestion and vehicular pollution. Many people in urban areas drive to work and this creates a severe traffic problem, especially during rush hours. Also as the cities grow in dimension, people will move to shop and access other social needs/wants which often cause traffic congestion and blockage.

6. Urban Crime:

Issues of lack of resources, overcrowding, unemployment, poverty, and lack of social services and education habitually lead to many social problems including violence, drug abuse, and crime. Most of the crimes such as murder, rape, kidnapping, riots, assault, theft, robbery, and hijacking are reported to be more prominent in the urban vicinities. Besides, poverty-related crimes are the highest in fast-growing urban regions. These acts of urban crime normally upset the peace and tranquility of cities/towns.

7. Unemployment:

The problem of joblessness is highest in urban areas and it is even higher among educated people. It is estimated that more than half of unemployed youths around the globe live in metropolitan cities. And, as much as income in urban areas is high, the costs of living make the incomes seem horribly low. The increasing relocation of people from rural or developing areas to urban areas is the leading cause of urban unemployment.

8. Housing Problems:

Urbanization attracts people to cities and towns which leads to a high population increase. With the increase in the number of people living in urban centers, there is a continued scarcity of houses. This is due to insufficient expansion space for housing and public utilities, poverty, unemployment, and costly building materials which can only be afforded by a few individuals.

7.5 INTERNATIONAL ENVIRONMENTAL AGREEMENT

International environmental agreements (IEAs) are treaties negotiated, signed, and ratified by individual nation-states to address transboundary environmental issues. This article provides an overview of the recent state of the art in the domain of the political economy of the formation of IEAs.
A product of the first UN Conference on the Human Environment, the Stockholm Declaration (1972) was the first international document to recognize the right to a healthy environment through 26 principles, many of which have played an important role in the subsequent development of IEL.

1. Stockholm Conference (UNCHE, 1972):

The United Nations Conference on Human Environment (UNCHE)—held in June 1972 in Stockholm, Sweden—marked the beginning of modern era of environmental governance,introducing more inclusive and comprehensive international agreements and regulations onenvironmental issues. This conference is also widely known as the Stockholm Conference.The event is broadly considered the first major worldwide attempt to address the globalenvironmental problems and preserve the human environment. The conference was also thefirst international environmental agreement recognizing the fact that ―environmental problems of broad international significance fall within the competence of the United Nationssystem (UN 1972: 34). In other words, Stockholm conference placed the environmentalproblems at the center of global debates, particularly those occurring within the domain ofinternational organisations like UN. As a result, the international organisations werecompelled to take appropriate measures to deal with the environmental problems—particularly those are global in nature. Since then, the international organisations have notonly successfully organised international events, but also singed a number of environmental

agreements aiming at the preservation and enhancement of the human environment.

The United Nations Conference on Human Environment in 1972 was attended by delegations from more than 110 countries and over 400 non-governmental and intergovernmental organisations. The _Stockholm Declaration', adopted at the UN conference, is one of significant documents in the history of global environmentalgovernance. While comparing the latter with Universal Declaration of Human Right (UDHR1948) in his book entitled, Introduction to International Law, J. G. Starke (1989: 406) termedthe Stockholm Declaration as an important environment manifesto ―expressed in the form anethical code intended to govern and influence future action and programmers, both at thenational and international levels.

2. United Nations Environment Programme (UNEP):

The establishment of United Nations Environment Programme (UNEP)' was one of the greatest achievements of the Stockholm Conference. This international environmental bodywas primarily set up, in December 1972 by the General Assembly, to coordinate theenvironmental activities within the United Nations system. UNEP headquartered in Nairobi, Kenya was labelled to be the environmental conscience of the UN system (Paehlke eds., 1995: 653). The main tasks of this organisation are to promote globalcooperation on ecological issues, guide other UN's environmental agencies, coordinate UNactivities' related to the environment, monitor global environmental management and encourage scientific research and projects among others. Also, it intends to raise public awareness about the dangers of environmental change and deterioration, and attempts toinculcate environmental education through sponsored television and radio programmes. It is estimated that more than 10,000 educators in over 140 countries have been involved inUNEP's educational activities (ibid., 654). Besides, UNEP does not only encourage thestates' agencies but also the private actors like NGOs, TNCs, multinational voluntaryorganisations and civil society groups to promote the sustainable use of the natural resources.Since its origin, UNEP has been one of the biggest proponents of the environmentfriendly and sustainable model of development. It has supported the varied scientificresearches, training programmes and projects aiming to develop an environment sensitivedevelopment agendas and models. It has also facilitated worldwide cooperation among thestates in global politics, particularly in the context of international environmental agreementsand policies. Maurice Strong, the first executive director of UNEP, coined the phrase theprocess is the policy,' which captures much of UNEP's strategy of bolstering internationalenvironmental concern and building national capacity for managing environmental problems (ibid., 653). It is observed that since the inception of UNEP, more than 40 multilateralenvironmental agreements were signed under its auspices (Kochtcheeva eds., 1999). Morespecifically, UNEP in the past three decades has played a substantial role in initiatingnegotiations on reducing the use of chemicals and gases causing ozone layer depletion. At thesame time, it has extended technical support to a number of international

conventions, likethe Montreal Protocol on Substances that Deplete the Ozone Layer (1987) and the UNconvention on Biological Diversity (1992) among others. In this way, UNEP intends todevelop a worldwide consensus among the both public and non-sate actors about theenvironmental problems and organizing collective actions for ensuring the sustainable andgreen future. Furthermore, UNEP has developed an international monitoring system, known as Earthwatch. It is designed to engage the governments in a free-flowing exchange ofenvironmental information and green ideas. Earthwatch also enables the global and nationalactor to assess potential risks and threats to human environment so they may act accordingly.

3. Montreal Protocol (1987):

The Montreal Protocol, entitled as ‗the Montreal Protocol on Substances that Deplete the Ozone Layer', was initially signed in 1987 by the twenty-four countries and the EuropeanCommunity at the Headquarters of the International Civil Aviation Organisation in Montreal,Canada. Later, the same treaty was ratified by more than 180 countries. This globalagreement is the first of its kinds in the history of environmental protection which wasdesigned to protect the stratospheric ozone layer by reducing the global production, emissionand usage of ozone-depleting chemical substances within the stipulated time period. Howeverthe Vienna Convention for the Protection of the Ozone Layer (1985)—that recognises theresponsibility of states to protect the environment and human health from the adverse effectsof ozone depletion—set out the framework under which the Montreal Protocol wasnegotiated. The protocol was thus adopted on September 16, 1987 but it came into force onJanurary 1, 1989 and subsequently amended many times.The Montreal Protocol recognised the worldwide emission of certain chemical substances that could deplete or substantially modify the earth‗s ozone layer in a way thatwas assessed to adversely impact the environment and human health.

4. Rio Conference (1992):

The United Nations Conference on Environment and Development‗ (UNCED), also popularly known as the Earth Summit or Rio Conference, was convened in 1992 in Rio deJaneiro. This global event marked the twentieth anniversary of historical StockholmConference held in 1972. The Rio Conference, the largest environment conference in UNhistory, was attended by over 170 government representatives, 35000 environmental activists,politicians and business representatives, along with thousands of journalists andrepresentatives of non-governmental organisations (NGOs) from around the world. Theconference negotiated on a wide range of environmental issues ranging from biodiversity, climate change, pollution, forest management, poverty and sustainable use of resources. The foremost purpose of the conference, however, was to reconcile the worldwide developmentalgoals with the need for environmental protection by evolving a sustainable model ofdevelopment.

5. Declaration on Environment and Development:

The Declaration on Environment and Development' adopted at the Earth Summit is also widely known as Rio Declaration comprising of 27 principles that reaffirmed the StockholmDeclaration and defined the responsibilities of state and non-state actors in safeguarding theplanet. In other words, it has urged the nations to pursue a sustainable and environmentsensitive developmental agenda on the one hand and encouraged the individuals to live amore eco-friendly lifestyle on the other. It has further highlighted the need of evolving newlevels of global corporation to deal with the emerging environmental challenges, and preserve and restore the earth's ecosystem.

6. Convention on Biological Diversity (CBD):

The Convention on Biological Diversity', also called Biological Treaty, is another significant achievement of the Rio Conference. The convention was opened for signatures in 1992 at the Earth Summit and entered into force on December 29, 1993. The biodiversityexists on Earth in the many forms of life including ecosystem, plants, animals,microorganisms, fungi to genetic diversity. The convention recognises the central role ofbiological diversity in maintaining the life sustaining systems of the biosphere, and thus itrequires the states to initiate measures for the protection and the sustainable use of biologicaldiversity (UN 1992). In other words, the CBD affirms that the preservation of biodiversity is a common concern of humankind demanding collective efforts at all levels (global, national, local and societal levels). This multilateral binding agreement has today been approved byover 190 countries and the European Union.

Agenda 21

7. Agenda 21:

It is the most significant agreement signed at the Earth Summit. It is widely recognised as an international blueprint or global plan of action for achieving sustainability in the twentieth century. Over 180 governments agreed to Agenda 21 in 1992 at the EarthSummit. The countries approved the same are to be monitored by the InternationalCommission on Sustainable Development, and are encouraged to promote the agenda 21 atall levels (local, regional, national and global levels). Agenda 21 outlines the actions thatinternational community, governments, non-governmental organisations, international organisations, civil society, and the communities can take to realise the aim of sustainableworld (Cunningham et al., 1994: 855). It also recognises the importance of everyone includedthe governmental agencies, NGOs, civil society, and local organisations among others inbuilding a sustainable future.

8. Paris Agreement (2015):

The Paris Agreement, also known as Paris Climate Accord or Paris Climate Agreement, was adopted on 12 December, 2015 by 195 nations at the twentieth-first Conference of Parties(COP 21) to UN Framework Convention on Climate Change (UNFCCC). The Agreement isanother noteworthy attempt to enhance the implementation of UNFCCC. It offers a newuniversal legally-binding framework to combat the global threat of

climate change andstrengthen the globally coordinated efforts towards a sustainable future beyond 2020. In otherwords, the Paris Climate Agreement is tended to replace the Kyoto Protocol after its second commitment period ends in January 2020. The agreement is primarily aimed at keeping the rise in global temperature to well below 2 degrees Celsius above pre-industrial levels, andlimiting the temperature increase to 1.5 degrees Celsius (UN 2015:3). Also, the agreementintends to strengthen the global capability of dealing with the potential impacts of climatechange.

7.6 SUMMARY

Trade can have both positive and negative effects on the environment. Economic growth resulting from trade expansion can have an obvious direct impact on the environment by increasing pollution or degrading natural resources.

it is evident that global warming is a real phenomenon, and it is happening right now. There are several factors that contribute to this issue, and the impacts can be seen both socially and environmentally. If we do not take the necessary precautions and act now, the situation is only going to worsen in the future.

International environmental agreements (IEAs) are treaties negotiated, signed, and ratified by individual nation-states to address transboundary environmental issues. This article provides an overview of the recent state of the art in the domain of the political economy of the formation of IEAs.

7.7 EXERCISE QUESTIONS

1. What is Urbanisation? Explain the causes of Urbanisation.
2. Explain the challenges of Urbanisation.
3. What is Global Warming? Explain its causes.
4. Discuss International Enviornmental Agreements.
5. Write a note on – a. Agenda 21
   b. Paris Agreement
6. Explain United Nations EnviornmentalProgramme.

7.8 SUGGESTED READINGS

1.Hanley N, J.F. Shogern and Ben White, Environmental Economics in Theory and Practice,Macmillan, 1997.
2. Kolstad,C.D., Environmental Economics, Oxford University Press, New Delhi, 1999.
3. Sankar,U. (Ed), Environmental Economics, Oxford University Press, New Delhi, 2001.
4. Bhattacharya, R.N. (Ed), Environmental Economics – An Indian Perspective, Oxford University Press, New Delhi, 2001

❖❖❖❖