**E-CONTENT (BDU)**

**SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN’S COLLEGE**

**SUNDARAKKOTTAI, MANNARGUDI.**

**(Accredited with ‘A’ Grade by NAAC)**

**PG & RESEARCH DEPARTMENT OF ECONOMICS**

**Subject name; ENVIRONMENTAL ECONOMICS**

**Staff name; Dr. R.Malathi**

**Class : III B.A ECONOMICS**

**ENVIRONMENTAL ECONOMICS**

**Objective**: To make the students understand the Nature and Scope ofEnvironomics in India.

**Module I : Definition and Scope of Environomics**

Definition and Scope of Environomics–Concepts and other Theories – Relationship with other sciences – Problems in Pollution – Approaches in Environomics- Environment and Economics - Natural Resources- Conservation of Natural Resources – Green House Effect – Ozone Depletion- Acid Rain-Tragedy of Commons.

**Module II : Welfare Economics and Environomics**

Welfare Economics and Environomics– Pareto Theory – Other effects-Environment quality as public good- Optimum Theory – Private and Social cost-Problem of Second cost- Population Menace and Degradation of Environment quality – Urbanisation-Land Use – Air and Water pollution- Noise Pollution.

**Module III : Economic Development and Quality of Environment**

Economic Development and Quality of Environment- Environmental Issues in Developed and Developing Countries – Uses of Resources – Environmental Protection Laws- Environmental Education in Curriculum.

**Module IV : Cost Benefit Analysis**

Cost Benefit Analysis – Environmental cost of Economic growth – Limits to growth –Pollution cost distribution- Effects- Plans – Total and Marginal Benefits of Pollution Control – Efficiency in Pollution- Pollution Control Boards.

**Module V: Measures of Pollution Control**

Measures of Pollution Control – Fiscal and Direct control measures – Taxes and Subsidies- Pollution Control Methods – Government Investment Programmes-Pollution Permits- Global Issues in Environmental Quality- Pole of Government Voluntary and Consumer organization – Treaties and Agreements at Global Level.

**References:**

1. Sankaran, S. (2004), Environmental Economics, Margham Publications, Chennai.
2. Karpagam,M.(2001), Environmental Economics, Sterling Publications Pvt Ltd, New Delhi.

**III B.A ECONOMICS**

**INTRODUCTION;**

**Environmental economics** is an area of **economics** that studies the financial impact of **environmental** policies. **Environmental economists** perform studies to determine the theoretical or empirical effects of **environmental** policies on the economy.





**PREPARED BY**

**Dr. R.Malathi**

**INTRODUCTION**

 Environment means different things to different people. To some it may refer to a village, a city, a country or the whole world ‘environ ‘and 'mint' meaning ‘encircle’ or ‘all round’. Environment is a complex of many variables, which surrounds man as well as the living organisms.

**Definition;**

All the conditions, circumstances, and influences surrounding and affecting the development of an organism or group of organisms

He study creates awareness among the people to know about various renewable and non renewable resources for a region.

* It provides the knowledge about ecological systems and cause and effect relationships.
* It enables one to evaluate alternative responses to environment issues before deciding alternative course of action.
* The study exposes the problems of over population, health, hygiene, etc.
* The study enables theoretical knowledge into practice and the multiple uses of environment.
* **Scope of Environment Studies**

 Environmental studies discipline has multiple and multilevel scope. This study is important and necessary not only for children but also for everyone:

1. The study creates awareness among the people to know about various renewable and non renewable resources for a region.
2. It provides the knowledge about ecological systems and cause and effect relationships.
3. It enables one to evaluate alternative responses to environment issues before deciding alternative course of action.
4. The study exposes the problems of over population, health, hygiene, etc.
5. The study enables theoretical knowledge into practice and the multiple uses of environment.

IMPORTANCE

* World population is increasing at an alarming rate especially in developing countries.
* The natural resources endowment in the earth is limited.
* The unplanned exploitation of natural resources lead to pollution of all types and at all levels.
* Education and training are needed to save the biodiversity and species extinction.
* The urban areas, coupled with industries, are major sources of pollution.

The importance of Environmental Economics lies on the fact that absolutely all economic activities performed by mankind are intrinsically linked to the environment, which provides all sorts of resources and also acts as a sink for our waste. Therefore, in order to keep paving the path of economic growth, it is mandatory to acknowledge, value, and consider the goods and services provided by

the Earth’s environmental systems, to sustain the supply of resources and energy without breaking the equilibrium of the fragile natural environment. Environmental Economics combines the study of environmental science with its interactions with human economic markets. It encompasses the understanding of the capacities and vulnerabilities of the planet, to adapt importance of environmental economics environmental Economics combines the study of environmental science with its interactions with human economic markets. It encompasses the understanding of the capacities and vulnerabilities of the planet, to adapt and respond to different challenges; considering natural resources.

**Greenhouse effect**

The greenhouse effect is the process thanks to which Earth has a higher temperature than it would have without it. The gases that radiate heat also known as greenhouse gases absorb the energy radiated out by the Earth and reflect a part of it back to Earth. Of all the energy that the Earth receives from the Sun, a part of it around 26% is reflected back to space by the atmosphere and clouds. Some part of it is absorbed by the around 19%.

The rest hits the ground and heats the surface of the Earth. This absorbed energy is radiated out of the earth in the form of Infrared Waves. These IR waves warm the atmosphere above the Earth. The atmosphere again radiates this energy it received from the Earth both upwards and downwards. The energy sent downwards results in a higher equilibrium temperature that if greenhouse gases were absent. This greenhouse effect is essential to supporting life on Earth.

**The greenhouse gases responsible for the greenhouse effect are:**

* Water Vapor
* Carbon Dioxide
* Methane
* Ozone

Global Warming refers to the increasing temperature of the Earth’s climate system and its related effects. Scientific evidence has conclusively proven that the Earth’s temperature is in fact rising and has risen by 0.85oC. This has an impact has affected different regions differently. The effects include rising sea levels, retreating glaciers, loss of sea ice in the poles, warming global temperatures, changing precipitation, expansion of deserts etc.

This raises significant threats for humans such as food security from decreasing crop yields, submergence of a low lying area due to the rising sea. To prevent irreversible damage to the delicate ecosystems on Earth, scientists have decided that the global warming should be limited to a maximum of 2.0oC relative to pre-industrial levels. Greenhouse effect plays an important role in the rising temperature. And hence to restrict global warming we need to limit the greenhouse effect and the gaseous emissions that cause the greenhouse effect.

The excessive burning of fossil fuels such as petrol, coal etc. has resulted in an increase in the number of greenhouse gases in the atmosphere resulting in a phenomenon known as Global Warming. This is an increase in the ambient temperature of Earth which will negatively affect life on Earth.

* RENEWABLE RESOURCES

 These resources are used over and over as they are ‘flow’ in nature .The perpetual harvest of these dynamic resources are dependent upon proper planning and management. They include water, soil fertility, forest, wild animals, human beings etc.

* NON RENEWABLE RESOURCES

The se are finite in nature and their exploitation lead to exhaustion of supplies .They in no hope for replacement of these materials. They include minerals, fossil fuels, and species of wildlife etc.

**FOREST RESOURCES**

Forests are one of the important renewable natural resources.

* Uses of Forests
* Provides raw materials for a variety of industries.
* Provides fuel wood.
* Provides employment.
* Forest serves as a habitat.
* Serves as an important biodiversity.
* Moderates Greenhouse effect.
* Regulates stream flow.

**Causes of Deforestation**

* Slash-and-Burn Farming.
* Commercial Agriculture.
* Cattle Ranching and Livestock Grazing.
* Mining and Petroleum Exploration.
* Infrastructure Development.

**WATER RESOURCES**

* Surface Water Resources.
* Groundwater Resources.
* Water Resources in Tamil Nadu.
* Groundwater Development.

MINERAL RESOURCES

 Mineral resources are one of the important non-renewable natural resources.

Uses of Mineral Resources

1. Metallic Minerals
* Iron
* Copper
* Aluminum
* Lead
* Zinc
* Silver
* Gold
* Other Metallic Minerals
1. Non-metallic Minerals
* Gem Stones
* Asbestos
* Barite
* Graphite
* Phosphate
* Sand

C) Mineral Fuels

* Coal
* Petroleum

ENVIRONMENTAL ECONOMICS

 Environmental pollution could be termed as ecological crisis which has posed threat to the properties of the basic amenities such as air, water and soil. Earlier, they were undisturbed, uncontaminated and supported every life to frame a joyful and peaceful life. But now, due to man’s activities the environment is no more pleasant.

 Man’s activities have resulted in the following pollution of the basic amenities.

**AIR POLLUTION**

 Is defined as the excessive concentration of foreign material which affects the health of individuals and also causes damage to the property.

**Classification of pollutants**

Natural contaminants

* Aerosols(particulates)
* Gases and vapours

**Primary Pollutants**

* Finer particles
* Coarse particles
* Sulphur compounds
* Oxides of nitrogen
* Carbon monoxide
* Halogen compounds
* Organic compounds
* Radioactive compounds.

**Secondary Air Pollutants**

* Ozone
* Formaldehyde
* PAN(Proxy Acetyl Nitrate)
* Photochemical smog and
* Formation of acid mists.

**Sources of Air Pollutants**

* Natural sources
* Anthropogenic sources or man made sources.

**Deforestation:**

 It refers to indiscriminate cutting of plants, trees and clearing of forest there by disturbing the balance between carbon dioxide and oxygen in the nature which results in global warming.

**Population Explosion:**

 Thomas Malthus in 1798 has published an essay ‘on the principle of population’ and has predicted that it will affect the future improvement of the society.

Burning of Fossil Fuels:

 Fossil fuels such as coal, oil and natural gas have been reported to meet 97% of the energy need in house and factories.

Vehicular Emissions:

 The automobiles such as two, three and four wheelers, heavy vehicles, aircrafts result in exhaust comprising mainly carbon monoxide, nitrogen oxides, hydrocarbons and particulate lead.

Rapid Industrialization:

 Air pollutants are released at a higher rate from various industries such as cement, petroleum refineries, mining, cotton mills, thermal power plant, atomic power station, metallurgical plants and smelters.

Agricultural Activities:-

 Application of pesticides, insecticides, herbicides results in are pollution as these poisonous substances are carried away by wind to different places affecting human health and also plants and animals.

War:

 War results in the in the usage of sophisticated explosives. The radioactive rays following the nuclear explosions and from atomic reactors have resulted in the air pollution to a greater extent.

Effect of Air Pollutants on Human Health

 Effects of Air Pollution.

* NO x
* SO 2
* CO
* NH 3
* Halogens
* Hydrocarbons
* Particulate Pollutants
* Radiation

**Effects of Air pollutants on Plants**

* NOX
* SO
* CO
* Hydrocarbons
* Radiation

**Effect of Air Pollutants on Materials**

* NO x
* SO2
* Hydrocarbon
* Particulate Pollutants
* Radiation
* Control of Air Pollutants
* Zoning
* Air Pollution control at source
* Installation of control
* Control of Gaseous Pollutants
* Vegetation cover
* Environmental legislation
* Awareness

WATER POLLUTION

 Water pollution refers to any adverse change in conditions or composition of the water, which may harmfully affect the life activities of man and domesticated species.

* Natural process

Decomposition of wastes which occurs in the main water resources.

* Anthropogenic processes
* Domestic sewage
* Industrial effluents
* Agricultural waste
* Micro organisms
* Plank tonic blooms
* Synthetic detergents
* Heavy metals
* Temperature
* Radioactivity
* Silt and oil

**Control of Water Pollution**

 Treatment of polluted water

* Primary Treatment
* Secondary Treatment
* Tertiary Treatment

 SOIL POLLUTION

 Soil pollution may be defined as direct or indirect alteration of the physical, chemical, biological and radioactive properties of the soil due to the deposition of domestic, community, industrial, vehicular and hazardous wastes.

 Sources of soil pollution:

* Synthetic Fertilizers
* Pesticide

 EFFECTS OF SOIL POLLUTION

* Effects of Industrial Effluents
* Effects of Urban Wastes

 Control of Soil Pollution

* Amelioration of Acidic Soil
* Amelioration of Saline and Alkali Soil
* Alkali soli reclamation
* Prevention of solid waste dumping
* Usage of bio-fertilizers and bio-pesticides

 MARINE POLLUTION

 It is defined as the discharge of waste substances into the sea posing threat to living resources, hazardous to human health, hindrance to fishery and impairment of quality of sea water. Marine pollution is associated with the change in physical, chemical and biological conditions the sea water.

 Main Pollutants in the sea

* Pathogens
* Sediments
* Soil wastes
* Heat
* Freshwater
* Brine
* Toxic in-organics
* Toxic organics
* Petroleum and oil
* Nutrients
* Radioactive materials
* Oxygen demanding material
* Acids and bases

 Sources of Pollutants

* Marine commerce
* Industry
* Electrical power generation
* Other non-industrial wastes
* Recreation
* Construction

 Impacts of Marine pollution

* Over burden of nutrients result in eutrophication
* Another nuisance is foaming agent used in synthetic detergents
* The danger of sewage lies in harmful bacteria which causes typhoid, dysentery, diarrhoea, cholera etc.,
* Along with sewage the man made chemicals such as pesticides, fertilizers, heavy metals results in marine pollution.
* Heavy metals such as Cr, Cd, Hg, BP, and Ni also pose dangers and major health hazards.

 Control of Oil Pollution

 Physical Methods:

* Skimming: The oil could removed from the surface.
* Oil can be removed by suitable absorbent Eg: saw dust, polyurethane foam.

 Chemical Methods:

* Evaporation, emulsification, absorbents, burning of oil are effective methods.
* Super bug has been proved to be effective to clean up the oil pollution.

 NOISE POLLUTION

 The term ‘noise’ is derived from the Latin word ‘nausea’. Noise could be defined as unwanted, unpleasant or disagreeable sound that causes discomfort.

The types of noises can be categorized on the basis of source.

* Industrial Noise
* Transport Noise
* Neighbourhood Noise

 Characteristics of Sound

* The frequency of sound waves
* The intensity of sound waves
* The time of exposure of sound waves
* Intermittence of sound waves

 Effects of Noise pollution

* It causes muscle contraction leading to nervous break down and tension.
* It may cause damage to heart, brain, kidneys, liver and also produce emotional disturbances.
* Impulsive noise also causes psychological and pathological disorders.

 Control of Noise Pollution

* Change in design and operation of machines, vibration control, sound proof cabins and sound absorbing materials can help in the reduction of noise.
* People can be educated through radio, television, newsreels in cinema halls about noise pollution.
* Government should pass the ‘Noise pollution Control Act’ to meet special Indian condition.

ENVIRONMENTAL QUALITY AS A PUBLIC GOOD

* People in society consume all possible goods and services. At the one end of array of goods and services, we have pure public goods.
* Pure private goods include most of personal services like automobile and TV repairing services, laundering our garments etc.,
* At the extreme end of pure public good is the national defence service.
* The environmental quality near the extreme end of public goods in the array of private-public good continuum
* Like national defence, once a given level of environmental quality is provided, it can be enjoyed by all in society at a zero cost.
* A pure public good may be defied as the limiting, or extreme, case of externalities. That is, a public good is one that is enjoyed in equal amounts by everyone in society.
* The basic problem of allocation is determination of the socially optimum level of environmental quality in all relevant dimensions.
* The existence of public goods implies that an individual takes the position of a free rider. Once the public good exists or once it is to cost of production.
* Public goods require government activity. Actually, there are wide range of potential government activities. If the public good “environmental quality” cannot be allocated through the market mechanism, three problems arise, viz.,
* What quantity of the public good “environmental quality” should be provided.
* By which procedures this target is determined.
* By which fulfilment of the target can be best reached
* A social welfare function is given to the policy markers, including environmental quality, as an argent variable. Environmental quality is determined by maximising this function.
* Through pragmatic approach, the government may study the costs and benefits of environmental policy and can use this information to determine the desired environmental quality.
* The government may try to base its target values on individual preferences and assign individualised prices for environmental quality.
* Since the Lindhal solution dose not guarantee that individual preferences are truly revealed, other mechanisms of social choice are sought

**Forest degradation**:

 The forests are tropical and temperate forests. In the former category we have equatorial and monsoon forest, later category are deciduous and coniferous forests.

 The principal causes for deforestation are:

 \*logging and timbering as an industry

 \*Overgrazing by cattle

 \*natural forest fires

 \*felling of trees for fuel.

Effects of deforestation

 \*mechanical friction effect

 \*cloud and fog stripping

 \*condensation nuclei

 \*production of soil

 \*destruction of micro climate

Growing awareness in India

 #CHIPCO movement

 #APPIKO movement

**ENVIRONMENTAL PROBLEMS IN DEVELOPED AND UNDER DEVELOPED COUNTRIES**

 \*Environmental pollution

 \*Global warming

 \*Acid rain

 \*Climate change

 \*Natural calamities

 \*Power crisis

 \*Green house effect.

**Cost-benefit analysis**

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

Cost-benefit analysis provides an organizational framework for identifying, quantifying, and comparing the costs and benefits (measured in dollars) of a proposed policy action. The final decision is informed (though not necessarily determined) by a comparison of the total costs and benefits. The benefits of environmental regulations can include, for example, reduced human and wildlife mortality, improved water quality, species preservation, and better recreation opportunities. The costs are usually reflected in higher prices for consumer goods and/or higher taxes. The latter are market effects readily measured in dollars, while the former are nonmarket effects for which dollar values are not available. In addition to complicating the practice of cost-benefit analysis (dollar values for the nonmarket effects must be inferred rather than directly observed) this raises ethical issues.

**Greenhouse effect**

The greenhouse effect is the process thanks to which Earth has a higher temperature than it would have without it. The gases that radiate heat also known as greenhouse gases absorb the energy radiated out by the Earth and reflect a part of it back to Earth. Of all the energy that the Earth receives from the Sun, a part of it around 26% is reflected back to space by the atmosphere and clouds. Some part of it is absorbed by the [atmosphere](https://byjus.com/physics/atmosphere/), around 19%.

The rest hits the ground and heats the surface of the Earth. This absorbed energy is radiated out of the earth in the form of Infrared Waves. These IR waves warm the atmosphere above the Earth. The atmosphere again radiates this energy it received from the Earth both upwards and downwards. The energy sent downwards results in a higher equilibrium temperature that if greenhouse gases were absent. This greenhouse effect is essential to supporting life on Earth.

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## Greenhouse Effect and Global Warming

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This raises significant threats for humans such as food security from decreasing crop yields, submergence of a low lying area due to the rising sea. To prevent irreversible damage to the delicate ecosystems on Earth, scientists have decided that the global warming should be limited to a maximum of 2.0oC relative to pre-industrial levels. Greenhouse effect plays an important role in the rising temperature. And hence to restrict global warming we need to limit the greenhouse effect and the gaseous emissions that cause the greenhouse effect.

The excessive burning of fossil fuels such as petrol, coal etc. has resulted in an increase in the number of greenhouse gases in the atmosphere resulting in a phenomenon known as Global Warming. This is an increase in the ambient temperature of Earth which will negatively affect life on Earth.

## Pareto Optimality

We now turn to the concept of Pareto Optimality, named after the economist Wilfred Pareto. It is a concept that you will find recurring frequently in the economics literature. The main proposition of Pareto Optimality can be summed up as follows.

**An economy is in a Pareto Optimal state when no further changes in the economy can make one person better off without at the same time making another worse off.**

You may immediately recognize that this is the socially optimal outcome achieved by a perfectly competitive market referred to above. It can be shown that an economy will be Pareto Optimal when the economy is perfectly competitive and in a state of static general equilibrium. The intuitive case for this is based on the fact that prices reflect economic values in a competitive market. If a unit of goods or services could produce more or bring greater satisfaction in some activity other than its present use, someone would have been willing to bid up its price, and it would have been attracted to the new use.

When this price system is in equilibrium, the marginal revenue product, the opportunity cost, and the price of a resource or asset will all be equal. Each unit of every good and service is in its most productive use or best consumption use. No transfer of resources could result in greater output or satisfaction.

This can be examined more formally in terms of three criteria that have to be met for a market equilibrium to result in Pareto Optimality. These are that there should be: exchange efficiency, production efficiency and output efficiency.

**Exchange efficiency**

Exchange efficiency occurs when, for any given bundle of goods, it is not possible to redistribute them such that the utility (welfare) of one consumer is raised without reducing the utility (welfare) of another consumer.

A simple example of this is where there are two individuals, one with a loaf of bread, the other with a block of cheese. Both can be made better off by exchanging bread for cheese. An efficient exchange system will allow exchange of bread and cheese to take place until neither party can be made better off without one of them becoming worse off.

In a multi-product, multi-consumer economy, exchange is far more complex and involves the use of money to facilitate exchange. However, the principle is the same. So long as products can be reallocated to make one person better off without making another worse off, the economy is operating sub-optimally from the point of view of exchange efficiency. In a perfectly competitive market, exchange will occur until this criterion is met.

Exchange efficiency alone does not necessarily result in Pareto Optimality. This is because it relates only to a specific bundle of goods. It may be possible to make one or more individuals even better off - without making any one else worse off - by altering the bundle of goods produced in the economy. This could involve raising the total volume of goods produced, as well as altering the combination of goods produced.

**Production efficiency**

Production efficiency occurs when the available factors of production are allocated between products in such a way that it is not possible to reallocate the production factors so as to raise the output of one product without reducing the output of another product.

This is analogous to technical or production efficiency at the level of the firm. What is being said here is that there are many situations in which it is possible to raise the total output in an economy by simply reallocating factors of production at no additional cost. This is because factors of production are more productive in some uses than they are in others. In a competitive economy, producers bid for factors of production until they are reallocated to their most productive use.

For example, if there is a lot of unproductive, low-wage labor employed in the agricultural sector and labor shortages in the industrial sector where labor productivity is potentially high, factory owners will bid up the price of labor and draw labor from the agricultural sector into the industrial sector. This could significantly raise output in the industrial sector without having a negative impact on output in the agricultural sector. So long as factors of production can be redistributed in a way that increases the output of one product without reducing the output of others, the economy is operating sub-optimally in terms of production efficiency.

**Output efficiency**

Output efficiency occurs where the combination of products actually produced is such that there is no alternative combination of products that would raise the welfare of one consumer without reducing the welfare of another.

Both the exchange efficiency and the production efficiency criteria must hold in order for this criterion to be met. The combination of outputs produced according to this criterion is distributed between consumers according to the exchange efficiency criterion, and the economy is operating with production efficiency.

Pareto Optimality is the result of rational economic behavior on the part of producers, consumers and owners of factors of production in a perfectly competitive economy. Although we don't have the scope to examine the underlying theory here it can be shown that Pareto Optimality will be achieved if all markets are perfectly competitive and in equilibrium.

It is important to realize that, whilst Pareto Optimality is the outcome in an economy that meets each of the three efficiency criteria listed earlier, this does not mean that there is only one 'optimal' allocation of resources. A Pareto efficient economy results in the maximization of aggregate economic welfare for a given distribution of income and a specific set of consumer preferences. A shift in income distribution changes the incomes of individual consumers. As their incomes change, so too will their preferences, as their demand curves for various products shift to the left or right. This will result in a different equilibrium point in the various markets that make up the economy. Every alternative distribution of income or set of preferences is characterized by a different Pareto Optimum. Thus, since there is an infinite number of different ways in which income can be distributed, there is also an infinite number of different Pareto Optimal equilibriums.

Obviously, in practice, no economy can be expected to attain the Pareto Optimum position. Moreover, the Pareto principle is of little practical use as a policy tool since it is rarely possible to devise a policy that makes someone better off without making someone else worse off. Nevertheless, it is an important concept in the neo-classical tradition of economics and integrates much of the theory. It is also a standard against which economists can explore the real world, where making one person better off almost invariably means making someone else worse off.

# Market Failures, Public Goods, and Externalities

**Definition of Market Failure** This occurs when there is an inefficient allocation of resources in a free market. Market failure can occur due to a variety of reasons, such as monopoly (higher prices and less output), negative externalities (over-consumed) and public goods (usually not provided in a free market)

#### Types of market failure:

1. [Positive externalities](https://www.economicshelp.org/micro-economic-essays/marketfailure/positive-externality/) – Goods/services which give benefit to a third party, e.g. less congestion from cycling
2. [Negative externalities](https://www.economicshelp.org/micro-economic-essays/marketfailure/negative-externality/) – Goods/services which impose cost on a third party, e.g. cancer from passive smoking
3. [Merit goods](https://www.economicshelp.org/micro-economic-essays/marketfailure/merit-demerit-goods/) – People underestimate the benefit of good, e.g. education
4. [Demerit goods](https://www.economicshelp.org/blog/glossary/demerit-goods/) – People underestimate the costs of good, e.g. smoking
5. [Public Goods](https://www.economicshelp.org/micro-economic-essays/marketfailure/public-goods/) – Goods which are non-rival and non-excludable – e.g. police, national defense.
6. [Monopoly Power](https://www.economicshelp.org/microessays/markets/monopoly/) – when a firm controls the market and can set higher prices.
7. [Inequality](https://www.economicshelp.org/blog/310/economics/rising-inequality-in-the-uk/) [– unfair distribution of resources in free market](https://www.economicshelp.org/blog/glossary/factor-immobility/)
8. [Factor Immobility](https://www.economicshelp.org/blog/glossary/factor-immobility/) – E.g. geographical / occupational immobility
9. [Agriculture](https://www.economicshelp.org/blog/4977/economics/problems-of-agriculture-market-failure/) – Agriculture is often subject to market failure – due to volatile prices and externalities.
10. [Information failure](https://www.economicshelp.org/blog/glossary/information-failure/) – where there is a lack of information to make an informed choice.
11. [Principal-agent problem](https://www.economicshelp.org/blog/26604/economics/principal-agent-problem/) – Two agents with different objectives and information asymmetries

#### Key Terms in Market Failure

* **Externalities**:  These occur when a third party is affected by the decisions and actions of others.
* **Social benefit**:  the total benefit to society =
Private Marginal Benefit (PMB) + External Marginal  Benefit (XMB)
* **Social Cost**: is the total cost to society =
Private Marginal Cost (PMC) + External Marginal Cost (XMC
* **Social Efficiency**: This occurs when resources are utilized in the most efficient way. This will occur at an output where social marginal cost (SMC) = Social Marginal Benefit. (SMB)

# Market Failures, Public Goods, and Externalities

Market failure is the economic situation defined by an inefficient distribution of goods and services in the free market. Furthermore, the individual incentives for rational behavior do not lead to rational outcomes for the group. Put another way, each individual makes the correct decision for him/herself, but those prove to be the wrong decisions for the group. In traditional microeconomics, this is shown as a steady state disequilibrium in which the quantity supplied does not equal the quantity demanded….

Positive externalities are benefits that are infeasible to charge to provide; negative externalities are costs that are infeasible to charge to not provide. Ordinarily, as Adam Smith explained, selfishness leads markets to produce whatever people want; to get rich, you have to sell what the public is eager to buy. Externalities undermine the social benefits of individual selfishness. If selfish consumers do not have to pay producers for benefits, they will not pay; and if selfish producers are not paid, they will not produce. A valuable product fails to appear. The problem, as David Friedman aptly explains, “is not that one person pays for what someone else gets but that nobody pays and nobody gets, even though the good is worth more than it would cost to produce.”…

Research and development is a standard example of a positive externality, air pollution of a negative externality….

Most economic arguments for government intervention are based on the idea that the marketplace cannot provide **public goods** or handle **externalities**. Public health and welfare programs, education, roads, research and development, national and domestic security, and a clean environment all have been labeled public goods….

**Externalities** occur when one person’s actions affect another person’s well-being and the relevant costs and benefits are not reflected in market prices. A positive externality arises when my neighbors benefit from my cleaning up my yard. If I cannot charge them for these benefits, I will not clean the yard as often as they would like. (Note that the free-rider problem and positive externalities are two sides of the same coin.) A negative externality arises when one person’s actions harm another. When polluting, factory owners may not consider the costs that pollution imposes on others….

**Acid rain**

acid rain, or acid deposition, is a broad term that includes any form of precipitation that contains acidic components, such as sulfuric acid or nitric acid, according to the [Environmental Protection Agency](https://www.epa.gov/acidrain/what-acid-rain) (EPA).

The precipitation is not necessarily wet or liquid; the definition includes dust, gasses, rain, snow, fog and hail. The type of acid rain that contains water is called wet deposition. Acid rain formed with dust or gasses is called dry deposition.

## Causes

The term acid rain was coined in 1852 by Scottish chemist [Robert Angus Smith](http://www.rsc.org/diversity/175-faces/all-faces/robert-angus-smith/), according to the Royal Society of Chemistry, which calls him the "father of acid rain." Smith decided on the term while examining rainwater chemistry near industrial cities in England and Scotland. He wrote about his findings in 1872 in the book "[Air and Rain: The Beginnings of a Chemical Climatology](https://archive.org/details/airrainbeginning00smitiala)."

## Effects

Acid rain affects nearly everything. Plants, soil, trees, buildings and even statues can be transformed by the precipitation.

Acid rain has been found to be very hard on trees. It weakens them by washing away the protective film on leaves, and it stunts growth. A paper released in the online version of the journal of Environmental Science and Technology in 2005 showed evidence of [acid rain stunting tree growth](https://www.livescience.com/6899-acid-rain-stunts-tree-growth.html).

"By providing the only preserved soil in the world collected before the acid rain era, the Russians helped our international team track tree growth for the first time with changes in soil from acid rain," said Greg Lawrence, a U.S. Geological Survey scientist who headed the effort. "We've known that acid rain acidifies surface waters, but this is the first time we've been able to compare and track tree growth in forests that include soil changes due to acid rain."

Acid rain can also change the composition of soil and bodies of water, making them uninhabitable for local animals and plants. For example, healthy lakes have a pH of 6.5 or higher. As acid rain raises the level of acidity, fish tend to die off. Most fish species can't survive a water pH of below 5. When the pH becomes a 4, the lake is considered dead, according to [National Atmospheric Deposition Program](http://nadp.slh.wisc.edu/educ/acidrain.aspx).

It can additionally deteriorate limestone and marble buildings and monuments, like gravestones.

## Solutions

There are several solutions to stopping manmade acid rain. Regulating the emissions coming from vehicles and buildings is an important step, according to the EPA. This can be done by restricting the use of fossil fuels and focusing on more sustainable energy sources such as solar and wind power.

Also, each person can do their part by reducing their vehicle use. Using public transportation, walking, riding a bike or carpooling is a good start, according to the EPA. People can also reduce their use of electricity, which is widely created with fossil fuels, or switch to a solar plan. Many electricity companies offer solar packages to their customers that require no installation and low costs.

**THE ENVIRONMENT (PROTECTION) ACT, 1986 (EPA)**

**Introduction**

The Environment (Protection) Act  was enacted in the year 1986. It was enacted with the main objective to provide the protection and improvement of environment and for matters connected therewith. The Act is one of the most comprehensive legislations with pretext to protection and improvement of environment.

The Constitution of India also provides for the protection of the environment. Article 48A of the Constitution specifies that the State shall endeavor to protect and improve the environment and to safeguard the forests and wildlife of the country. Article 51 A further provides that every citizen shall protect the environment.

**Premises of the Act**

It is now generally accepted that environment is threatened by a wide variety of human activities ranging from the instinctive drive to reproduce its kind to the restless urge of improving the standards of living, development of technological solutions to this end, the vast amount of waste, both natural and chemical, that these advances produce. Paradoxically, this urge to grow and develop, which was initially uncontrolled is now widely perceived to be threatening as it results in the depletion of both living and non-living natural resources and life support systems. The air, water, land, living creatures as well as the environment in general is becoming polluted at an alarming rate that needs to be controlled and curbed as soon as possible.

The 1986 Act was enacted in this spirit. From time to time various legislations have been enacted in India for this purpose. However, all legislations prior to the 1986 Act have been specific relating to precise aspects of environmental pollution. However, the 1986 Act was a general legislation enacted under Article 253 (Legislation for giving effect to international agreements.—Notwithstanding anything in the foregoing provisions of this Chapter, Parliament has power to make any law for the whole or any part of the territory of India for implementing any treaty, agreement or convention with any other country or countries or any decision made at any international conference, association or other body) of the Constitution, pursuant to the international obligations of India. India was a signatory to the Stockholm Conference of 1972 where the world community had resolved to protect and enhance the environment.

The United Nations conference on human environment, held in Stockholm in June 1972, proclaimed that “Man is both creator and molder of his environment, which gives him physical sustenance and affords him the opportunity for intellectual, moral, social and spiritual growth. In the long and tortuous evolution of the human race on this planet a stage has reached when through the rapid acceleration of science and technology man has acquired the power to transform his environment in countless ways and on unprecedented scale. Both aspects of man’s environment, the natural and man made are essential to his well being and to the enjoyment of basic human rights even the right to life itself”.

Objectives

As mentioned earlier, the main objective of the Act was to provide the protection and improvement of environment and for matters connected therewith. Other objectives of implementation of the EPA are:

* To implement the decisions made at the UN Conference on Human Environment held at Stockholm in June, 1972.
* To enact a general law on the areas of environmental protection which were left uncovered by existing laws. The existing laws were more specific in nature and concentrated on a more specific type of pollution and specific categories of hazardous substances rather than on general problems that chiefly caused major environmental hazards.
* To co-ordinate activities of the various regulatory agencies under the existing laws
* To provide for the creation of an authority or authorities for environmental protection
* To provide a deterrent punishment to those who endanger human environment, safety and health.

**Scope and Applicability**

The Environment (Protection) Act is applicable to whole of India including Jammu & Kashmir. It came into force on November 19, 1986.

**Definitions**

Section 2 of the EPA deals with definitions. Some important definitions provided in the Section are:

Section 2 (a) “Environment” includes water, air, and land and the interrelationship that exists among and between water, air and land and human beings, other living creatures, plants, micro-organism and property. This definition is not exhaustive but an inclusive one.

Section 2 (b) “Environmental Pollutant” means any solid, liquid or gaseous substance present in such concentration as may be, or tend to be injurious to environment.

Section 2 (c) “Environmental Pollution” means the presence in the environment of any environmental pollutant6 . This implies the imbalance in environment. The materials or substances when after mixing in air, water or land alters their properties in such manner, that the very use of all or any of the air water and land by man and any other living organism becomes lethal and dangerous for health.

Section 2 (e) “Hazardous Substance” means any substance or preparation which, by reasons of its chemical or physic-chemical properties or handling, is liable to cause harm to human beings, other living creatures, plants, micro-organism, property or environment.

**Powers of Central Government to take measures to Protect and Improve Environment** According to the provisions of the Act, the Central Government shall have the power to take all such measures as it deems necessary or expedient for the purpose of protecting and improving the quality of the environment and preventing controlling and abating environmental pollution. Such measures may include measures with respect to all or any of the following matters, namely: a) co-ordination of actions by the State Governments, officers and other authorities-

(a) under this Act, or the rules made there under, or

(b) under any other law for the time being in force which is relatable to the objects of this Act;

1. b) planning and execution of a nation-wide programmed for the prevention, control and abatement of environmental pollution;
2. c) laying down standards for the quality of environment in its various aspects;
3. d) laying down standards for emission or discharge of environmental pollutants from various sources whatsoever: Provided that different standards for emission or discharge may be laid down under this clause from different sources having regard to the quality or composition of the emission or discharge of environmental pollutants from such sources;
4. e) restriction of areas in which any industries, operations or processes or class of industries, operations or processes shall not be carried out or shall be carried out subject to certain safeguards;
5. f) laying down procedures and safeguards for the prevention of accidents which may cause environmental pollution and remedial measures for such accidents;
6. g) laying down procedures and safeguards for the handling of hazardous substances;
7. h) examination of such manufacturing processes, materials and substances as are likely to cause environmental pollution;
8. i) carrying out and sponsoring investigations and research relating to problems of environmental pollution;
9. j) inspection of any premises, plant, equipment, machinery, manufacturing or other processes, materials or substances and giving, by order, of such directions to such authorities, officers or persons as it may consider necessary to take steps for the prevention, control and abatement of environmental pollution;
10. k) establishment or recognition of environmental laboratories and institutes to carry out the functions entrusted to such environmental laboratories and institutes under this Act;
11. l) collection and dissemination of information in respect of matters relating to environmental pollution;
12. m) preparation of manuals, codes or guides relating to the prevention, control and abatement of environmental pollution;
13. n) such other matters as the Central Government deems necessary or expedient for the purpose of securing the effective implementation of the provisions of this Act.

The Central Government may, if it considers it necessary or expedient so to do for the purpose of this Act, by order, published in the Official  Gazette, constitute an authority or authorities by such name or names as may be specified in the order for the purpose of exercising and performing such of the powers and functions (including the power to issue directions under section (5) of the Central Government under this Act and for taking measures with respect to such of the matters referred to in sub-section (2) as may be mentioned in the order and subject to the supervision and control of the Central Government and the provisions of such order, such authority or authorities may exercise and powers or perform the functions or take the measures so mentioned in the order as if such authority or authorities had been empowered by this Act to exercise those powers or perform those functions or take such measures.

As considerable adverse environment impact has been caused due to degradation of the environment with excessive soil erosion and water and air pollution due to certain development activities therefore it is necessary to protect the environment. This can be achieved only by careful assessment of a project proposed to be located in any area, on the basis of an environment impact assessment and environment management plan for the prevention, elimination or mitigation of the adverse impacts, right from the inception stage of the project.

Ocean deflection

Coastal currents are affected by local winds. Surface ocean currents, which occur on the open ocean, are driven by a complex global wind system. To understand the effects of winds on ocean currents, one first needs to understand the Carioles force and the Ekman spiral.

**Carioles Effect**

If the Earth did not rotate and remained stationary, the atmosphere would circulate between the poles (high pressure areas) and the equator (a low pressure area) in a simple back-and-forth pattern. But because the Earth rotates, circulating air is deflected. Instead of circulating in a straight pattern, the air deflects toward the right in the Northern Hemisphere and toward the left in the Southern Hemisphere, resulting in curved paths. This deflection is called the Carioles effect. It is named after the French mathematician Gaspard Gustavo de Carioles (1792-1843), who studied the transfer of energy in rotating systems like waterwheels. (Ross, 1995).

Ecosystem services

Document Actions

Ecosystem services are the direct and indirect contributions of ecosystems to human well-being (TEEB D0). They support directly or indirectly our survival and quality of life.

According to TEEB, ecosystem services can be categorized in four main types:

**Provisioning services** are the products obtained from ecosystems such as food, fresh water, wood, fiber, genetic resources and medicines.

**Regulating services** are defined as the benefits obtained from the regulation of ecosystem processes such as climate regulation, natural hazard regulation, water purification and waste management, pollination or pest control.

**Habitat services** highlight the importance of ecosystems to provide habitat for migratory species and to maintain the viability of gene-pools.

**Cultural services** include non-material benefits that people obtain from ecosystems such as spiritual enrichment, intellectual development, recreation and aesthetic values.

 Some **examples** of key services provided by ecosystems are described below:

**Climate regulation** is one of the most important ecosystem services both globally and on a European scale. European ecosystems play a major role in climate regulation, since Europe’s terrestrial ecosystems represent a net carbon sink of some 7-12% of the 1995 human generated emissions of carbon. Peat soils contain the largest single store of carbon and Europe has large areas in its boreal and cool temperate zones. However, the climate regulating function of peat lands depends on land use and intensification (such as drainage and conversion to agriculture) and is likely to have profound impacts on the soil capacity to store carbon and on carbon emissions (great quantities of carbon are being emitted from drained peat lands).

**Water purification** by ecosystems has a high importance for Europe, because of the heavy pressure on water from a relatively densely populated region. Both vegetation and soil organisms have profound impacts on water movements: vegetation is a major factor in controlling floods, water flows and quality; vegetation cover in upstream watersheds can affect quantity, quality and variability of water supply; soil micro-organisms are important in water purification; and soil invertebrates influence soil structure, decreasing surface runoff. Forests, wetlands and protected areas with dedicated management actions often provide clean water at a much lower cost than man-made substitutes like water treatment plants.

**Pests and diseases** are regulated in ecosystems through the actions of predators and parasites as well as by the defense mechanisms of their prey. One example of these regulating services is provided by insectivorous birds in farms that use most of their land for agriculture.

**Soil biodiversity** is a major factor in soil formation, which supports a range of provisioning services such as food, fiber and fuel provision and is fundamental to soil fertility, being a highly important ecosystem service in Europe. In addition, a diverse soil community will help prevent loss of crops due to soil-borne pest diseases.

**Cultural services** provided by ecosystems are also very important to EU citizens. Evidence can be found in the scale of membership of conservation organizations. For example, in the United Kingdom the Royal Society for the Protection of Birds has a membership of over one million and an annual income of over £50 million.

Although most people associate them mainly with nature conservation and tourism, well managed protected areas can provide vital ecosystem services, such as water purification and retention, erosion control and reduced flooding; they support food and health security by maintaining crop diversity and species, play an important role in climate change adaptation and contribute to mitigation through the storage and sequestration of carbon.

A **new classification** of ecosystem services is under development at **international level**, the Common International Classification of Ecosystem Services (CICES) to facilitate integration of ecosystem services in environmental accounting.

At **EU level**, a conceptual framework for Mapping and Assessment of Ecosystems and their Services ([**MAES**](https://biodiversity.europa.eu/maes)) has been developed to steer a more harmonized approach to ecosystem and ecosystem services assessments across EU Member States.

# sustainable development

### "Sustainable development is development that meets the needs of the present, without compromising the ability of future generations to meet their own needs."

The concept of sustainable development can be interpreted in many different ways, but at its core is an approach to development that looks to balance different, and often competing, needs against an awareness of the environmental, social and economic limitations we face as a society.

All too often, development is driven by one particular need, without fully considering the wider or future impacts. We are already seeing the damage this kind of approach can cause, from large-scale financial crises caused by irresponsible banking, to changes in global climate resulting from our dependence on fossil fuel-based energy sources. The longer we pursue unsustainable development, the more frequent and severe its consequences are likely to become, which is why we need to take action now.

### So is it all just about the environment?

Living within our environmental limits is one of the central principles of sustainable development. One implication of not doing so is climate change.

But the focus of sustainable development is far broader than just the environment. It's also about ensuring a strong, healthy and just society. This means meeting the diverse needs of all people in existing and future communities, promoting personal wellbeing, social cohesion and inclusion, and creating equal opportunity.

### If sustainable development focuses on the future, does that mean we lose out now?

Not necessarily. Sustainable development is about finding better ways of doing things, both for the future and the present. We might need to change the way we work and live now, but this doesn't mean our quality of life will be reduced.

A sustainable development approach can bring many benefits in the short to medium term, for example:

Savings - As a result of SDC scrutiny, government has saved over £60m by improving efficiency across its estate.

Health & Transport - Instead of driving, switching to walking or cycling for short journeys will save you money, improve your health and is often just as quick and convenient.

Effects

The way we approach development affects everyone. The impacts of our decisions as a society have very real consequences for people's lives. Poor planning of communities, for example, reduces the quality of life for the people who live in them. (Relying on imports rather than growing food locally puts the UK at risk of food shortages.)

Sustainable development provides an approach to making better decisions on the issues that affect all of our lives. By incorporating health plans into the planning of new communities, for instance, we can ensure that residents have easy access to healthcare and leisure facilities. (By encouraging more sustainable food supply chains, we can ensure the UK has enough food for the long-term future.)

We all have a part to play. Small actions, taken collectively, can add up to real change. However, to achieve sustainability in the UK, we believe the Government needs to take the lead. The SDC's job is to help make this happen, and we do it through a mixture of scrutiny, advice and building organizational capacity for sustainable development.

# What is climate change?

Climate change is the rise in average surface temperatures on Earth, mostly due to the burning of fossil fuels.

### What are the causes of climate change?

The primary cause of climate change is the burning of fossil fuels, such as oil and coal, which emits greenhouse gases into the atmosphere—primarily carbon dioxide. Other human activities, such as agriculture and deforestation, also contribute to the proliferation of greenhouse gases that cause climate change.

While some quantities of these gases are a naturally occurring and critical part of Earth’s temperature control system, the atmospheric concentration of CO2 did not rise above 300 parts per million between the advent of human civilization roughly 10,000 years ago and 1900. Today it is at about 400 ppm, a level not reached in more than 400,000 years.

### What are the effects of climate change?

Even small increases in Earth’s temperature caused by climate change can have severe effects. The earth’s average temperature has gone up 1.4° F over the past century and is expected to rise as much as 11.5° F over the next. That might not seem like a lot, but the average temperature during the last Ice Age was about 4º F lower than it is today.

Rising sea levels due to the melting of the polar ice caps (again, caused by climate change) contribute to greater storm damage; warming ocean temperatures are associated with stronger and more frequent storms; additional rainfall, particularly during severe weather events, leads to flooding and other damage; an increase in the incidence and severity of wildfires threatens habitats, homes, and lives; and heat waves contribute to human deaths and other consequences.

 **Marginal Costs & Benefits**

Marginal costs and benefits are a vital part of economics because they help to provide the relevant measurement of costs and benefits at a specific level of production and consumption. Even if we do not realize it, we all make decisions based on our marginal evaluations of the alternatives. In other words, ?what does it cost to produce one more unit?? or ?what will be the benefit of acquiring one more unit??

When necessary, individual and social marginal cost and benefit curves can be drawn separately in order to understand the different effects that a given action or policy might produce. In the case of pollution, the social cost is generally higher than the individual cost due to externalities. However, as a whole, an economic system is considered efficient at the point where marginal benefit and marginal cost intersect, or are equal. Similar to the production of goods and services, we can utilize the same information in order to analyze pollution abatement—in terms of the production or reduction of pollution—within the market. In order to assess environmental improvement, we must take cost into consideration. The cost of these improvements is often thought of as the direct cost of any action taken in order to improve the environment.

Marginal cost measures the change in cost over the change in quantity. For example, if a company is producing 10 units at $100 total cost, and steps up production to 11 units at $120 total cost, the marginal cost is $20 since only the last unit of production is measured in order to calculate marginal cost. Mathematically speaking, it is the derivative of the total cost. Marginal cost is an important measurement because it accounts for increasing or decreasing costs of production, which allows a company to evaluate how much they actually pay to ?produce? one more unit.

Initially, marginal cost will normally decrease through a short range, but increase as more is produced. Therefore the marginal cost curve is typically thought of to be upward sloping and can represent a wide range of activities that can reduce the effects of environmental externalities, like pollution. The key point is that most environmental improvements are not free; resources must be expended in order for any improvement to occur. For example, take an environment that has been polluted—while the initial unit of cleanup may be cheap, it becomes more and more expensive as additional cleanup is done. If cleanup is undertaken to point ?Q?, the total cost of the cleanup is P\*Q the white and light gray areas on the graph below.



Marginal benefit is similar to marginal cost in that it is a measurement of the change in benefits over the change in quantity. While marginal cost is measured on the producer’s end, marginal benefit is looked at from the consumer’s perspective—in this sense it can be thought of as the demand curve for environmental improvement, representing the tradeoff between environmental improvement and other things we could do with the resources needed to gain the improvement.

Again take an environment that has been polluted, the first unit of this pollution that is cleaned up has a very high benefit value to consumers. Each additional unit is valued at a somewhat lower level than each previous one because the overall pollution level continues to decrease. Once the pollution is reduced below a certain point, the marginal benefit of additional pollution control measures will be negligible because the environment itself is able to absorb a low level of pollution. Taking a look at the graph above, the total consumer benefit that is represented as the dark grey area, the net benefit is greatest when the quantity—?Q?—reaches the marginal benefit curve. We could increase total benefit by adding pollution controls beyond Q, but only with marginal costs (MC) greater than marginal benefits (MB), so it is no longer efficient to continue to increase the benefits.

**CONCLUSION**

With the passing of the Resource Management Act and the increasing
involvement of New Zealand in international environmental agreements
and information exchanges, the need for better environmental information is now widely recognised. The improvements are needed in three areas: national indicators, basic research and applied research.