Dr.K.Ushakumari,
Assistant Professor of Economics,
K.N.Govt. Arts College for women (A), Thanjavur.

I-M.A. ECONOMICS

ENVIRONMENTAL ECONOMICS

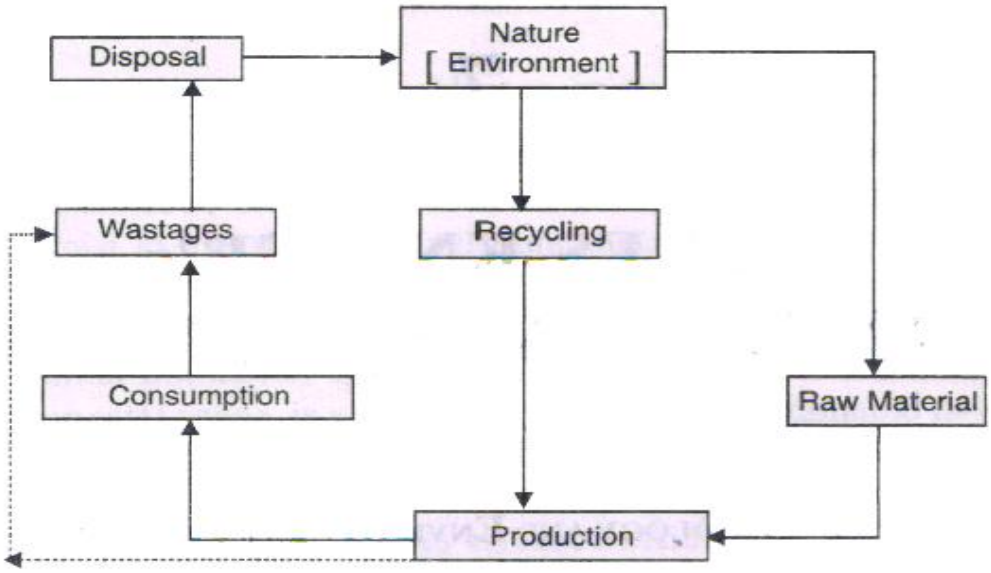
UNIT - I COURSE CODE: 18KP1ECELEC1

MATERIAL BALANCE PRINCIPLE:

The functions of an economy are related to production, consumption and distribution and distribution activities. These activities have a direct relation with nature, Nature provides raw materials to the economy for its production and consumption activities. Residuals from both the product ion and consumption processes usually remain and and they usually render disservices like killing fish, reducing public health, soiling and deteriorating buildings due to industrial pollution. Some wastes (residuals) from production and consumption activities are ultimately returned to nature. Remaining wastages are recycled. Further, all emission of residuals do not cause pollution damage because of assimilative capacity of the environment.

Ayres and Kneese[1], "If waste assimilative capacity of the environment is scarce, decentralized voluntary exchange process cannot be free of uncompensated technological external diseconomies unless all inputs are fully converted into outputs, with no unwanted material residuals along the way and all final outputs are utterly destroyed in the process of consumption. The model is explained in the Material Flow Diagram.

Material Flow Diagram



The material flow diagram implies that mass inputs must equal mass outputs for every process. Moreover, all resources extracted from the environment must eventually become unwanted wastes and pollutants. This means, among other things, externalities (market failures) associated with production and consumption of materials are actually pervasive an d they tend to grow in importance as the economy itself grows. Materials recycled can help but recycling is energy intensive and imperfect, so it cannot fully compensate.

Economics of the environment may be defined as a study which concerns allocation of resources among alternatives uses in such a way that there is an efficient reduction of the waste or residuals in the environment, which lead to an increase in social welfare.

ITS IMPLICATIONS

The material balance model has important implications.

1. Disposal activities may affect both consumers and producers. The environment can act as a conduit for carrying the disposal activities. Business firms generally smoke into the air and this may affect the consumer's welfare.
2. The environment has a large waste assimilation capacity, but this is not infinite. Too much wast entering the environment rather than being recycled or reused will put too much stress on the assimilative capacity of the environment to handle such waste safty.

3. With the application of the laws of thermodynamics, economics production and consumption activities always generate some pollution and waste, If requires proper disposal.
4. In a general sense, policy makers can weigh up the social benefits of various productive activities and compare them with the social costs (including disposal) imposed by these activities.
5. If a balance can be reached between acceptable levels of materials flows, there will be an increase in output and improvement in environmental quality.
6. From the policy point of view, this approach emphasizes recycle process and less residual generating production process. It is only possible by modifying an environmental medium through investment in control facilities so as to improve its assimilative capacity.
7. It is important to develop not only measures for the external costs resulting from different concentrations and duration of residuals in the environment but more systematic methods for forecasting emissions of extern al cost-producing residuals, technical and economic trade-offs between them, and the effects of recycle on environmental quality.
8. The application of the law of thermodynamics to the problem of waste is an important event in integrated residuals management. Residuals are generated by all production and consumption activities.
9. The importence of the materials balance principle lies in the fact that it provides a coherent frame work in which an economic analysis of resources use and its implications for the environment can be placed.

Conclusion : As suggested by **S.Beker**, to emprove the analysis of environmental economy interactions, the empirically relevant and up-to-date knowledge of ecological and natural sciences needs to be used and integrated into environmental economics in a more systematic way.

Resilience and Carrying capacity: Carrying capacity and ecosystem resilience The environmental resource base upon which all economic activity ultimately depends includes ecological systems that produce a wide variety of services. This resource base is finite. Furthermore, imprudent use of the environmental resource base may irreversibly reduce the capacity for generating material production in the future. All of this implies that there are limits to the carrying capacity of the planet.

RIt is, of course, possible that improvements in the management of resource systems, accompanied by resource-conserving structural changes in the economy, would enable economic and population growth to take place despite the finiteness of the environmental resource base, at least for some period of time. However, for that to be even conceivable, signals that effectively reflect increasing scarcities of the resource base need to be generated within the economic system.

Carrying capacities in nature are not fixed, static, K. Arrow et al. / Ecological Economics (1995) 91-95 93 or simple relations. They are contingent on technology, preferences, and the structure of production and consumption. They are also contingent on the everchanging state of interactions between the physical and biotic environment. A single number for human carrying capacity would be meaningless because the consequences of both human innovation and biological evolution are inherently unknowable. Nevertheless, a general index of the current scale or intensity of the human economy in relation to that of the biosphere is still useful. For example, Vitousek et al. calculated that the total net terrestrial primary production of the biosphere currently being appropriated for human consumption is around 40%. This does put the scale of the human presence on theplanet in perspective.

A more useful index of environmental sustainability is ecosystem resilience. One way of thinking about resilience is to focus on ecosystem dynamics where there are multiple (locally) stable equilibria .

Resilience in this sense is a measure of the magnitude of disturbances that can be absorbed before a system centered on one locally stable equilibrium flips to another .

Economic activities are sustainable only if the life-support ecosystems upon which they depend are resilient. Even though ecological resilience is difficult to measure and even though it varies from system to system and from one kind of disturbance to another, it may be possible to identify indicators and early-warning signals of environmental stress. For example, the diversity of organisms or the heterogeneity of ecological functions have been suggested as signals of ecosystem resilience. But ultimately, the resilience of systems may only be tested by intelligently perturbing them and observing the response using what has been called "adaptive management".

The loss of ecosystem resilience is potentially important for at least three reasons. First, the discontinuous change in ecosystem functions as the system flips from one equilibrium to another could be associated with sudden loss of biological productivity, and so to a reduced capacity to support human life.

Second, it may imply an irreversible change in the set of options open both to present and future generations (examples include soil erosion, depletion of groundwater reservoirs, desertification, and loss of biodiversity.) Third, discontinuous and irreversible changes from familiar to unfamiliar states increase the uncertainties associated with the environmental effects of economic activities. If human activities are to be sustainable, we need to ensure that the ecological systems on which our economies depend are resilient. The problem involved in devising environmental policies is to ensure that resilience is maintained, even though the limits on the nature and scale of economic activities thus required are necessarily uncertain.

3. Economic growth and environmental policy We conclude that economic liberalization and other policies that promote gross national product growth are not substitutes for environmental policy.

On the contrary, it may well be desirable that they are accompanied by stricter policy reforms. Of particular importance is the need for reforms that would improve the signals that are received by resource users. Environmental damages, including loss of ecological resilience, often occur abruptly. They are frequently not reversible. But abrupt changes can seldom be anticipated from systems of signals that are typically received by decision-makers in the world today. Moreover, the signals that do exist are often not observed, or are wrongly interpreted, or are not part of the incentive structure of societies. This is due to ignorance about the dynamic effects of changes in ecosystem variables (for example thresholds, buffering capacity, and loss of resilience) and to the presence of institutional impediments, such as lack of well-defined property rights. The development of appropriate institutions depends, among other things, on understanding ecosystem dynamics and on relying on appropriate indicators of change. Above all, given the fundamental uncertainties about the nature of ecosystem dynamics and the dramatic consequences we would face if we were to guess wrong, it is necessary that we act in a precautionary way so as to maintain the diversity and resilience of ecosystems.

Economic growth is not a panacea for environmental quality; indeed, it is not even the main issue. What matters is the content of growth--the composition of inputs (including environmental resources) and outputs (including waste products). This content 94 K. Arrow et al. /Ecological Economics 15 (1995) 91-95 is determined by, among other things, the economic institutions within which human activities are conducted. These institutions need to be designed so that they provide the right incentives for protecting the resilience of ecological systems. Such measures will not only promote greater efficiency in the allocation of environmental resources at all income levels, but they would also assure a sustainable scale of economic activity within the ecological life-support system. Protecting the capacity of ecological systems to sustain welfare is of as much importance to poor countries as it is to those that are rich.

It is also widely used as an indicator of environmental sustainability. Carrying capacity often serves as the basis for sustainable development policies that attempt to balance the needs of today against the resources that will be needed in the future.

Carrying capacity into six categories: physical, economic, perceptual, social, ecological and political.

Carrying capacity is defined as the "maximum population size that an environment can sustain indefinitely." For most species, there are four variables that factor into calculating carrying capacity: food availability, water supply, living space, and environmental conditions.

In a population at its carrying capacity, there are as many organisms of that species as the habitat can support. ... If resources are being used faster than they are being replenished, then the species has exceeded its carrying capacity. If this occurs, the population will then decrease in size.

When we will reach our carrying capacity (I hope we will not see anytime), water, food, shelter and resources will be very limited (per capita). People will be unhappy due to hunger (or maybe due to other reasons). ... The Earth will be fine but will have no trees and a lot of polluted water in the ocean.

As a result of the loss of their main predator, the deer population began to boom. ... Eventually, deer began to starve because their large numbers depleted their main source of food; they had reached their carrying capacity.

There are limits to the life-sustaining resources earth can provide us. In other words, there is a carrying capacity for human life on our planet. Carrying capacity is the maximum number of a species an environment can support indefinitely. Every species has a carrying capacity, even humans.

Many scientists think Earth has a maximum carrying capacity of 9 billion to 10 billion people.

Some examples: Some examples of limiting factors are biotic, like food, mates, and competition with other organisms for resources. Others are abiotic, like space, temperature, altitude, and amount of sunlight available in an environment. Limiting factors are usually expressed as a lack of a particular resource.

While food and water supply, habitat space, and competition with other species are some of the limiting factors affecting the carrying capacity of a given environment, in human populations, other variables such as sanitation, diseases, and medical care are also at play.

In general, any increase in the carrying capacity of the environment for one species will negatively affect other species. ... The degradation of Earth's carrying capacity for humans is associated with two integrated factors: (1) overpopulation and (2) the intensity of resource use and pollution.

The size of the population then fluctuates slightly above or below the carrying capacity. Reproductive lag time may cause the population to overshoot the carrying capacity temporarily. Reproductive lag time is the time required for the birth rate to decline and the death rate to increase in response to resource limits.

Carrying capacity can be defined as a species' average population size in a particular habitat. The species population size is limited by environmental factors like adequate food, shelter, water, and mates.

To find carrying capacity on a graph, you need to locate the point on the graph where the population line is horizontal. Alternatively, the carrying capacity may be

explicitly marked with a dotted horizontal line or a horizontal line of a different color. Thus, the carrying capacity is the maximum number of individuals of a species that an environment can support. Population size decreases above carrying capacity due to a range of factors depending on the species concerned, but can include insufficient space, food supply, or sunlight.

The resources in any given habitat can support only a certain number of wildlife. As seasons change, food, water, or cover may be in short supply, causing damage to the animals or the habitat. Carrying capacity is the number of animals the habitat can support all year long.

As competition increases and resources become increasingly scarce, populations reach the carrying capacity (K) of their environment, causing their growth rate to slow nearly to zero. This produces an S-shaped curve of population growth known as the logistic curve (right).

Carrying capacity is the maximum population size that an ecosystem can sustainably support without degrading the ecosystem. ... Disease, competition, predator-prey interaction, resource use and the number of populations in an ecosystem all affect carrying capacity.

In human ecology, the concept of 'carrying capacity' implies an optimum level of development and population size based on a complex of interacting factors - physical, institutional, social, and psychological.

Externalities and market inefficiency: An externality stems from the production or consumption of a good or service, resulting in a cost or benefit to an unrelated third party. ... Externalities lead to market failure because a product or service's price equilibrium does not accurately reflect the true costs and benefits of that product or service.

Market failure arises when the outcome of an economic transaction is not completely efficient, meaning that all costs and benefits related to the transaction are not limited to the buyer and the seller in the transaction. ... Producers do not consider those costs to others in their decisions

The four types of market failures are public goods, market control, externalities, and imperfect information. Public goods causes inefficiency because nonpayers cannot be excluded from consumption, which then prevents voluntary market exchanges.

There are four types of externalities considered by economists. Positive consumption externalities, negative consumption externalities, positive production externalities, and negative production externalities.

A positive externality exists if the production and consumption of a good or service benefits a third party not directly involved in the market transaction. For example, education directly benefits the individual and also provides benefits to society as a whole through the provision of more…

Market failure

Air pollution is an example of market failure, as the factory is imposing a negative external cost on the community.

Central to environmental economics is the concept of market failure. Market failure means that markets fail to allocate resources efficiently. As stated by Hanley, Shogren, and White (2007):[4] "A market failure occurs when the market does not allocate scarce resources to generate the greatest social welfare. A wedge exists between what a private person does given market prices and what society might want him or her to do to protect the environment. Such a wedge implies wastefulness or economic inefficiency; resources can be reallocated to make at least one person better off without making anyone else worse off." Common forms of market failure include externalities, non-excludability and non-rivalry.

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. In the absence of private property rights, there is no path to a solution that satisfies all parties

Markets are efficient at producing private goods, largely because producers and consumers have the right of ownership of the resources exchanged in an economic transaction involving a private good. However, markets are less efficient when property rights do not exist.

Secure property rights allow landowners to travel from their land for employment, and to let their land work for them. Property rights formalization is, appropriately, often linked with economic prosperity.

The Constitution protects property rights through the Fifth and Fourteenth Amendments' Due Process Clauses and, more directly, through the Fifth Amendment's Takings Clause: “nor shall private property be taken for public use without just compensation.”

In short, the stronger the private property rights system, the better the economy is at efficiently allocating resources and expanding wealth creating opportunities. ... A private property system gives the exclusive right to individuals to use their resources as they see fit and to voluntarily transfer them.

In economics, non-convexity refers to violations of the convexity assumptions of elementary economics. Basic economics textbooks concentrate on consumers with convex preferences (that do not prefer extremes to in-between values) and convex budget sets and on producers with convex production sets; for convex models, the predicted economic behavior is well understood When convexity assumptions are violated, then many of the good properties of competitive markets need not hold: Thus, non-convexity is associated with market failures where supply and demand differ or where market equilibria can be inefficient Non-convex economies are studied with nonsmooth analysis, which is a generalization of convex analysis

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Demand with many consumers

If a preference set is non-convex, then some prices determine a budget-line that supports two separate optimal-baskets. For example, we can imagine that, for zoos, a lion costs as much as an eagle, and further that a zoo's budget suffices for one eagle or one lion. We can suppose also that a zoo-keeper views either animal as equally valuable. In this case, the zoo would purchase either one lion or one eagle. Of course, a contemporary zoo-keeper does not want to purchase half of an eagle and half of a lion. Thus, the zoo-keeper's preferences are non-convex: The zoo-

keeper prefers having either animal to having any strictly convex combination of both.

Supply with few producers

Non-convexity is important under oligopolies and especially monopolies.[8] Concerns with large producers exploiting market power initiated the literature on non-convex sets, when Piero Sraffa wrote about on firms with increasing returns to scale in 1926,[31] after which Harold Hotelling wrote about marginal cost pricing in 1938.[32] Both Sraffa and Hotelling illuminated the market power of producers without competitors, clearly stimulating a literature on the supply-side of the economy.

Pareto optimal provision of public goods: What Is Pareto Efficiency? Pareto efficiency, or Pareto optimality, is an economic state where resources cannot be reallocated to make one individual better off without making at least one individual worse off. The optimal quantity of a public good occurs where the demand (marginal benefit) curve intersects the supply (marginal cost) curve. The government uses cost-benefit analysis to decide whether to provide a particular good.

The first condition for Pareto optimality relates to efficiency in exchange. The required condition is that “the marginal rate of substitution between any two products must be the same for every individual who consumes both.”

An allocation is Pareto efficient if there is no other allocation in which some other individual is better off and no individual is worse off. Example. Consider an economy that contains only one good, which everyone likes. Then every allocation is Pareto efficient: the only way to make someone better off is to give them more of the good, in which case someone else will have less of the good, and hence be worse off.

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 recognise that this is the socially optimal outcome achieved by a perfectly competitive market referred to above.

Pareto efficiency is important because it provides a weak but widely accepted standard for comparing economic outcomes. ... A policy or action that makes at least

one person better off without hurting anyone is called a Pareto improvement. The term is named for an Italian economist, Vilfreo Pareto.

Environmental economics is distinguished from ecological economics in that ecological economics emphasizes the economy as a subsystem of the ecosystem with its focus upon preserving natural capital.[2] One survey of German economists found that ecological and environmental economics are different schools of economic thought, with ecological economists emphasizing "strong" sustainability and rejecting the proposition that human-made ("physical") capital can substitute for natural capital.

An externality exists when a person makes a choice that affects other people in a way that is not accounted for in the market price. An externality can be positive or negative but is usually associated with negative externalities in environmental economics. For instance, water seepage in residential buildings occurring in upper floors affect the lower floors.[6] Another example concerns how the sale of Amazon timber disregards the amount of carbon dioxide released in the cutting.[7][better source needed] Or a firm emitting pollution will typically not take into account the costs that its pollution imposes on others. As a result, pollution may occur in excess of the 'socially efficient' level, which is the level that would exist if the market was required to account for the pollution. A classic definition influenced by Kenneth Arrow and James Meade is provided by Heller and Starrett (1976), who define an externality as "a situation in which the private economy lacks sufficient incentives to create a potential market in some good and the nonexistence of this market results in losses of Pareto efficiency".[8] In economic terminology, externalities are examples of market failures, in which the unfettered market does not lead to an efficient outcome.

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If property rights are not well-defined, four different types of goods can exist: private goods, public goods, congestible goods, and club goods.

Buyers do not directly pay for public goods (although they often pay for them indirectly, such as through taxes) nor do sellers provide them, since they receive nothing for the provision, so there is a market failure by private markets in allocating resources to produce public goods.

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The Pareto Principle, named after esteemed economist Vilfredo Pareto, specifies that 80% of consequences come from 20% of the causes, asserting an unequal relationship between inputs and outputs. This principle serves as a general reminder that the relationship between inputs and outputs is not balanced.

The terms "Pareto optimality" and "Pareto efficiency" are used interchangeably in the literature, even though the former is often used as a normative criterion indicating

desirable situations, while the latter implies a more neutral description in positive economics (Berthonnet and Delclite, 2014) .

Graaf, is free from making any interpersonal comparisons. It is based on a very broad ethical positive view that 'one should always do well to all'. But it has its weaknesses. (1) There can be an infinite number of Paretian Optima, each with a different level of welfare.

Definition:

Pareto's efficiency is defined as the economic situation when the circumstances of one individual cannot be made better without making the situation worse for another individual. Pareto's efficiency takes place when the resources are most optimally used.

Thus someone who does not buy the good values a unit more than the marginal cost of producing it. ... It follows that a monopoly equilibrium is not Pareto efficient: someone can be made better off without making anyone worse off.

Pareto efficiency, also referred to as allocative efficiency, occurs when resources are so allocated that it is not possible to make anyone better off without making someone else worse off. Context: ... Pareto optimality is sometimes used interchangeably with Pareto efficiency

For example, he observed that 80% of the peas in his garden came from 20% of his pea plants. The 80:20 ratio of cause-to-effect became known as the Pareto Principle. Definition: Pareto Principle. Pareto principle is a prediction that 80% of effects come from 20% of causes.

This “universal truth” about the imbalance of inputs and outputs is what became known as the Pareto principle, or the 80/20 rule. While it doesn't always come to be an exact 80/20 ratio, this imbalance is often seen in various business cases: 20% of the sales reps generate 80% of total sales.

A Pareto Chart is a graph that indicates the frequency of defects, as well as their cumulative impact. Pareto Charts are useful to find the defects to prioritize in order to observe the greatest overall improvement

UNIT - II.

THEORY OF ENVIRONMENTAL POLICY:

A Pigovian (Pigouvian) tax is a tax assessed against private individuals or businesses for engaging in activities that create adverse side effects for society. Adverse side effects are those costs that are not included as a part of the product's market price. These include environmental pollution, strains on public healthcare from the sale of tobacco products, and any other side effects that have an external, negative impact. Pigovian taxes were named after English economist, Arthur Pigou, a significant contributor to early externality theory.

A Pigouvian tax is a government cost on any activity that creates socially harmful externalities.1 An externality is an activity that creates a negative effect on others in a society but not necessarily the person who does that activity.

Pollution is an externality, for example. Drivers of non-compliant vehicles don't suffer immediately from their exhaust, but everyone behind them does. Their exhaust also increases pollution for everyone in the community.

The government imposes Pigouvian taxes on non-compliant vehicles to impose a higher cost on the drivers to compensate for the suffering they cause. The revenue from the tax is often used to ameliorate the external cost.

Ideally, a Pigouvian tax will cost the producer the amount equivalent to the harm it causes others.

British economist Arthur Pigou developed the concept of externalities.2 He argued that the government should intervene to correct them by taxing activities that harm the economy as a whole and subsidizing activities that help society as a whole.

Key Takeaways

A Pigouvian tax is placed on any activity that creates socially harmful externalities. Pigouvian taxes shift the costs from society to the producers of these externalities. Gas, carbon, and noise taxes are examples of Pigouvian taxes.Pigouvian taxes can increase the burden on low-income earners.

Examples of Pigouvian Tax

Let's imagine a manufacturer poisoned the groundwater in its first five years of operations.2 The manufacturer emitted 100,000 gallons of waste during that period, and it cost the nearby town $1 million to clean it up. The town would impose a $1 million fine for past behavior.

The town would also impose a Pigouvian tax of $10 a gallon going forward. That would cover the cost of future pollution. If it was worth it to the firm to continue making its toxin-producing product, then it would pay the fine. If not, then it would go out of business. Either way, the town will have clean water.

Gas Taxes

A gasoline tax is an example of a Pigouvian tax. It raises the driver's cost to cover the negative externalities created by driving automobiles. In the United States, the federal gas tax was $0.183 per gallon in 2019.3 The average state gas tax was $0.2868 per gallon. The revenue goes into the federal Highway Trust Fund to pay for roadway maintenance.

Noise Taxes

France levies a Pigouvian noise tax on airplanes at its nine busiest airports.4 It ranges from 2 euros to 35 euros depending on the airport and the weight of the aircraft. The government uses the revenue to soundproof houses that are exposed to noise levels beyond 70 decibels.5

Carbon Taxes

About 40 countries impose carbon taxes on companies that burn coal, oil, or gas, which produce greenhouse gas emissions. These emissions cause climate change, which can bring about more natural disasters, raise sea levels, and increase droughts.

Although Pigouvian taxes may work in one sense, they can have some unanticipated or unintentional negative effects.

Pigouvian taxes are regressive when they impose a harsher burden on the populations with lower incomes compared to those with higher incomes.

Important :Some Pigouvian taxes, such as the gas tax or cigarette tax, are regressive because they're flat, or the same for everyone. They end up taking take a greater percentage of income from people who make less money.

Externalities problem : Pigouvian Tax is a tax on economic activities that generate negative externalities, which create costs that are borne by unrelated third parties. ... The main purpose of Pigouvian taxes is to oppose market inefficiencies by increasing the marginal private cost by the amount generated by the negative externality.

A Pigovian tax is intended to tax the producer of goods or services that create adverse side effects for society. Economists argue that the cost of these negative externalities, such as environmental pollution, are borne by society rather than the producer.

Definition of Positive Externality: This occurs when the consumption or production of a good causes a benefit to a third party. For example: ... (positive consumption externality) A farmer who grows apple trees provides a benefit to a beekeeper. The beekeeper gets a good source of nectar to help make more honey.

Examples of negative externalities

Loud music. If you play loud music at night, your neighbour may not be able to sleep.

Pollution. If you produce chemicals and cause pollution as a side effect, then local fishermen will not be able to catch fish. ...Congestion. ...Building a new road.

Market failure: An externality stems from the production or consumption of a good or service, resulting in a cost or benefit to an unrelated third party. ... Externalities lead to market failure because a product or service's price equilibrium does not accurately reflect the true costs and benefits of that product or service.1

Marketable Pollution permits and mixed instruments : In environmental law and policy, market-based instruments (MBIs) are policy instruments that use markets, price, and other economic variables to provide incentives for polluters to reduce or eliminate negative environmental externalities. MBIs seek to address the market failure of externalities (such as pollution) by incorporating the external cost of production or consumption activities through taxes or charges on processes or

products, or by creating property rights and facilitating the establishment of a proxy market for the use of environmental services. Market-based instruments are also referred to as economic instruments, price-based instruments, new environmental policy instruments (NEPIs) or new instruments of environmental policy.

Examples include environmentally related taxes, charges and subsidies, emissions trading and other tradeable permit systems, deposit-refund systems, environmental labeling laws, licenses, and economic property rights. For instance, the European Union Emission Trading Scheme is an example of a market-based instrument to reduce greenhouse gas emissions.

Market-based instruments differ from other policy instruments such as voluntary agreements (actors voluntarily agree to take action) and regulatory instruments (sometimes called "command-and-control"; public authorities mandate the performance to be achieved or the technologies to be used). However, implementing an MBI also commonly requires some form of regulation. Market based instruments can be implemented in a systematic manner, across an economy or region, across economic sectors, or by environmental medium (e.g. water). Individual MBIs are instances of environmental pricing reform.

According to Kete (2002), "policymaking appears to be in transition towards more market-oriented instruments, but it remains an open-ended experiment whether we shall successfully execute a long-term social transition that involves the private sector and the state in new relationships implied by the pollution prevention and economic instruments rhetoric.

Transferable permits A market-based transferable permit sets a maximum level of pollution (a 'cap'), but is likely to achieve that level at a lower cost than other means, and, importantly, may reduce below that level due to technological innovation.

When using a transferable-permit system, it is very important to accurately measure the initial problem and also how it changes over time. This is because it can be expensive to make adjustments (either in terms of compensation or through undermining the property rights of the permits). Permits' effectiveness can also be affected by things like market liquidity, the quality of the property right, and existing

market power. Another important aspect of transferable permits is whether they are auctioned or allocated via grandfathering.

An argument against permits is that formalising emission rights is effectively giving people a license to pollute, which is believed to be socially unacceptable. However, although valuing adverse environmental impacts may be controversial, the acceptable cost of preventing these impacts is implicit in all regulatory decisions.

Market-based vs command and control

An alternate approach to environmental regulation is a command and control approach. This is much more prescriptive than market-based instruments. Command and control regulatory instruments include emissions standards, process/equipment specifications, limits on input/output/discharges, requirements to disclose information, and audits. Command and control approaches have been criticised for restricting technology, as there would be no incentive for firms to innovate.[3] Empirical studies have shown the opposite; external price changes can induce innovation as companies are forced to address the market failure of under-investment.

Market-based instruments do not prescribe that firms use specific technologies, or that all firms reduce their emissions by the same amount, which allows firms greater flexibility in their approaches to pollution management. However, command and control approaches may be beneficial as a starting point, when regulators are faced with a significant problem yet have too little information to support a market-based instrument. Command and control approaches can also be preferred when regulators are faced with a thin market, where the limited potential trading pools mean the gains of a market-based instrument would not exceed the costs (a key requirement for a successful market-based approach).

Market-based instruments may also be inappropriate in dealing with emissions with local impacts, as trading would be restricted to within that region. They may also be inappropriate for emissions with global impacts, as international cooperation may be difficult to attain.

For a variety of reasons, environmental advocates initially opposed the use of market-based instruments except under very constrained conditions. However, after

the successful use of freely traded credits in the lead phasedown in the U.S. environmental advocates recognized that trading markets has benefits for the environment as well.[5] Thereafter, beginning with the proposal of the acid rain allowance market, environmental advocates have supported the use of trading in a variety of contexts.

The Coase theorem is central to understand the policy implications of externalities. It does this through indicating those situations in which market activities will eliminate the effects of externalities and suggests new perspectives on why market solutions to externalities may fail and appropriate policy responses.

The Coase Theorem offers a potentially useful way to think about how to best resolve conflicts between competing businesses or other economic uses of limited resources.

But the "Coase Theorem," a term coined by Coase's University of Chicago colleague George Stigler, took on a life of its own. Economic policy analysts on the political right began treating "zero transaction costs" not as a heroic simplifying assumption, but as a plausible policy goal.

Coasean market solutions in the context of common entitlements

Taking part in market transactions is where common ownership turns out to be “the largest impediment”. For multiple parties, co-owners of resources, to enter a market deal, they should first agree on the value of their resources, the value of each share, whether the exchange is worthwhile, and numerous further details. Consent is a major issue not only for communities and informal associations, but also for collective and stock companies, partnerships and any other collective entities.

Coase refers several times to the standard example of a factory with a smoky chimney, but only twice mentions that it affects “a vast number of people engaged in a wide variety of activities” . These seem to be the only occasions when he refers specifically to situations in which multiple victims are affected by an externality, and he does not go into detail. But these situations are so prevalent in reality that the implications of the Coasean approach in such circumstances merit in-depth investigation.

I begin by analysing the activities involved in a Coasean solution to externalities that affect multiple victims by elaborating on Bass v. Gregory, in which there were two plaintiffs – the owner and the tenant of a public house. They acted as a single party in the court case, because they both had a common interest in preserving “the free passage of air from [the] cellar upwards through the well”. Still, obviously, the interest of the owner was greater than the interest of the tenant, because if they lost the case, the tenant could move to another public house, whereas the owner would still have a cellar with no ventilation. Hence, the difference in their interests is a reason for them to define in advance how the solicitor’s honoraria and the court expenses, as well as the eventual gains or losses, would be allocated between them. This agreement is by nature a Pigovian measure, if only because it is made before the litigation. Yet the Pigovian nature of the agreement between multiple third parties is much more evident when the number of third parties is larger. Consider the case of the straying cattle.

As noted in the second section, Coase investigates in detail the options for allocating the costs of erecting a fence between a single cattle-raiser and a single neighbouring farmer; however, the situation he envisions seems improbable – it is more likely that the cattle-raiser would be surrounded by several farms. In that case, there would be no point in erecting a fence only between the cattle-raiser and one of the neighbouring farmers, and if there were several neighbours, the calculation of the costs would be overly complicated. Whether this complicated allocation of costs will be feasible depends on the existing legal system.

The fencing issue is widely recognized by the legal systems of the United States, for instance. Because Pigovian and Step 1 Coasean solutions are connected (see the previous subsection), there are no purely Pigovian or purely Coasean legal provisions. Still, some laws may be considered more Pigovian (i.e. liabilities are more strictly defined by legal rules), and some are more Coasean (i.e. liabilities are to some extent negotiable). If specific fencing duties are not strictly defined or detailed, but owners bear general civil or criminal liability, Coasean negotiations are a likely solution, especially when the law recognises the costs and benefits of fencing (e.g. freedom from intrusion by livestock and trespassing neighbours, increased land value by virtue of fostering agriculture, and diminution of lawsuits; Tidgren 2016). However, when multiple farmers bargain with a cattle-raiser about the costs of

fencing or take the case to court, collective action has key advantages but is also quite expensive. To reduce the cost of negotiating, collective action would benefit from centralised Pigovian rules.

But this is possible only on one key condition – that the farmer is the exclusive/private owner of the air above her farm. Otherwise, she may not negotiate on her own. This is obviously a wrong assumption, because the air over different farms is constantly moving and intermingling. Ignoring this problem and pursuing a Coasean approach results in a 'market' process with obvious deficiencies.

The market price of pollution would, therefore, remain unknown; hence, such one-by-one negotiations can hardly qualify as a genuine market process. But there is an even greater problem. Suppose the polluter has paid 16 of the 30 farmers (more than 50% of them). Has he really bought their polluting rights? Can he pollute the air if he has bought the rights of two-thirds or three-quarters of the farms? Obviously, even if he has paid 29 farms for the rights to pollute the air above their land, the polluter still is not entitled to pollute the air of the area, because volumes of air are constantly exchanging and he is also polluting the air of the 30th farm, which he has not paid for. Clearly, for the Coasean solution to work – for the market mechanism to function – the polluter must pay all co-owners of the air in the area. Thus to carry out 'genuine' Coasean bargaining over a common resource, the polluter must bargain with all co-owners together.

Negotiations generally incur high transaction costs; collective negotiations are much more expensive, and so are collective Coasean bargains. Alternative institutional arrangements may be used to reduce transaction costs as examined in the following paragraphs; however, certain general considerations apply. First, although collective bargaining with 30 co-owners is expensive, 30 individual bargains no doubt incur much higher costs. Hence, organization saves transaction costs, especially if one takes into account the cost of risk to negotiate successfully with 29 farmers and fail with the 30th. Second, even if farmers are organized, negotiating with all 30 of them may still be prohibitively costly. Electing "a small management group" (Demsetz 1967, 355) to conduct the negotiations will reduce the costs substantially, despite all the drawbacks of collective management. Thirdly, establishing a system of

centralized (actually Pigovian) rules is in fact a basic mechanism for cost reduction in organizations.

The following paragraphs examine four possible arrangements that allow the farmers to negotiate over air pollution. Two of these arrangements involve individual entitlements, and two involve shared/common entitlements. The latter two unavoidably employ Pigovian measures.

The first solution involves organising either a formal or informal association of farmers. As already shown, the farmers need to bargain with the factory owner collectively, but it is too expensive for all 30 of them to take part in the negotiations, so, as explained, they should organise and elect “a small management group” to bargain with the polluter. Any form of collective management of property rights is associated with difficulties, such as organisation problems, possible misuse of central powers, etc., yet this is the least expensive way for the farmers to defend their common air. What is particularly important for this research is that organisation necessarily involves Pigovian measures. First of all, the management group should acquire powers and a central position. To establish a mandate for the management group to bargain, the farmers should organise a meeting and define their main terms of the negotiations. Thus some aspects of the negotiations’ results are defined the bargaining parties may choose only between the limited alternative options of the mandate. Some smaller details will be determined in the course of the bargain, and then the management group will exercise its central powers. However, all expenses associated with the bargain should be covered by all farmers. For that purpose each one should pay his or her contribution, which is similar to taxing. Hence, if an association is a party involved in solving an externality problem, it employs Pigovian measures to carry out Coasean bargaining.

I next examine the second alternative solution, establishing a private company. There are two options for this company – it can be an individual property if one person buys up all “adjoining properties”, or it can be in collective ownership. The first option has two sub-options: the person who buys up all properties in the area may be the owner of the factory, or it may be one of the farmers. If the factory owner buys all properties in the area, this is the solution defined by Coase as the “firm” solution that internalises the externalities. Alternatively, if one of the farmers buys the

properties of her neighbours, then this will facilitate Coasean bargaining between one buyer and one seller. Thus both outlined options result in ‘pure’ Coasean solutions – either through internalisation of the externalities or through Coasean.

Establishing a collective company will solve the externality issues, but only insofar as the producer of the negative externality will have one legal entity to bargain with and negotiations will be facilitated. To the factory owner the new company will be a private entity, but to the farmers it will be a collective body. In fact, as in the first case of an association, many of the externality issues will be transformed into issues of collective management with all associated organizing costs and drawbacks, such as possible misuse of management powers and corruption, public choice problems and agency problems. Yet, because the organisation of the company is based on its own private statutes, as well as on private contracts between the shareholders and the management, and between the management and the employees, many of the problems will be solved, but others will remain.

Coase theorem is the idea that under certain conditions, the issuing of property rights can solve negative externalities. For example, a Forrester will manage their forest to ensure its longevity and protect it from fires. It is their incentive to do so in order for them to be able to sell logs in future years.

Environmental Monitoring

Environmental monitoring refers to systematic sampling of air, water, soil, and biota in order to observe and study the environment, as well as to derive knowledge from this process.

At its core, environmental monitoring is designed to help us understand the natural environment and protect it from any negative outcomes of human activity. The process is an integral part of environmental impact assessments and results can directly determine whether or not projects are given the all clear.

Environmental Monitoring Benefits

Validation and verification of cleaning and sanitation programs. ...

Provides data of the overall effectiveness of your sanitary program, personnel practices, and operations procedures. ...

Provides data about indicator organisms, spoilage organisms, and pathogens to prevent outbreaks.

Environmental economists perform studies to determine the theoretical or empirical effects of environmental policies on the economy. This field of economics helps users design appropriate environmental policies and analyze the effects and merits of existing or proposed policies

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.

Environmental economics is a sub-discipline of economics that aims to understand, and influence, the. economic causes of human impacts on the non-human world, such as atmospheric pollution. It seeks. to apply the main concepts and methods of economic thought to environmental goods

Environmental economics will help you understand some important and controversial issues – such as climate change policy, nuclear power, recycling policy, and traffic congestion charging. ... In very broad terms, environmental economics looks at how economic activity and policy affect the environment in which we live.

Environmental economics deals with the exploitation, allocation and use of renewable and fixed natural resources. Environmental policy refers to sets of safe rules of conduct that organisations have to implement in order to address various environmental issues.

Environmental economists study the economics of natural resources from both sides - their extraction and use, and the waste products returned to the environment. They also study how economic incentives hurt or help the environment, and how they can be used to create sustainable policies and environmental solutions.

Environmental economics is a sub-field of economics concerned with environmental issues. ... Environmental economics is distinguished from ecological economics in that ecological economics emphasizes the economy as a subsystem of the ecosystem with its focus upon preserving natural capital.

The aim of E.V.S.(environmental studies) is to develop a world population that is aware of and concerned about the environment and its associated problems and which has the knowledge ,Skills, attitudes ,motivations and commitment to work individually and collectively towards solutions of current problems and prevention ..

Environmental protection is the practice of protecting the natural environment by individuals, organizations and governments. Its objectives are to conserve natural resources and the existing natural environment and, where possible, to repair damage and reverse trends.

The goals of environmental education are: to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment; to create new patterns of behavior of individuals, groups, and society as a whole towards the environment.

This is because people generally exhibit an endowment effect, in which they value something more once they actually have possession of it. Thus, the Coase Theorem would not always work in practice because initial allocations of property rights would affect the end result of the negotiations.

The Coase theorem states that when transaction cost are low, two parties will be able to bargain and reach an efficient outcome in the presence of an externality. In practice, private parties often fail to resolve the problem of externalities on their own.

Economic carrying capacity takes the form of maximum global economic welfare derivable from the sustainable throughput flows of the ecosphere. ... The shape of this curve is determined by the rising costs associated with the ecosystemic impact of increasing throughput rates as required by a growing economy.

Coasian bargaining

Coasian bargaining is based on the ideas of Ronald H. Coase who earned the 1991 Nobel Prize in economics ‘for his discovery and clarification of the significance of transaction costs and property rights for the institutional structure and functioning of the economy’. In his article, The Problem of Social Cost (1960), he proposes that well-defined property rights can overcome the problems of externalities, because many environmental problems arise from poorly defined, or a lack of, property rights.

Assuming that property rights are held by the polluter and that transaction costs are zero, the Coase theorem states that a polluter and a victim can reach a mutually beneficial bargain if the damage from pollution is higher than the polluter's net return from the sale of the good generating the pollution. In this case, a payment from the affected party to the polluter would reduce the pollution.

Thus, the Coase theorem states that the most efficient solution to resolving interdependent uses of the environment, including pollution cases, is a bargaining process among relevant property holders. If property rights are given to polluters, victims can pay them not to pollute, creating a market-like solution akin to a scheme for payments for ecosystem services. Alternatively, if property rights are given to the victims, the polluters may compensate the victim or buy the right to pollute. Thus, the cost of the negotiated outcome is shared between the parties without any external intervention

As an example, consider a chemicals factory producing useful products but also polluting smoke. If the initial legal framework gives people the right to breathe clean air, they could make the factory produce less or nothing at all. However, assume that the factory is willing to pay up to USD 5 per unit for the right to pollute enough to produce its output. If this amount is considered of greater value than that of clean air, people will take the money and put up with (the economically optimal level of) pollution. On the other hand, if the right to pollute lies with the firm, people can bribe the firm to pollute less.

The Coasian bargaining approach is an attractive one to some: an economy may be able to achieve Pareto-efficient resource allocation (that is, no individuals can be made better off without making someone else worse off) without pervasive government regulation. Moreover, Coasian bargaining solutions can be particularly interesting for international externalities, since there is no supranational environmental protection agency with the necessary authority to impose abatement directives or pollution taxes.

However, the number of situations for which Coasian bargaining is feasible and desirable is limited. First, Coasian bargaining does not eliminate the role of government in assigning initial property rights. This process will be subject to special interest group lobbying and rent seeking. In addition, because many environmental

externalities are indirect, cumulative and uncertain and because resorting to the legal system involves inefficiency, the costs of enforcing or striking a Coasian bargain may be large. Moreover, as many externalities are intertemporal, future generations are simply not present in any bargain.

Another limit to Coasian markets comes from the fact that many environmental externalities, like car emissions or noise in the vicinity of airports, or global effects such as climate change and ozone layer destruction, involve a large number of people. For example, a farmer who pollutes his water supply may be one of numerous upstream farmers affecting thousands of downstream neighbors'. Bringing all the relevant agents to the negotiating table would be difficult and expensive. The transaction costs (of aggregating the interests of all the affected parties, hiring lawyers, negotiating an optimal abatement level, and enforcing a market agreement) will prevent a private bargain even with a clear allocation of rights. Moreover, individuals will be tempted to act as free riders in negotiations, undermining the negotiations themselves. Individuals would treat the outcome of negotiations as beyond their control and therefore, be unwilling to bear any transaction costs (Baumol and Oates, 1988). Thus, when externalities take place in future, or when transaction costs are important and when the number of participants is large, Coasian solutions to environmental externalities must be ruled out.

Tradable pollution -Characteristics

Ensuring good water quality is an essential step towards water security. Consequently, pollution control is a big part of water resource management. Tradable pollution permits are so-called cap and trade schemes. They give companies a legal right to pollute a certain amount per fixed time span. Firms that pollute less can then sell their leftover pollution permits to firms that pollute more. The point of this is that polluting firms and public agencies differ in their ability to abate their pollution – some can do it easily and cheaply, for others it would be more difficult and costly. Consequently, tradable pollution permits can be a cost effective way to achieve a reduction in overall pollution.

The freedom to trade pollution "entitlements" gives an incentive for polluters to consider abatement (since they can sell their surplus quotas) while others face the cost of having to purchase permits. For society, the existence of tradeable permits

enables pollution abatement to be achieved in the least costly manner. Over time, pollution standards can be tightened, increasing the value of the permits and the pressure on market participants. Credits are traded within defined trading areas.

Trading in pollution permits arises in the following situations: Permits to discharge into specific water bodies issued to local firms and wastewater treatment plants (e.g. Fox River, USA);

Nutrient trading (e.g. in parts of the USA, Canada, Netherlands, and Australia). Transactions listed under some schemes include “bubble licensing” (in which several wastewater treatment plants are considered together in applying nitrogen and phosphorous load discharge limits) and “diffuse source offsets” (in which a water authority can purchase offset credits from external sources using much cheaper ways of reducing overall nutrient pollution).

A number of these schemes in water pollution are still in the pilot phase, and experience is still accumulating. Mainly, tradeable permits are used to manage air pollution.

There is a need for a mechanism for initial allocation of rights (whether for water or pollution discharges) which should be seen to be fair, and be equitable and effective. Initial prices can be set by governments or determined through public auctions.

The decision on how long permits are valid is important if ever governments want to change the price for a pollution unit. If permits are valid indefinitely, companies can “bank” unused pollution certificates which means that later price corrections will be less effective.

In order to be effective, monitoring systems need to be put in place to keep track of the pollution discharges of companies and/or other users so their actual discharge can be determined and fines imposed if companies surpass the pollution levels allotted through their permits.

A system that relies on pollution permits as opposed to mandatory pollution cuts or limits set by the government allows companies that are wealthy enough to keep polluting.

It is also possible to set up a system in which credits are not just sold or given out, but also generated through environmental services or water treatment. An example of such a system is the Maryland Nutrient Trading System, where farmers can produce credits in the trading system by installing riparian buffers or covering crops. To qualify as credits, these practices must be certified and inspected by appropriate authorities.

Environmental in WTO regime:

The WTO came into existence in 1995 and the Committee on Trade and Environment was established as per a decision adopted during the Uruguay Round. Its main aim was to identify the relationship between trade and environment to promote sustainable development. The agenda was an extention of the GATT 1991. Its preamble include : (a) the Agreement on Technical Barriers to Trade (TBT) and the Agreement on the Application of Sanitary and Phytosanitary (SPS) Measures: (b) It also recognized the importance of furnishing technical assistance to developing country members; and (c) Transfer of Technology.

TECHNICAL BARRIERS TO TRADE (TBT)

A technical regulation is defined in the TBT Agreement as “Document which lays down product characteristics or their related processes and production methods. It may also include or deal exclusively with terminology, symbols, packaging, marking or labeling requirements as they apply to a product, and its process.”

Agreement Sanitary and Phytosanitary (SPS) Measures

Sanitary or Phytosanitary Measures include all relevnt laws, decrees, regulations, requirements and procedures including, inter alia, end product critera, process and production methods, testing, inspection, certification, relevant requirements associated with the transport of animals or plants, methods of risk assessment packaging and labeling requirements directly related to food safety.

GENERAL AGREEMENT ON TRADE IN SERVICES (GATS)

According to WTO committee on Trade and Environment (CTE), GATS contains a commitment to progressi ve liberalization and to increasing the participation of developing countries. It will improve the environmental protection in these countries.

The environmental services include sewerage services, refuse disposal services and sanitation services. Further sub-classification includes clean9ing of eshaust gases, noise abatement services, and la ndscape protection serviceds.

THE DOHA DEVELOPMENT AGENDA:

After the pronounced failure of WTO members to agree opon an agenda for further multilateral trade negotiations at the Seattle Ministerial Meeting of 1999, a new round of multilateral trade negotiations was initiated at the WTO'S Forth Ministerial conference in Doha, Qoatar in November 2001.

The 4th WTO Ministerial Conference ended and country to many predictions, members did manage to put together a declaration in the true WTO tradition of give and take consensus while some may argue that most of the statements in various declarations are innocuous and ambiguous, which will lead to different interpretations and new problems related to developing countries.

Sustainable development and protection and preservation of the environment are fundamental goals of the WTO. They are enshrined in the Marrakesh Agreement, which established the WTO, and complement the WTO's objective to reduce trade barriers and eliminate discriminatory treatment in international trade relations. While there is no specific agreement dealing with the environment, under WTO rules members can adopt trade-related measures aimed at protecting the environment provided a number of conditions to avoid the misuse of such measures for protectionist ends are fulfilled.

The WTO contributes to the protection and preservation of the environment through its objective of ensuring sustainable development and avoiding protectionism, through its rules and enforcement mechanism, and through work in different WTO bodies.

Dr. K. Ushakumari,
Assistant Professor of Economics,
K.N.Govt. Arts College for women (A), Thanjavur.

I-M.A. ECONOMICS

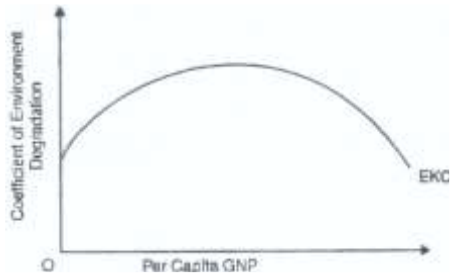
ENVIRONMENTAL ECONOMICS

UNIT - III COURSE CODE: 18KP1ECELEC1

ENVIRONMENTAL QUALITY AND ECONOMIC DEVELOPMENT

The relationship between environmental quality and economic development is explained in terms of Environmental Kuznets Hypothesis, In other words, it explains the relationship between pollution level and income growth Pollution level would increase during the early stages of economic development and will reach the maximum. The maximum level of pollution is referred to as the turning point after which it begins to decline as the country gains adequate resources to tackle the pollution problem.

Environmental Kuznets Curve which displays an inverted ***U***-shape. It shows the tendency of many forms of environmental degradation to follow an inverted ***U***-shape when plotted against per capita **GNP**.



Vernon W.Ruttan was the first economist to formulate the Environmental Kusnets Hypothesis. According the him, "In relatively high income countries, the income elasticity of demand for commodities and services related to sustenance is low and declines as income continues to rise, while the income elasticity of demand for more effective disposal of residuals and for environmental amenities is high and continues.

As pointed out be T.Panayotou, at very low levels of economic activity, environmental impacts are generally low, but as development proceeds the rate of

land, resources use and waste generation per capita increase rapidly. However, at higher levels of development, structural changes towards information, intensive industries and services, coupled with increased environmental regulations, better technology and higher environmental expenditures, result in leveling off and gradually decline of environmental degradation.

T. Selden and D.Song have argued in favour of an inverted ***U***-shape curve for air pollutants due to the following reasons: (a) positive income elasticities for environmental quality; (b) structural changes in production and consumption associated with higher incomes; (c) increasing information on environmental consequences of economic activities as income rises.

There are different views regarding the upswing and downswing of the EKC. The cause of the upswing of the inverted U-shape of the EKC is that greater output per head generates more emissions. The cause of the downswing is more controversial. The developed countries are better able to enforce regulations that yield the higher environmental quality. They produce more services relative to manufacturers and within manufacturing they tend to specialize in cleaner industrial demnd for the output of direct industries which are met by imports from poor countries. If this latter explanation is correct, than at international level, the countries with per capita incomes above the turning point of the inverted U-shape curve for a certain from of environment degradation does not improve environmental quality but instead they redistribute degradation to less developed countries.

CRITICISM: A number of EKC studies have refuted the ***U***-shape curve hypothesis on the following grounds. The inverted U-shape curve has been found for only a few pollutants mainly those that have local health effects.

The existing empirical work focuses on the relationship between income and pollutants which is due to the stock nature of many environmental problems. But it does not fully account for environmental impacts.

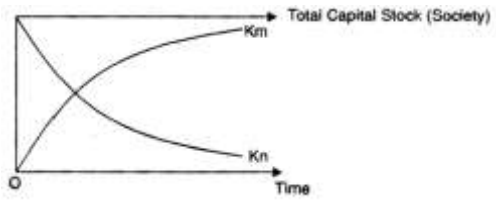
Environmental Kuznets curve estimates and their interpretations. They are : (a) the assumption of unidirectional causality from growth to environmental quality and the reversibility of environmental change; (b) the assumption that changes in trade relationships associated with development have no effect on environmental quality; (c) ambient concentrations versus emissions; (d) asymptotic behavior; and (e) the mean-median income problem.

SUSTAINABLE DEVELOPMENT : Sustainable development means that development should 'keep going'. It emphasizes the creation of sustainable improvement in the quality of all people through increase in real income per capita, improvements in education, health and general quality of life and improvements in quality of natural environmental resources.

SUSTAINABLE DEVELOPMENT RULES: Different schools of thought have formulated certain rules and approaches to define sustainability from different perspectives.

1. Safe Minimum Standards: Safe minimum standard analysis is one decision methodology which can be used to address those economical concerns only which are given little attention in economic cost-benefits analysis. SMS analysis is a time tested standard operating procedure that is widespread throughout engineering design, health planning and industrial worker safety.

2. Hartwick – Solow Rule: Hartwick-Solow rule of intertemporal equity states that future generations are able to be at least as well off as current generations by maintaining the constant levels of society's capital stock. While natural resources exhaustion must be translated into the flows of income that are invested into other forms of capital.(i.e. human capital)

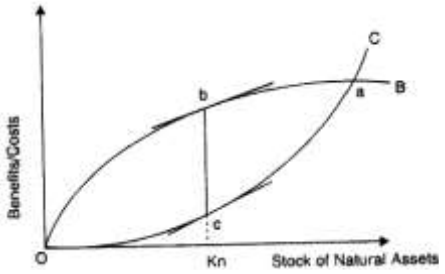


The above figure indicates the stock of natural capital (Kn) is falling towards zero over due course of time, but the stock of man-made capital (Kn) is increasing in order to maintain society's capital stock.

Total capital stock includes man made capital (e.g., accumulated knowledge and embodied training) and natural capital (e.g., forests, ozone layer and natural resource stocks). With sustainability rule, it is permissible to exhaust some of the natural capital endowment so long as the overall capital stock is maintained. Thus, the present generation can make choices that use up some of the natural capital provided the proceeds from this consumed stock, finance offsetting increase in other capital stock so that subsequent generation are well-off.

3. ***London School Thought***: The stock of natural resources assets or of environmental assets includes soil fertility, forests, fisheries, the capacity to assimilate waste, oil, gas, coal, the ozone layer and biogeochemical cycles. The necessary condition for sustainable development is that the natural capital stock should be conserved and improved. This is interpreted to mean that the natural capital stock should remain at least constant. This can be measured in terms of the cost-benefit analysis of changes in the natural capital stock. It it is reduced, say in terms of clearing forests for cultivating land or for habitation etc., there will be benefits in terms of the use of the land for more productive purposes. Similarly, when the atmosphere is kept clean, it is a benefit and the damage of polluted environment is a cost. Therefore, sustainability is consistent with maintaining and improving natural capital assets.

The stock of natural assets is shown on the horizontal axis while benefits and costs on the vertical axis in below figure. The cost curve C shows that as the stock of natural capital (KN) increases, there are increasing costs in the form of foregone benefits for not conserving the environment. The benefit curve shows the benefits to users and non-users of natural environments. If the difference between two curves is the maximum, then it is a situation of optimum stock of environment. In terms of the figure, the difference is equal to be and Kn optimum stock of environment. If the difference is less than *bc*, or the existing stock is to the left of optimum level Kn, then there is a need for improvement in environmental quality and vice versa.



Some economists do not agree that more importance should be attached to natural capital than to man-made capital and human capital. According to them, sustainable development relates to the conservation and improvement the overall capital stock comprising natural, man-made and human. This view is consistent with efficiency and intergenerational equity.

4. ***Daly's Operational Principles for Sustainable Development***:

Human Daly has formulated four principles of sustainability:

First, Daly calls upon the need to maximize resources efficiently with respect to renewable resources by exploiting them can profit maximizing sustainable yield bases.

Second, with respect to the physical volume of inputs into the economy and its outputs by consciously limiting the over scale of resources use.

Third, technical progress for sustainable development should increase efficiency rather than an increase in throughput.

Fourth, with respect to non-renewable resources to maintain the total stock of natural capital by depleting non-renewable natural components (such as mineral deposits) at a rate corresponding to the creation of renewable substitutes.

INDICATORS AND MEASURES OF SUSTAINABLE DEVELOPMENT:

The ecological economists have measured sustainability in trms of the following criteria:

1.**Pearce-Atkinson** ***Measure (PAM)***: **Pearce** and **Atkinson** proposed measure of 'week sustainability' which is an empirical application of the Hartwick rule. Pearce-Atkinson measure is known as genuine savings. According to this test, whether a

country is following the Hartwick rule by comparing the saving rate with the sum of depreciation of natural and man-made capital, all expressed as a fraction of national income. If all savings are reinvested in these two forms of capital, it is argued then the aggregate capital stock will not be falling, and a constant consumption stream can be maintained.

$$\text{PAM} = \frac{S}{Y} - \left[\left(\frac{\delta_m}{Y}\right) - \left(\frac{\delta_n}{Y}\right)\right]$$

Where S is savings, Y is income, S_m is depreciation of man-made capital (Km) and S_n is depreciation of natural capital (Kn).

Genuine savings measure is referred to as a weak sustainability measure since no special conditions are placed on the level of Kn. This can be allowed to decline so long as Km is built up in compensation. This follows from the substitutability assumption made in that Kn and Km are essentially regarded as identical in their in their ability to produce welfare.

CRITICISM OF PAM: Many economists have criticized the Pearce-Atkinson measure.

First, it is difficult to measure depreciation of natural capital empirically.

Second, it pays no attention to measures of intra-generational fairness in the distribution of income.

Third, since the measure of resource changes in genuine savings is a money measure, changes in resource prices may mark changes in physical stocks in either a more or a less sustainable direction.

2.THE INDEX OF SUSTAINABLE ECONOMIC WELFARE (ISEW): Daly and Cobb3 have formulated the index of sustainable economic welfare as the genuine progress indicator. The approach is to adjust elements of the conventional national accounts for wider determinants of welfare in a somewhat and hoc manner. These adjustments include an estimate for non-monetarised contributions to welfare (i.e., the services derived from unpaid household labour), deducting those public expenditures that are defensive (i.e., offsetting environmental degradation) in nature and net capital growth (an adjustment to account for the changes in the stock of man-made

capital). Deductions are also made for defensive private expenditure, the cost of environmental damage and an estimate of the costs associated with the loss of natural capital such wed lands. Therefore,

$$ISEW = C_{[adj]} + P + G + W - D - E - N.$$

Where C_{adj} stands for consumer expenditure adjusted to account for income distribution, P for non-defensive public expenditure, G for growth in capital and net change in international position, W for estimate of non-monetarised contributions to welfare, D for defensive private expenditure, E for costs of environmental degradation, and N for depreciation of natural capital.

Arising path of ISEW over time would indicate that an economy was becoming more sustainable, in the same sense as rising Green NNP is claimed to indicate increasing sustainability, a falling path would indicate the opposite. The measure is expressed in monetary terms, as are all adjustments except for the distributional weights.

Further, Cobb has formulated the Genuine Progress Indicator (GPI) to provide a new economic score-card that more accurately reflects the health of the economy in a common sense manner. GPI is essentially an estimate of the net production of services, may be capital or natural and human. There is similarity of elements in each index but there are some elements different from ISEW. They are the exclusion of both public and private defensive expenditures on health and education and the inclusion of deductions of cost estimates for the loss of leisure time, underemployment and the loss of forests.

A rising CGPI over time indicates that an economy is becoming more sustainable whereas a falling GPI reflects the opposite case. Both measure are based on current flows rather than stocks and thus do not really address the maintenance of capacity which some would argue is at the heart of sustainability.

3. ENVIRONMENTAL SPACE MEASURE (ESM): The environmental space as a measure of sustainable development is associated with the pioneer work of Schmidi-Bleek.[4] ESM is essentially concerned with the fairness of resource use in any one country, as measured relative to world average use of the resource. The technique involves comparing global mean use of a given resource expressed in per capita units, with national per capita consumption.

Resources chosen for study generally include non-renewable resources-arable land, forestry and water resources. Further, the use of resources in the production of goods. The life cycle analysis is used to estimate total resources consumption. It also includes masses of soil, rock removed and processed is winning non-renewable resources in the country.

CRITICISM OF – ESM:

1. Moffatt has criticized this measure on following grounds.

(a) Methodology: According the Moffatt, there are many flaws which exist within the environmental space methodology. These include the difficulties in specifying maximum and minimum permissible use rates for resources, carrying capacities and assimilative capacities. In addition, selection of the resources to be included is arbitrary. Moreover, it is impossible to aggregate across all different resources to obtain an overall environmental space for the country as measurement units differ.

(b) The Problem of Double Counting: It seems likely that resource may have double use. Therefore, the problem of double counting may arise in the analysis.

(e) Policy Matter: The policy ideal on which the measure is based seems so far removed from reality and is of doubtful usefulness.

4. ECOLOGICAL FOOTPRINTS MEASURE (EFM): An ecological footprint is the total area a person occupies in terms of land used for agricultural purposes, wood consumption and to absorb polluting emissions. Further, these are aggregated at the country level to show the relative impact on the planet of land consumed and compared to population levels.

***Rees and Wackernage*1[6]** have developed EPM as an indicator of sustainability. This is land-based measure which essentially compares human demands in country (I) in terms of consumption, with the extent to which those demands can be met from the land area in this country II) Energy, food and timber consumption per capita are expressed in terms of land areas necessary to produce these amounts. Given population figures, this can then be compared with available land area (excluding unproductive land) and a country's footprint on the world calculated.

Rees and Wackernagel study indicates that not all countries in the world can have a positive footprint. A positive ecological footprint is an indication of an unsustainable system in this method. Alternatively, in country (I)'s land demand in ha/capita can be compared with the world average. Exceeding this average has the same interpretation as having a positive footprint. Therefore, a positive foot print or ecological deficit means either that the country's natural capital is being depleted or that it is imposing part of its footprint on other countries viz importation.

EPM assumes that the only sustainable form of energy is that from renewable resources which is surely corrected in the long-run. Moreover, changes in the ecological footprint depend both on changes in per capita consumption levels and the growth of population.

ECONOMICS OF NATURAL RESOURCES MANAGEMENT: Basic human needs are fulfilled by materials provided by nature itself. They are air, water, soil, minerals, coal, petroleum, animals and plants. These stocks of the nature, useful to mankind are called natural resources. In primitive age, man had used only those resources that supported his life. But the process of economic growth and increase in population have led to mismanagement of natural resources.

There are two types of natural resources :

1) Non-renewable Resources:

These resources were formed in millions of years and hence will get exhausted sooner or later. Some non-renewable resources are coal, petroleum, natural gas, minerals etc. The stock of these resources is limited. They are susceptible to be degraded in quantity and quality by human activities.

2. Renewable Resources:

These resources are present in unlimited quantity in the nature. They are solar radiation, air and waste. These are not likely to be exhausted by human activities.

ROLE OF NATURAL RESOURCES IN ECONOMIC DEVELOPMENT:

The principal factor affecting the development of an economy is the natural resources such as the fertility of land. "Land" as used in economics includes natural resources

such as the fertility of land, its situation and composition, forest wealth, minerals, climate, water resources and sea resources etc. For economic growth, the existence of natural resources in abundance is essential. A country which is deficient in natural resources will not be in a position to develop rapidly. As pointed out by Lewis, "Other things being equal, men can make better use of rich resources than they can of poor."

In LDCs, natural resources are either unutilized, underutilized or misutilised. This is one of the reasons for their backwardness, The presence of abundant resources is not sufficient for economic growth. What is required is their proper exploitation. If the existing resources are not being properly exploited and utilized, the country cannot develop. J.L. Fisher has rightly said, "There is little reason to expect natural-resource development if people are indifferent to the products or services which such resources such resources can contribute."

This is the to economic backwardness and lack of technological factors. Therefore, natural resources can be developed through improved technology and increase in knowledge. In reality, as pointed out be Lewis, "the value of a resource depends upon it usefulness, and its usefulness in changing all the time through changes in tastes, technique or new discovery". When such changes are taking place, any nation can develop itself economically through the fuller utilization of its natural resources. For example, Britain underwent agricultural revolution by adopting the method of rotation of crops between 1740 to 1760. Similarly, France was able to revolutionise its agriculture on the British pattern despite shortage of land. On the other hand, the countries of Asia and Africa have n to been able to develop their agriculture because they have been using old methods of production.

It is often said that economic growth is possible even when an economy is deficient in natural resources. As pointed out by Lewis, "A country which is considered to be poor in resources today may be considered very rich in resources at some later time, not merely because unknown resources are discovered, but equally because new uses are discovered for the known resources". Japan is one such country which is deficient in natural resources but it is one of the advanced countries of the world because it has been able to discover new uses for limited resources. Moreover, by importing certain raw materials and minerals from other countries, it has been successful in

overcoming the deficiency of its natural resources through superior technology, new researches, and higher knowledge. Similarly, Britian has developed without non-ferrous metals.

Thus for economic growth the existence of abundant natural resources is not enough. What is essential is their proper exploitation through improved techniques so that there is little wastage and they could be utilized for a longer time.

CONSERVATION AND MANAGEMENT OF NATURAL RESOURCES: Growing population at the global level and a desire to uplift the standard of living by the development of science and technology have affected the environment a great deal. Natural resources are being misused in the name of industrial and urban development that has put all life into danger. Today, a state of imbalance has been created in environment due to consumerist culture and impatient use of natural resources.

Man is an integral part of the environment, exchanging materials with the environment in a continuous cycle. With the increase in population, he needs more space to utilize resources from other places which he had not exploited earlier. It must, therefore, be realized that as an individual he should try to conserve his environment and use natural resources in a rational manner so that human race is not exposed to environmental hazards.

MEANING AND OBJECTIVES OF CONSERVATION:

Conservation has been defined as management for the benefit of all life, including human kind, of the bio-sphere so that it may yield sustainable benefits to the present generation while maintaining its potential to meet the needs and aspirations of the future generations.

The objectives of conservation are: (a) to focus on relative aspects to environment protection through conservation; (b) rational use of natural resources; and (c) protection of earth for sustainable lifestyles.

CONSERVATION OF NON-RENEWABLE RESOURCES:

1.**Energy Conservation**: The question of is how much energy necessarily involves a basic issue concerning man, his life style, and his environment. Similarly, the

question of how much energy is needed to keep these wheels of society well lubricated and moving is one of the difficult questions. They type of energy conservation includes the following measures:

Improving the efficiency of energy supply systems, (b) decreasing the energy-intensiveness of a given standard of living through acceptable life style changes (e.g. thermostat settings, lighting levels, or smaller cars and car-pooling), and (c) shifting from gas or electricity to solar energy system.

Energy influences practically every single economic activity and its availability and cost determine the economic future and well-being of the nation as well as the quality of life. Optimum conservation of energy implies use for the benefit of mankind on a long-term rather than on a shot-term basis and to prevent unnecessary wastages. As such, conservation of energy can bring about substantial gain to the utility of human life, The production of coal, electricity and natural gas is not adequate to all as per our present requirements. It is important to use economically the available resources and compensate the scarcity with alternatives which society faces today.

Energy is only a means to the end of economic well-being. Energy frees man from heavy labour. It enables him to use low cost resources and to create many physical comforts. It is important to know, however, that the amount of energy used as a function of its price relative to the price of its substitutes/alternative sources. Therefore, energy conservation simply becomes the implementation of cost-effectiv eness or socially desirable substitutes.

Specific energy conservation actions are deemed desirable if one of the two criteria is met : (a) the value of the energy saved equals or exceeds the additional operating cost or investment (both appropriately discounted) required to achieve it; (b) compared to the alternate measure to increase energy supply; and (c)the particular conservation option is superior in terms of total cost (including capital investment, enerfy price, economic and environment impact) of non-exhaustive source of e energy.

2. MINERAL CONSERVATION:

D.Meadow is of the view that at the present rate of expansion, silver, tin and uranium may being short supply even at higher prices by the turn of the century. By the year

2050, several more minerals maybe exhausted if the current rate of consumption continues.

Non-renewable energy resources like coal, oil and natural gas cannot be recycled or reused. Some material resources such as copper and aluminium can be recycled or reused to some extent. Pollution from mining can be reduced by efficient methods.

Mineral oil is the greatest demand in modern industry, and it supplies half the world's energy. Natural gas may occur in association with petroleum in the uppermost part of an oil reserve. In fact, exploitation in all parts of the world is continually extending the known resources of energy despite the fact that production and consumption continue to increase every year. This exhaustive source of energy, in which our country has almost sixty per cent slef-efficiency in production, invites conservation initiatives.

CONSERVATION OF RENEWABLE RESOUCES: Conservation of land, soil, minerals, water, vegetation and wildlife which is very essential in ensuring a continuous yield of plants used as food and other materials for the growing population.

1. Soil Conservation: Soil is the top cover of the earth in which plants can grow. Top soil is essential for the growth of plants which in turn provides food for human beings and animals. But rain water, wind and other natural forces gradually erode the top soil. Farmers can reduce soil erosion by planning trees, strip cropping and crop rotation methods etc.

2. Water Conservation: Conjunctive use of surface and ground water should be encouraged to atomize the water use and to alleviate the degradation of water and soil resources. Some of the measures include; (a) avoiding wastage of water, and encourage recycling of water; (b) reducing water pollution by treating sewage and factory wastes before disposing them; and (c) adopting various technologies for groundwater recharge such as use dug-wells and ponds.

3.Forests Conservation: Forests are homes for a number of wild animals. For man, these provide fuel, coal, timber, paper, rubber and lac, etc. They protect water loss from top soil and thus prevent formation of deserts. They help in regulating rainfall, avoid erosion, silting of streams and floods.

During World War If, the indiscriminate felling of trees has resulted in the denudation of areas and frequent floods. Thus realizing the importance of forests, reforestation programmes have been put into effect in several countries. For reforestation, knowledge of ecological succession and climax community is very essential. If the valuable trees are climax in a particular forest, the ecological problem is to speed the return of the climax community after the trees have been cut. Presently, various insecticides and pesticides are being used to destroy the insects and posts in forest lands.

4. Fish conservation: Man is trying to supplement his existing food resources through an increased yield of fish from ponds, lakes, rivers and seas. In his own interest, man has reduced the number of certain species of fish by overfishing. The number of reduced vrieties cn be restored by implementing the following steps:

(a)Regulation of rate of fishing and of fish production.

(b)Prohibition of overfishing

(c)Taking fish of the optimum size. Very young and sexually nature fishes should not be caught.

(d)Rate of fish breeding should be increased.

For increased yield of fish, artificial breeding under controlled conditions in lakes, ponds, rivers and seas are also practiced. This needs proper attention to the physic-Chemical factors of the environment such as temperature, light, salinity, abundance of food and breeding grounds.

5.Biodiversity Conservation: The increasing human pressureon wildlife had led to the extinction or disappearance of some of the species. There is over-exploitation of animal species for commercial use, such as the selling of the skins of leopards, tigers and other animals. Even their teeth and claws are sold. Global trade in wildlife is estimated to be over 20 billion US dollors annually. Global trade includes atleast 40,000 primates, ivory from at least 90,000 African elephants, 1 million orchids, 4 million live birds, 10 million reptile skins, 15 million furs and over 350 million tropical fish.

OECD divides incentive measures for the conservation and sustainable use of biodiversity into the following categories:

1. Positive Incentives:

The mechanisms (monetary or otherwise) that encourage governments, organizations and individuals to protect biodiversity.

2.Disincentives :

The internalization of the cost of use and damage to biodiversity, thus discouraging behaviours that deplete it.

3. Indirect Incentives: Eco-labels for the biological resources should be encouraged.

4. People's Participation :

An effective and practical approach is to involve a competitive task-force of the local people in the biodiversity process.

5. Ban on Trade : A ban on the exploration and export of rare and endangered animals and plants should be legally imposed by the governments.

6. Other Steps : There are technical, social and legal steps for the conservation and restoration of biodiversity:

(a)Planning and co-ordinated efforts for sustainable use of biodiversity within the management systems for forestry, fisheries and agriculture.

(b)Conserving genetic diversity in existing domesticated plant and animal varieties.

(e)Equitable sharing the benefits of biodiversity through social and economic instruments

(d) Building human and institutional capacity to integrate measures at bio-regional scales.

There are many other issues related to socio-economic measures important for biodiversity conservation such as the investments required, monitoring mechanisms, information base and involvement of people particularly living in rural areas.

UNIT – IV

VALUING THE ENVIRONMENT:

Value can be broadly categorized as either instrumental or intrinsic, Instrumental value refers to the capacity of something when used, to satisfy a want or preference. Intrinsic value is regarded by ecological economists as being inherent in something.

Instrumental of use value, can be defined as "accruing from those benefits which are attributed to present consumption of the resources". A distinction is made between direct and indirect use values. Direct use value may emerge from exchange or outside of exchange through self-consumption of resources to which individuals have access. On the other hand, indirect use value is the main consequence of the ecological functions that the natural resources perform. There is also option value and existence value and existence value. Option value refers to willingness of the people to keep the option of postponing the decision on the use of the resources. Existence value represents the value which an individual is willing to pay for the environmental amenity, even though that person receives no direct value. The existence value is often termed as non-use value.

Conceptually, the total economic value(TEV) of a resource consists of its use value (UV) and non-use value (NUV)

$$TEV = UV + NUV \qquad \ldots\ldots(1)$$

Further, use value may be divided in to direct use value (DUV), the indirect the value (IUV) and the option value (OV). Therefore, equation (1) can be rewritten as

$$TEV = [DUV + TUV + OV] + [NUV]$$

In the context of uncertainty, quasi option value is said to define the value of preserving options for future use in the expectation that knowledge about the potential benefits or costs is associated with the option.

The basix concept of economic valuation underlying all these techniques is the Willingness to pay (WTP) of individuals for an environmental service or resource. A measure used in survey-based valuation techniques, known as contingent valuation method, indicates an individual's willingness to pay money to obtain some derived

level of a good or service for n improved environment. The WTP measure is used when market prices do not exist.

Another concept of economic valuation is Willingness to Accept (WTA). It is a measure of what an individual would have to be given to cause him/her to accept a loss in welfare caused by, for example, a decline in the level of resources or environmental quality. The WTA measure indicates the monetary equivalent that would be necessary to compensate for the welfare loss from the change.

NEED FOR ENVIRONMENTAL VALUATION:

The need for environmental valuation arises for the following:

(i) Environmental Litigation :

Non- market demand valuation have traditionally been used by government to assess the damage compensation and need for further changes in environmental policy

(ii) Environmental Dispute Resolution :

Environmental disputes frequently arise with respect to logging, new water storage, new mines, power stations and resort development etc. Estimates of environmental values potentially has a role to play in supporting more informed decision making in these cases, and in making decisions more transparent to stakeholders.

(iii) Guiding Environmental regulations :

Policy makers have to take decisions regarding environmental regulations. They will be better informed if environmental damage cost considerations are taken into account.

(iv) Evaluating Proposed Environmental Programmes:

A Public cost-benefit framework is appropriate to assess the desirability of government initiative, such as green house gas reduction programmes and health programmes. These usually involve various social and environmental impacts of these programmes which the policy makers want to assess.

METHODS OF ENVIRONEMNTAL VALUATION:

The following methods are used for environmental valuation :

(A) Expressed Preference Methods:

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

CONTINGENT VALUATION METHOD (CVM):

Analytic survey techniques rely on hypothetical situations to place a monetary value on goods or services. Most survey-based techniques are examples of contingent valuation method. Contingent valuation frequently elicits information on willingness to pay or willingness to accept compensation for an increase or decrease in some usually non-marked goods or services.

This method puts direct questions to individuals to determine how much they might be willing to pay for environmental resources or how much compensation they would be willing to accept if they were deprived of the same resources. This method is more effective when the respondents are familiar with the environmental good ro service and have adequate information on which to base their preferences.

We will discuss trade-off game method, costless-choice method, and Delphi method as part of contingent valuation approach.

Trade-off Game Method:

This method relates to a set of contingent valuation techniques that rely on the creation of hypothetical market for some good or service. In a single-bid game the respondents are asked to give a single bid equal to their willingness to pay or willingness to accept compensation for the environmental good or service described. In an iterative (repeating) bid game the respondents are given a variety of bids to

determine at what price they are indifferent between receiving (or paying) the hid or receiving (or losing) the environmental good as issue.

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

COSTLESS-CHOICE METHOD:

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

DELPHI METHOD:

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

This is really a specialized survey technique designed to overcome the speculative and isolated nature of expert opinions. A sufficiently large sample of experts is presented individually with a list of events on which to attach probabilities and to which other events, with probabilities may be added. Some recent Delphi exercises have been recreation-specific. But testing the accuracy of their forecasts is not yet possible, especially since the predictions are only meant to be general perspectives.

(B) THE REVEALED PERFERENCE METHODS:

The demand for environmental goods can be revealed by examining purchases of related goods in the private market place. There may be complementary goods or other factor inputs in the household's production function. There are a number of

revealed preference methods such as travel cost method, hedonic price method and property value method.

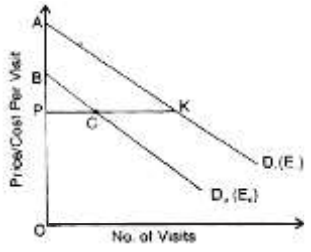
Travel-Cost Method:

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

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

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

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



The travel cost method is esplained in above Figure suppose there is a single lake in a city, where the entry fee is OP which is fixed per visit. Initially, recreational demand

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

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

ITS CRITICISM:

1. This approach is most successful where there is wide variation in the travel cost of various users and where recreation at the site in question will be the primary objective of visits. But wide variations in tastes and preferences and substitute availability at different distances from the site, distort demand estimates.

2. The travel–cost method is of limited value if congestion is a problem. Small changes effecting recreational quality may be difficult to evaluate using this method.

3. The basic assumption of travel-cost method is that consumers treat increase in admission fees as equivalent to increase in travel cost. This is subject ot question.

4. Another problem associated with this method is tht it assumes recreational quality remains constant over the range from zero use to full present use at the going admission fee. This is highly hypothetical.

5. **Bateman**[2] is of the view that the travel-cost method measures only the use value of recreation sites. Underestimation of site value due to the truncation of non-visitors would be made worse if the non-use value of both visitors and non-visitors were relevant. This method is not capable of producing any total economic value estimate in that it cannot estimate non-use items such as existence value.

THE HEDONIC PRICE METHOD:

The underlying assumption of the hedonic price is that the price of a property is related to the stream of benefits to be derived from it. The method relies on the hypothesis that the prices which individuals pay for commodities reflect both environmental and non-environmental characteristics. The implicit prices are sometimes referred to as hedonic prices, which relate the environmental attributes of the property. Therefore, the hedonic price approach attempts to identify how much of a property differential is due to a particular environmental difference between properties, and how much people are willing to pay for an improvement in the environmental quality that the face and what the social value of improvement is.

The hedonic price method is based on consumers which postulates that every good provides a bundle of characteristics or attributes. Again, made goods can be regarded as intermediate inputs into the production of the more basic attributes that individuals really demand. The demand for goods, say housing can, therefore, be considered as a derived demand. For example, a house yields shelter, but through its location it also yields access to different quantities and qualities of public services, such as schools, centres of employment and cultural activities etc. Further it accesses different quantities and qualities of environmental goods, such as open space parks, lakes etc.

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

The hedonic price function describing the house price *Pi* of any housing unit is given below: $Pi = f [S_{li} \ldots\ldots S_{ki,} \ N_{li} \ldots\ldots\ldots N_{mi}, \ Z_{li} \ldots\ldots\ldots Z_{ni}]$

Where, S represents structural characteristics of the house i. i.e., type of construction, house size and number of rooms, N represents neighborhoods characteristics of house i, that is accessibility to work, crime rate, quality of schools etc. It is assumed that only one environment variable affects the property value i.e., air quality (2).

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

$P_1 = [a_o + a_1S_{li} + \ldots\ldots\ldots a_kS_{ki} + \beta_1N_{li} + \ldots\ldots\beta_mN_{li} + \gamma_aZ_a]$

and $\gamma_a > 0$.

Theerre is a positive relation between air quality and property price as shown in Figure -1. The figure indicates that house price increases with air quality improvement.

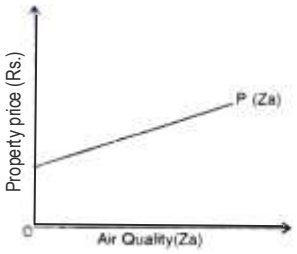


Figure -1.

Figure -2.

Figure-2 indicates that the implicit marginal purchase price of Z_a (air quality) varies according to the ambient level (Z) prior to the marginal change.

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

Its Criticism

1. This method is of no relevance when dealing with many types of public goods i.e., defence, nationwise air pollution and endangered species, etc. as no prices are available for them.

2. The hedonic price method may be used to estimate the environmental benefits provided to local residents by an area as it exists today. But in fact, it cannot reliably predict the benefits which will be generated by future improvements because those improvements will have the effect of shifting the existing function.

3. Another problem is whether an individual's perception and consequent property purchase decisions are based upon actual or historic levels of pollution and environmental quality. If expectations are not the same as measured by present pollution estimate, then are clearly problems relating to value derived from purchases.

4. Moreover, expectations regarding future environmental quality may bias present purchases away from that level dictated by present characteristics levels.

5. This method has been criticized for making the implicit assumption the households continually re-evaluate their choice of location.

6. Further, there is considerable doubt that such an assumption can hold in the context of spatially large study areas. If people cluster for social or transportation reasons, the results of this method will be biased.

(3) *Preventive Expenditure method* :

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

In the preventive expenditure method, the value of the environment is inferred from what people are prepared to spend to prevent its degradation. The ***averting or mitigating behavior*** method infers a monetary value for an environmental impact. For example, by moving to an area with less air pollution at a greater distance from their place of work thus incurring additional transportation costs in terms of time and money. Both of these methods are again, conceptually closely linked.

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

(4) Surrogate Markets :

When no market existsfor a good or service and therefore, no market price is observed, the surrogate (or substitute) markets can be used to derive information n on values. For example, travel-cost information can be used in estimate value for visits to arecreational area; property value data are used to estimate values for non-marked environmental attributes such as view, location or noise levels.

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

(5) Property-value Method :

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

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

(6) Wage-differential Approach:

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

Wages also very in response to various factors such as education and training, natural dexterity, experience, demand and supply in each labour market area, occupational

risks to health, probability of death, and associated living conditions including environmental ambience etc.

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

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

Where, P is the payment rate for a given job, J is a vector of another job-related attributes e.g. working hours, holiday, sickness benefits etc., R is the risk of death and S is a vector of skills required to do the job.

The hedonic wage approach has traditionally been used to measure employment attributes, principally risk of death or injury in particular labour markets. However, by observing variations in wage levels over space, and netting out the influence of other attributes, they have also been used to value the quality of life over large areas such as countries or continents.

(C) COST BASED METHODS: Cost ***based methods are discussed below***:

(1) Opportunity Cost Method:

This method values the benefits of environmental protection in terms of what is being forgone to achieve it. This forms the basis of compensation payments for the compulsory purchase by the government of land and property under eminent domain laws. Further, it assumes that the land owner or user has property rights over the use of the land or the natural resource, and that to restrict these rights the government, on behalf of the society, must compensate the owner.

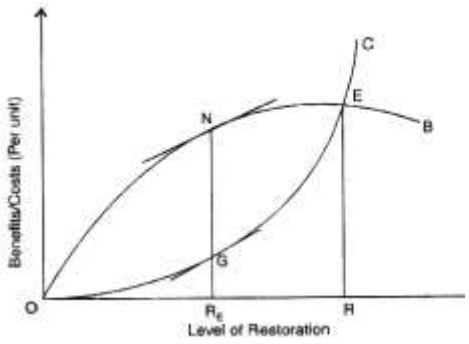
The opportunity cost method does not include non-marketed public good values of land. The fact that land and its attributes produce externalities is explicitly recognized in regulatory land-use planning controls, which seek to minimize external 'bads' through development control and land-use class orders, by separating externality producing land uses spatially. Thus planning controls seek to preserve amenity benefits by restricting the development of land. However, by imposing such restrictions, the price of land, such as green belt land, has a lower financial value than its opportunity cost value.

(2) Relocation Cost Method:

This is a cost-based technique used to estimate the monetary value of environmental damages based on the potential costs of relocating a physical facility that would be damaged by a change in environmental quality. The method relies on data on potential expenditures.

This is a Cost-based technique that measures the potential expenditures that would be required to replace or restore a productive asset that would be damaged by some project or development. These costs are then compared to the costs of preventing the damage from occurring to determine which in more efficient.

If an environmental resource that has been impaired is likely to be replaced in future by another asset that provides equivalent services, then the cost of replacement may be used as a proxy for the environmental damage, assuming that the benefits from the original resources are at least as valuable as the replacement expenses. A shadow project is usually designed specifically to effort the environmental damage caused by another project. For example, if the original project was a dam the inundated some forest land, then the shadow project might involve the replanting of an equivalent area of forest elsewhere. It values an environment good by the cost incurred in restoring the environment to its original state of level after it has damaged.



The above figure the benefits and costs per unit are measured on the vertical axis while the level of restoration is at the horizontal axis. The restoration level means to replace the lost environmental good. The slope of curve B indicates that with the increase in restoration level, benefits increase at a decreasing rate. The slope of curve C indicates that the restoration costs are an increasing function of the level of restoration. The economic efficiency is achieved at the restoration level OR_E where

the difference between curve B and curve C is the maximum. The net NG at this level of restoration.

(D) OTHER METHODS: There are some other methods of valuing the environment.

(1) Dose-Response Method: The method requires information on the effect that a change in a particular chemical or pollutant has on the level of an economic activity or a consumer's utility. For example, ground level of air pollution, such as ozone, affect the growth of various plant species differentially. Where this results in a change in the output of a crop, the loss of output can be valued at market or shadow (adjusted or proxy) market prices.

Dose response relationships or production function approaches, are perhaps the most familiar valuation techniques. Essentially, a link is established between say, a pollution level and a physical response, for example, the rate at which the surface of a material decays. The decay is valued by supplying the market price (costs of repair) or by borrowing a unit valuation from non-market studies. Notable examples include the valuation of health damage. Once air pollution is linked to morbidity and morbidity is linked to days lost from work, the day us lost can be valued, perhaps using a market wage rate. The main effort of the analysis is devoted to indentifying the link between dose and the response.

(2) Human Capital or Foregone Earning Approach:

The human capital approach values environmental attributes through their effects on the quantity and quality of labour. The loss earnings approach focuses on the impact which adverse environmental conditions have on human health and the resultant costs to society in terms of income lost through illness, accidents and spending on medical treatments.

The principle involved in this approach is that of valuing life in terms of the value of labour. Given adequate data regarding lifetime earning participation rates in the labour force mortality rates, etc., it is possible to estimate the value of the expected future earnings of individuals in any age group. On the assumption that wage rates are a precise indicator of productivity, the same measure with some adjustmen t to allow for social preferences being different from private preferences can be used as measure of the value of the future output of the individual to society. The social

values emerging are usually referred to as the economic value of life. The other being non-economic or intangible aspects which are additional to that part of life which the method has been able to measure. This type of valuation system is the one most commonly found in practice.

The adjusted stream of life-time earnings has to be discounte4d to convert it to present value terms. This present value stream of future earnings with these various adjustments made, represents the human capital value of life span. In some cases, the measurement of lost output is taken net of consumption and in others a gross figure is used. The reasoning behind the adoption of a net of consumption estimate is that when a worker dies due to an accident that occurs in factory, the earnings of the workers will be stopped. The society loses the difference between what he would have produced and what he would have consumed.

DIFFICULTIES IN MEASURING ENVIRONMENTAL VALUES: We discuss some problems of measurement of environmental values:

1. Market Price:

When there are adverse health effects and loss in productivity due to environmental damage, market pieces are to evaluate them. The procedure is to evaluate damages due to soil erosion, deforestation, and air and water pollution. For this purpose, the ecological relationship between environmental damages and its effects on production or health are estimated on the basis of prices to derive monetary values. Welfare losses relating to health risks due to polluted environment are measured by income foregone because of illness or premature death. Such estimates are difficult to compute because they rely on loss in income.

2. Costs of Replacement:

People and firms invest in installing alternate devices to avert environmental damage of air, water and land. Such investments can provide an estimate of environmental damage. But the effects of damages cannot be evaluated.

3. Surrogate Markets:

The effects of environmental damages on other markets like property values and wages of workers are also evaluated. Valuation in the case of property is based on

risks involved in evaluating the value of property due to environmental damage. Similarly, jobs with high environmental risks will have high wages which will include larger risk premiums. But this technique is impracticable because property owners and workers are ignorant of the effects of environmental damages.

4. Social Discount Rate: Environmental degradation leads to costs and environmental improvements confer benefits on resource users.

1.The problem of measuring environmental damage is to evaluate it and compare it with the cost of preventing it. It concerns comparing the benefits of environmental protection with the costs incurred on it.

2.But the main problem is how to measure costs and benefits of f environmental effects on the present and future generations. For this, a rate of discount is needed for discounting all costs and benefits. But there is lot of confusion and differences among economists in discounting environmental costs and benefits on the following grounds:

Critics do not favour discounting in general and high discount rates in particular. According to them, there is no unique relationship between high discount rates and environmental degradation. When discount rates are high, the level of investment falls which discourages development projects and slows down the pace of development. In thus shifts the burden of high costs to future generations. Even demand declines for resources on which investments are to be made.

However, the main problem is how to choose a social discount rate. This cannot be the market rate of interest because of uncertainties and imperfections of capital markets. Therefore, the majority of economists measure the social rate of discount at government's borrowing rates on long-term securities because they are riskless. But there are numerous borrowing rates on government securities relating to different time periods. The problem is which rate to choose as the social discount rate.

Many economists, therefore, favour social rate of time preference and opportunity cost of capital in measuring the cost and benefit of environmental degradation. But like the social discount rate, they have their problem of measurement and the effects on environmental degradation on the present and future generations are unclear.

UNIT - V

ENVIRONMENTAL LAWS IN INDIA: ***Objectives of Environmental Laws***: The objective of environmental law is to preserve and protect the nature's gifts from pollution. Further, the objective of environmental law is to protect the man's fundamental fights of freedom, equality and adequate conditions life in an environment of quality that permits a life of dignity and wellbeing.

The Constitution of India Obligates the state as well as citizens to protect and improve the environment. The Constitution (Forty-Second Amendment) Act, 1976 and Article 51A(g) cites. "The requirement of the time is that are should be real citizens of the country striving towards excellence in all spheres of individual and collective activity including the protection of environment.

THE ROLE OF MINISTRY OF ENVIRONMENT AND FORESTS: The Department of environment was created in Nov.1981 and since then it has acted as a nodal agency for environmental protection. It has also been assigned administrative responsibility for pollution monitoring and regulation, as well as conservation of ecosystems and biosphere reserves. It has set up a computerized Environment Information System at Botanical Survey of India. There is also the Ministry of environment and Forests which performs the following functions in the country: 1. Survey of natural resources in the country. 2. Conservation of natural resources including forestry and wildlife. 3. The management action plans for wetlands and coral reefs of Andaman and Nicobar. 4. Lake conservation. ***5. Biodiversity conservation***: The convention on biodiversity was ratified by India on 18th February, 1994 and it has come into force from 19th May, 1994. ***6. Forest Conservation***: Out of the 6253proposal received till date under the Forest conservation Act 1980, more than 3232 proposals have been approved so far. ***7. Wildlife Conservation***: The network of protected areas in the country now consists of 89 national parks, 490 sanctuaries and 13 biosphere reserves covering an area of 1,48,700 sa.km. ***8. Animal Welfare***: Twentyone States/UTs have so far constituted State Advisory Boards and 29 States have appointed Nodal Office for Animal Welfare. 9. Environmental Information System: environmental information system network with its 20 centres on various subject areas continues its activities in environmental information collection, storage retrieval and dissemination to all concerned. ***10. Forestry Education and Research***: The Indian Council of Forestry Research and Education is the main forestry research and education centre in the country. It organizes seminars and conferences on forest management.

THE WATER (PREVENTION AND CONTROL OF POLLUTION) ACT, 1974: Water pollution has assumed such high proportion today that not only the aquatic eco-systems are greatly damaged but even the lives of animals no land are threatened. The pollution of rivers, lakes and seas is a direct result of the population explosion and large scale industrialization. The water (Prevention and Control of pollution) Act

was passed by the Parliament in 1974 to tackle this problem. The Act tends to provide legal deterrents against the spread of water pollution.

Its Objectives: The ***Act was passed with the following objectives***: 1.***To Control Water Pollution***: The main objectives of this Act was to provide for the prevention and control of water pollution and maintaining or restoring of wholesomeness of water (in streams or wells or sewer or on laundry). 2.***To Maintain the Quality of Water***: It was realized that on account of large scale discharge of industrial waste into the rivers an d streams, the quality of water as well as its utility have been adversely affected. In this direction, the Act was passed and there was provision to take action against industries or persons in-this regards. 3. ***Establishment of Central and State Boards***: The Act made provisions for establishment of Central and State Boards with a view to carry out the above objectives.

The Water (Prevention and Control of Pollution)Act,1974 has defined some terms related to water pollution:

1.Pollution: Under this act, pollution means such contamination of water or such alternation of the physical, chemical or biological properties of water of such discharge of any sewage or trade effluent or of any other liquid, gascous of solid substance into water (whether directly or indirectly) as may, or is likely to create a nuisance or render such water harmful or injurious to public health or safety, or to domestic, commercial, industrial agricultural or other legitimate uses, or to the life and health of animals or of aquatic organisms. **2. Trade Effluent**: Trade effluent includes any liquid gaseous or solid substance which is discharged from any premises used for carrying on any (industry, operations or process or treatment and disposal system) other than domestic sewage. **3. Sewage Effluent**: Sewage effluent means effluent from any sewerage system or sewage disposal works and includes sullage from open drains. **4. Outlet**: Outlet includes any conduit pipe or channel, open or closed, carrying sewage or trade effluent or any other holding arrangement which causes, or it likely to cause pollution.

POWERS AND FUNCTIONS OF CENTRAL POLLUTION CONGTROL BOARD: The following are the powers and functions of central and State Pollution Boards as per Water (Prevention and Control of Pollution)Act,1974. ***The Central Pollution control Board (CPCB)has to perform the following functions***: ***1.Adviser To Government*****:** CPCB advises the central government on any matter concerning the prevention and control of water pollution is India. ***2. Coordinate Activities***: It coordinates the activates of the State Pollution Control Boards and resolve disputes. ***3. To publish Statistical Data***: CPCB collects, compiles and publishers technical and statistical data related to water pollution. It suggests measures for its effective prevention and control. ***4. To organize Training*** : It plans and organizes the training of persons engaged or to be engaged in programmes for the prevention, control or abatement of water pollution. ***5. To Sponsor Research*** : It provides technical assistance and guidance to the State Pollution Control Boards for carrying out

research. It sponsors investigations and research relating to problems of water pollution and prevention.

POWER AND FUNCTIONS OF STATE POLLUTION CONGTROL, BOARDS: ***The State Pollution Control Board has to perform the following functions***: **(i) Adviser to State Government**: It advices the State Government any matter concerning the prevention, control or abatement of water pollution. **(ii) Setup Effluent Treatment Plants**: The Board inspects works and plants for the treatment of sewage and to review plans for the purification of water. **(iii) Coordinate Activities**: The Board Coordinates the activities of Central Water Pollution Control Board and resolves disputes. **(iv) Effluent Standards**: It lays down, modify or annual effluent standards for the sewage and grade effluents. It evolves methods of utilization of sewage and suitable trade effluents in agriculture. **(v) Laboratory Testing**: The Board may establish laboratories to test the samples of water from any stream or well or of samples of any sewage or trade effluents.

PROMOTION ON USE OF STREAM OF WELL FOR DEPOSAL OR POLLUTION OR WATER :

(a)No person shall knowingly cause or permit any poisonous, noxious or polluting matter determined in accordance with such standards as may be laid down by the State Board to enter (whether directly or indirectly) in to any stream or well or sewer or on land, or

(b) No person shall knowingly cause or permit to enter into any stream any other matter which may lend, either directly or in combination with similar matters, to impede the proper flow of the water of the stream in a manner leading or likely to lead to a substantial aggravation of pollution due to other causes or of is consequences.

RESTRICTIONS ON NEW OUTLETS AND NEW DISCHARGES BY INDUSTRY OR ANY PERSON : No person shall, without the previous consent of the State Board, establish or take any steps to establish any industry, operation or process, or any treatment and disposal system or any extension or addition thereto, which is likely to discharge sewage or trade effluent into a stream or well or sewer or on land.

PENALTIES UNDER THE WATER ACT, 1974: Failure to comply with the directions of the Act shall, on conviction, be punishable with imprisonment for a term which may extend to three months or with fine which may extend to ten thousand rupees or with both and in case the failure continues, with an additional fine which may extend to five thousand rupees for every day during which such failure continues after the conviction for the first such failure.

THE AIR (PREVENTION AND CONTROL OF POLLUTION) ACT, 1981: The Act has been passed to provide for the prevention, control and abatement of air pollution. According to its statement of objectives, "Various pollutants discharged

through industrial emission and from certain human activities connected with traffic, heating, use of domestic fuels, and refuse have a detrimental effect not only on the health of the people, but also on animal life, vegetation and property."

***The are some important definitions mentioned in this Act*: 1.Air Pollutant**: It means any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment. **2. Automobile**: It means any vehicle powered either by internal combustion engine or by any method of generating power to drive such vehicle by burning fuel. **3. Chimney**: It includes any structure with an opening or outlet from or through which any air pollutant may be emitted.**4.Emission** : It means any solid or liquid for gaseous substance coming out of any chimney, duct or flue or any other outlet.

The Act was amended in 1987, Failure to comply with the provisions of this Act or directions shall be punishable with imprisonment for a term which shall not be less than one year and six months but which may extend to six years and by imprisonment for a term which may be extended to Ten Thousand Rupees or with both. But in the case at continuing contravention with an additional fine which may extend to Five Thousand Rupees for everyday during which such contravention continues after conviction of the first such contravention.

In contravention of the New Industrial Policy of 1980, the Act extended certain rule for setting up of industries in the country. It issued new guidelines in this regard; (a)clearance certificate from State Pollution Control Board; (b) shifting of industries from urban areas; (c) industries have to follow the air quality measurements as per State/Central pollution boards; and (d) replacement of pollution generating machinery.

POWERS AND FUNCTIONS OF CENTRAL AND STATE POLLUTION CONTROL BOARDS: ***The Central Pollution Cannot Board has to perform the following functions***: **1.Adviser to Government**:CPCB advise the Central government on any matter concerning the prevention and control of air pollution in India. **2. Co-ordinate Activities** : It coordinates the activities of the State pollution Control Boards and resolves disputes. **3. To Publish Statistical Data** : CPCB collects, compiles and publishes technical and statistical data related to water pollution. It suggests means for its effective prevention and control. **4. To organize Training** : It plans and organizes the training of persons engaged or to be engaged in programmes for the prevention, control or abatement of air pollution. **5. To Sponsor Research**: It provides technical assistance and guidance to the State Pollution Control Boards for carrying out activities, It sponsors investigations and research relating to problems of pollution and prevention. ***The State Pollution Control Board has to perform the following functions: (1)Adviser to State Government:*** It advises the State Government any matter concerning the prevention, control or abatement of air pollution. ***(2)Coordinates Acti*vities: The State Pollution Control Board coordinate the

activities of Central Pollution Control Board and resolves disputes. ***(3)Effluent Standards***: It lays down, modify or annul effluent standards. ***(4)laboratory Testing***: The Board establishes laboratories to test air pollution.

THE ENVIRONMENTAL (PROTECTION) ACT, 1986:The water (Prevention and Control of Pollution) Act was passed is 1974. It aimed at maintaining the purity of water by preventing water pollution and provided for establishment of Pollution Control Board at State level. Similarly the Air (Prevention and Control of Pollution) Act was passed in 1981 to control air pollution. Inspite of these Acts, it was realized that environment was deteriorating at an alarming rate in the country. Therefore, a more comprehensive and general piece of legislation was framed in the form of the Environmental (protection) Act, 1986. ***The Act was passed with the following objectives***: **1. To Improve the Quality of Environment**: Under this Act, the Central Government has the power to take all such resources as it deems necessary for the purpose of protecting and improving the quality of Environment. **2. Safe Limits** : The Act lays down standards for emission or discharge of Environmental pollutants from various sources. Moreover, it restricts the areas in which any industry operations or processes or class of industries shall be carried out subject ot certain safeguards only. **3. Handling of hazardous Substances**: The Act was passed for the protection, regulation of discharge of environmental pollutants and handling of hazardous substances. **4. Prevention of Accidents** : The Act lays down procedures and safeguards for the prevention of accidents which may cause environmental pollution and remedial measures for such accidents and deterrent punishment to those who endanger human environment, safety and health.

SALIENT FEATURES OF THE ACT: Environment has been widely defined under the Act as inclusive of "Interrelationship that exists among and in between water, air, land and human beings, other living creatures, plants, micro-organisms and property."

(a)This Act is said to be a more effective and bold measure to fight the problem of pollution as compared to all the previous laws in this regard. Under the Act, the Central Government has been empowered to take all appropriate measures to prevent and control pollution and to establish an effective machinery to achieve this object. Until such a new machinery is established, the existing machinery will be used for implementation of the Act.

(b) The Act enables the Central Government 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. The Central Government is also empowered to constitute and authority for exercising the power vested in it and to frame rules for that purpose.

(c) The Act has adopted a new stand with regard to the question of *locus standi* so that now even a citizen has the right to approach a court provided he has given notice of

not less than 60 days of the alleged offence and his intention to made the complaint to the Central Government or the competent authority.

(d) The Act strengthens the penal provisions. The maximum penalties for contravention of Act are imprisonment up to five years or fine up to one lakh rupees or both. If the failure or contravention continues beyond a period of one year after the date of conviction, the offender shall be punishable with imprisonment for a term which may extend to seven years.

(e) The Government has been given the powers to collect samples of air, water, soil or other substances as evidence of the offences under the Act.

(f) The Act applies to the pollution generated by the Government agencies as well, where an offence under this Act has been committed by any department of Government. The Head of the Department shall be deemed to be guilty of the offence and liable under the Act unless he proves that the offence was committed without his knowledge or that he exercised all due diligence to prevent such offence.

(g) A special procedure can be prescribed for handling hazardous substance and no person can handle such substance except in accordance with procedure.

(h) The Central Government has beenvest4d with powers of entering and inspecting any place though any person or agency authorized by it.

(i) This Act also authorizes the Central Government to issue direction for the closure, prohibition or regulation of any industry, operation or process. It also authorizes the Central Government to stop or regulate the supply of electricity or water or any other service directly without obtaining a court order.

CRITICISM OF THE ENVIRONMENT (PROTECTION) ACT: ***The Act has been criticized on the following grounds:***

(1) The Act is criticized on the ground that its radical approach regarding the rule of *locus standi* is rendered ineffective by the requirement of sixty days notice which gives a long enough time to the offender to make, amend and escape liability under the Act.

(2) The Act does not cover some major areas of environmental hazards. There are inadequate linkages in handling matters of industrial and environmental safety. Control mechanisms to guard against slow, invidious build up of hazardous substances, especially new chemicals, in the environment, are weak.

(3) If the authority contemplated by the Central Government continues to be the existing Pollution Control Boards, it is feared that the entire exercise is foredoomed to failure. This is so because the present Pollution Control Boards seem to have adopted a soft line *vis-a-vis* the industry and prefer to be persuasive rather than punitive.

(4) Inspite of the bold departure under the Act from the *locus standi* rule, since only the Central Government has been given the authority to collect samples of air, water, soil or other substances, the aggrieved citizen or private agency will apparently have no means of proving that an offence has been committed by the alleged offender.

THE NOISE POLLUTION (RUGULATION AND CONTROL) Rule-2000: Under the Environment (Protection) Act, 1986, the central government made the Noise Pollution Rules in 2000 for regulation and control of noise producing and generating sources.

The Rules relate to the following: **1. Development Activities**: All development authorities and local bodies while planning development activity or carrying out functions relating to town and country planning shall take into consideration all aspects of noise pollution as parameter of quality of life to avoid noise to achieve the objective of maintaining the ambient air quality standards in respect of noise.

2. Silence Zone: An area comprising not less than 100 metres around colleges, Schools, hospitals and courts comes under silence zone.

3. Noise Standards for Different Zones: For the purpose of implementation of noise standards for different zones, the State Governments may categorize the areas into industrial zone, commercial zone, and silence zone.

FOREST (CONSERVATION) ACT, 1980: After independence, the Government of India adopted the National Forest Policy wherein it emphasized on the need of protection of forests and categorized forests of India into four categories, namely, protected forests, national forests, village forests and tree forests. State Governments were left free in forest administration, provided that it was in consonance with the centre's forest resources. Subsequently, the Forest (Conservation) Act was also promulgated in 1980 to make certain reforms over the preceding Act of 1927 which imposes restrictions on the reservation of forests or use of forest land for non-forest purposes by States.

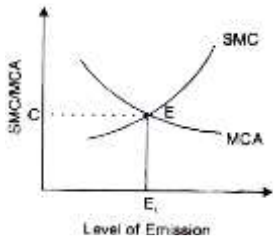
AMENDMENTS OF FOREST (CONSERVATION) ACT: ***In 1992, some amendments were made in the Forest Act 1980***: (i) Some non-forest activities in forests were allowed without cutting trees with the prior approval of the Central Government. These activities are setting of transmission lines, seismic surveys exploration, drilling and hydroelectric projects. (ii) Prior approval of central Government is required in the case of cultivation of fruit-bearing trees, oil-yielding plants or plants of medicinal value. (iii) Removal of stones, bajri or boulder etc. from river-beds located within the forest area will be considered under non-forest activities. (iv) Ban on mining activities near forest area and prior approval of Central Government is mandatory. (v) Plantation of mulberry for rearing silkworm is considered as a non-forest activity. (vi)Wildlife Sanctuaries and National Parks are totally prohibited for any exploration or survey without prior approval of Central Government. (vii) Cultivation of spices, rubber, tea, coffee and plants which are cash

crops are included under non-forestry activities. Their cultivation is not allowed in forest reserve areas.

POLICY MESURES TO CONTROL ENVIRONMENTAL POLLUTION: Policy makers face a major challenge in improving environmental management in the following ways:

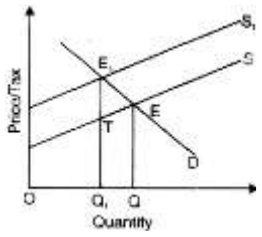
1.Direct Regulation: One way of controlling activities both directly or indirectly is to set standards and to regulate the activities of firms or individual. In cases in which waste disposal causes significant external diseconomies economists general agree that government intervention may be justified. But how can be government intervence? Perhaps the simplest way in government control body is direct regulation through the issuance of certain enforceable rules for waste disposal. Generally these rules are referred to as command and control strategies. Under this approach, the regulator sets a technical standard or a performance standard for sources that pollute the environment. Consider a factory that emits pollutants which damage air quality in a particular area. The firm can reduce its emissions only at a cost.

Below this Figure, the horizontal axis represents the level of emission. The curve labeled SMC represents the Social Marginal Cost of emission. The SMC curve represents the increased harm associated with the emission of the factory. The SMC slopes upward because the marginal cost externality is high. The curve labeled as MCA is the Marginal Cost of Abating (reducing) emissions. It slopes downward because the marginal cost of reducing emissions remains low due to the installation of pollution control equipment. The optimal pollution control level is at point E where SMC = MCA. If the firm exceeds OE_L limit, then it can face monetary penalties.



Command and control policies are sometimes the only effective way of attaining certain environmental goals, such as regulating the use of very sensitive ecological areas or eliminating the use of extremely long-lived and toxic compounds. Although these policies allow governments to set specific standards, achieving results often is costly. Because they deny different users or firms the flexibility to respond in the most cost effective manner. Therefore, such policies can miss important opportunities for cost savings and for achieving multiple benefits. The use of command and control approaches is well understood and many governments are comfortable with this strategy. There is growing realization, however, that relying on such policies often imposes excessive costs on an economy, and that monitoring and enforcement of these measures may exceed the regulatory of many countries.

2. Emission Tax: One of economist's favourite solutions to the pollution is a tax on emissions of pollutants, popularly known as the Pigovian tax[1]. Under an emission tax, those who produce emissions face a tax per unit of emissions. If can act as an incentive to reduce pollution and use resources more efficiently and thus generate revenues. Sulphur and carbon taxes have been used indifferent countries to discourage the use of certain also raising government revenues. Suppose, a paper factory situated in a residential area emits smoke which affects adversely the health of the people. The Government decides to impose a pollution tax as per unit of emissions. In such a situation, the factory pay a tax equal to TE_1 which reduces the production from OQ to OQ_1 with shifting of supply curve from S to S_1 as shown in below **Figure**.



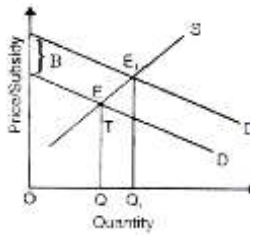
In contrast to command and control approaches, the pollution tax does not set limits on emissions. Instead, firms or other regulated entities are free to either emit pollutants and pay the tax or pay for installation of controls to reduce emissions.

The challenge for government regulators is to calculate the level of tax that will change behavior sufficiently to achieve environmental objectives. When an emission tax is used, all that the government has to do is to measure the amount of pollution a firm produces and charge accordingly. It is left to the firms to figure out the most ingenious and effective ways to cut down the pollution and save on the emission tax. Some economists tend to favour the use of emission tax than direct regulation. Some ways of disposing of certain types of waste are so dangerous that the only sensible thing to do is to ban them.

There is an indirect burden of emission tax on consumers which is the justified. In terms of above **Figure**, the factory owner pays a pollution tax equal to TE_1 and reduces the production of steel from OQ to OQ_1. Now the factory owner sets a higher price equal to E_1Q_1 which is an indirect burden consumers when it raises the price from EQ to E_1Q_1.

3. Environmental Subsidy: A subsidy can be used to reduce pollution. Under this policy, the government will pay the firm to stop them from polluting. The firm will agree to stop polluting as long as the subsidy is greater than the cost of treating the pollutant. When the cost of treating pollution becomes greater that the subsidy, the firm will stop treating pollution and forfeit the subsidy. This is explained in below Figure where initially D and S are demand and supply curves of the firm. Both intersect at point E and output is OQ which generates some pollution. Now the government decides to give subsidy to the firm to stop polluting. The government

decides to give subsidy to the firm to stop polluting. The government gives subsidy equivalent to B to a firm which causes the demand curve to shift upwards from D to D_1. It will encourage the firm to increase its output from OQ to OQ_1.

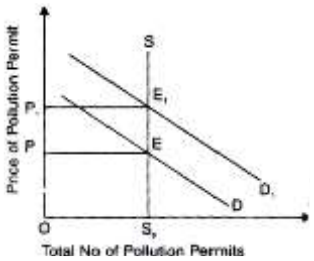


Many countries currently subsidize activities that lead to environmental degradation. For example, subsidies that reduce the price of fuels encourage their use and accompanying emissions of Greenhouse gases. The removal of subsidies that harm the environment can produce multiple benefits by reducing demand for previously subsidized resources and thus reducing pressure on the environment. According to OECD, the removal of fossil fuel subsidies worldwide would reduce global emissions by 18 percent.

4. Tradable Permits: J.H. Dales has proposed the idea of sale of pollution rights. Tradable quotas or permits assign "rights to use resources or emit certain levels of pollution". These pollution rights can be bought and sold in the market. In practice, governments issue the permits or assign a quota for emissions of a specified pollutant or assumption of a resource over a given period.

Once an overall level of pollution or resource use has been set, the permits or quotas can be bought and sold among the industries. This strategy can be extremely cost-effective. The tradable permits have great potential to yield social welfare gain by allowing trade between groups to save costs, when there is agreement on a goal of total pollution levels or resources usage. Since the issuance of permits creates property rights, it is important that initial allocations of permits re determined equitably and that there are no artificial obstruction to trade permits.

The market mechanism for pollution permits is illustrated in below Figure. The curve D represents the demand for pollution permits. The supply of permits is limited by the pollution control agency in the country. SS_p is the supply curve for pollution permits and OS_p is their limits. Initially, the demand curve D cuts the supply curve S at point E. At price OP and efficient level for permits is OS_p.



Now there is a secondary market for pollution rights. If overtime, the demand for pollution rights increases, then the demand curve will shift from D to D_1. Therefore, the price of pollution rights will increase to OP_1.

5. Deposit Refund system: Under these systems, purchases of potentially polluting products have to pay a surcharge which is refunded to them when they return the product to an approved centre for proper disposal. These systems are also helpful in the removal of CO_2. For a deposit refund system to be feasible means of encouraging carbon fixation, there must exist alternative actions that decision makers can take to avoid creating the environmental externality in question. This could be a choice between controlling emissions at source and end-of-pipe emissions removal.

6. Participatory And Voluntary agreements: Participatory and voluntary agreements belong to an important class of policies that complement command and control market-based policies. They are particularly useful when many of the benefits of changes accrue to the public at large, offering little financial incentive for companies or governments to take action unilaterally. A wide array of initiatives is available to harness public and private support for environmental measures. These include product specific environmental behavior of producers, and voluntary agreements among industrial entitles to improve environmental practices.

7. Liability Rules: Another method relates to the legal framework of liability rules. Here the generator of externality is legally liable for any damage caused to other person. Liability involves holding the polluter firm or person liable for any damage it may cause to its workers. It is meant to regulate a risky activity that causes injury or illness to a worker through negligence. The worker can sue the firm to compensate the victim of an accident. According to Kolstad. **"**When a victim is injured in any accident, the victim may sue the injurer (firm) to recover damages. Country to popular belief, the primary purpose of liability law is not to compensate the injured but rather to provide incentives to potential injurers to behave responsibly and take precautions when engaged in risky activities. Liability effectively internalizes the accident damage into the cost-benefit calculation of the person undertaking the risky activity. That should ensure the **"right amount"** of risk or the **"right amount"** of precautionary behavior.**"**

RULE OF FORESTS IN ECONOMIC DEVELOPMENT: Forests play an important role in the economic development of a country. They provide several goods which serve as raw material for many industries. Wood grown in forests serves as a source of energy for rural households. Most of the world's paper is made from wood and one rather reliable index to the degree of economic development of a country is its per capita consumptions of paper. As an economy develops economically, paper is used as packaging material, in communications and in across of other uses. No really satisfactory substitute for paper, exists for many of its uses.

While it has long been recognized that forests play many roles in the economic development of a country in addition to providing wood fiber for many uses, The non-wood outputs of forests are coming increasingly to be recognized and valued everywhere in the world. Forests have watershed values especially in areas with fragile and easily eroded soils, tree cover may be highly valuable simply as protection to the watershed.

Forests are valued as a place for outdoor recreation. The kinds of forests most valuable for outdoor recreation are not always the same as the kinds most valuable for wood production and vice versa. The dense forest with tree closely spaced to take full advantage of the sunlight, moisture and fertility to grow wood, is often less attractive to the recreationist than a more open forest.

Forest are the home for many species of wildlife including mammals, reptiles and birds. Some of these forms of wildlife are clearly valuable to man. Ecologists have been much distributed at the reduction in wildlife numbers, sometimes to the point of extinction, as tropical forests are cleared.

Some important services provided by forests are as follows: **(a)Water**: Forests absorb rainwater and release it gradually into streams. Its prevents floods. **(b)Watershed**: forests keep soil from eroding into rivers. **(c) Climate**: Forests stabilize our ecological stability. **(d) Recreation**: Forests serve people directly for recreation. National parks and biosphere reserves sanctuaries are a great attraction for tourists. Biosphere reserves are multipurpose protected areas created to deal with conservation of bio-diversity and its sustainable use. In biosphere reserves local area resources are developed. Agricultural activities are allowed to the local communities and employment is provided to the people. Tourism in parks, sanctuaries and biosphere reserves brings revenue to the authorities the manage them. **(e) Maintenance of the Pool of Genetic Resources**: forests contain a diversity of species, habitats, and genes that are probably their most valuable assets. They provide the gene pool that can protect commercial plant strain against changing conditions of climate. **(f) Some Goods**: Some goods provided by forests are food, biomass, pulp and paper, rayon, fibers, lac, wooden articles and medicine plants.

The cover of forest on the surface of our planet has a great role to play in balancing the oxygen - carbondioxide ratio, wood, wildlife, recreation, watershed, wilderness and aesthetic values. Of late, with the increase in continues biotic pressure and high population growth, the total forest cover slowly dwindles in many parts often leading to a state of obliteration.

Many factors are responsible for the over-exploitation of forest resources in the world. They are: (a) high rate of human population indifferent parts of the country; (b) poverty; (c) urbanisation; (d) increase in infrastructure activities; (e) increase in mining activities; and (f) change in the life styles of the people.

FOREST MANAGEMENT: The success of forest management depends on afforestation and collective participation. By afforestation, we mean creation of forests by large scale plantation Many great people have said that a nation grows with the trees. A growing tree is a living symbol of a progressive nation. Therefore, it has assumed an important place in environmental protection programmes.

The role of trees and tree planting outside forests has not been understood and recognized adequately. It is not just the concentrated plantations that matter, the dispersed tree plantation makes an even greater contribution to environment well-being, apart from meeting local demands of tree products. Trees may be planted as windbreak, shelterbelt, field boundary demarcation, field fence, and groves in other vacant lands. Plantation of trees also has a significant positive effect on the agricultural productivity of fields. Plantations reduce dryness and wind erosion, add to fertility by recycling nutrients in the deeper zones of soil by adding organic matter to it. Moreover, tree planning by the individual farmer has greater potential than public planting programmes, because the private initiative is always a more effective, sustained and carefully pursued method of ushering in a change.

URBAN FORESTRY: Tree planting along public utilities such as roads, railways, canals and other facilities has a great potential. Urban habitations are another potential areas for tree planting. The benefits of trees in urban colonies, parks, hospitals, temples, playgrounds and premises of institutions such a schools and colleges are well-known. If planted with a little thoughtful planning, trees can transform both the aesthetic and the climatic environment of urban areas.

***Objectives of Urban Forestry*:** Some of main objectives of urban forestry are: (a) maintenance of natural processes such as water, nutrient cycle and support of flora and fauna; (b) aesthetic and recreational values; and (c) social cultural, economic and environmental consequences.

Maintenance and Management of Urban Forests: Normally, plants should be arranged in groups and lines so as to create purposeful rhythms when moving though a park on foot. Tree spacing can be uniform or varied to bring about dramatic changes that are reflected by the light and shade patterns magnified in the ground shadows. For successful tree planting in cities, the three cardinal principles are that the trees must be large enough to give immediate shade, they must be spaced closely together and there must be enough of them to create visual continuity.

Locality Factors: General factors of the urban locality are not conducive for the proper growth and development of plants. Therefore, the plants to be grown in urban localities should be able to withstand these difficult factors. ***(a) Space***: This is most crucial factor for locating urban trees. The buildings, roads, overhead wires, traffic signals, signs, street lights, vehicle stands and parking places, pedestrian clearance and underground utilities all restrict the space available for planting. The trees chosen must be able to grow in the available space or must be so pruned and trimmed so that

they do not overgrow the space. ***(b) Soil***: The soil in urban surrounding is often compacted, infertile and drained. The top soil has been lost in most cases, and the planting site is filled with rubble and sand. The soil needs special treatment to make it fit for good plant growth. ***(c) Climate***: Because urban areas are man-made, each site within as urban setting has it shown micro-climate. In general, cities tend to be warmer and have a wind velocity and relative humidity lower than the surrounding countryside. ***(d) Pollution***: Air pollutants have their origin in industries, automobiles, locomotives, airborne herbicides and insecticides. Soil is polluted by gases, fertilizers and pesticides. Light pollution due to mercury, metal and sodium lamps, affects the environment of urban forests. ***(e) People***: The landscape in a city should be designed so as to keep the people relaxed, happy and at the same time alert. Urban forests, groves or rows of trees have to exist in an environment dominated people. The sites are challenging and the plants have to be so selected that they adapt to peculiar sites. ***(f) Maintenance***: Shrubs, trees and other woody perennial plants of urban forests have to be meticulously maintained and properly looked after. Watering and manuring should be done as per the requirements. The protection of plants, particularly when they are young, against sun, frost and other types of trees should be ensured. The regular monitoring of diseases and insect pests is essential to maintain urban plants in good health.

NATURAL FOREST POLOCY 1952*: ***(1) Objectives***: ***The following are the objectives of National Forest Policy (1952)****:*

(a)the need for evolving a system of balanced and complementary land-use under which each type of land is allotted to that form of use under which it would produce most and deteriorate least; (b) the need for checking:- (i) denudation in mountainous regions, on which depends the perennial water supply of the river system whose basin constitute the fertile core of the country. (ii) the erosion progressing space along the treeless banks of the great rivers leading to ravine formation, and on vast stretches of undulating wastelands depriving the adjoining fields of their fertility; (c)the need for establishing treelands, wherever possible, for the amelioration of physical and climatic conditions promoting the general well-being of the people; (d) the need for ensuring progressively increasing supplies of grazing, small wood for agricultural implements, and in particular of firewood to release the cattle dung for manure to step up food production; (e) the need for sustained supply of timber and other forest produce required for defence, communications and industry.

(2) LAND USE AND EROSION: The correct solution of the land problem is to evolve a system of balanced and complementary and use under which each type of land is allotted to that form of use under which it would produce most and deteriorate least. A detailed survey of lands with a view to their proper utilization is, therefore, highly desirable. The progressive denudation of hill sides with serious repercussions on the fertility of the land, and the growing erosion along the banks of rivers, of which the Yamuna, the Chambal, the Mahi, the Nrmada, the Kosi, and the Damodar are

notorious examples, constitute the major considerations demanding immediate attention.

(3) CLASSIFICATION OF FORESTS: ***(a) Protection Forests***: 'Protection forests' denote forests found, or required, on hill slopes, river banks, sea-shores, or other erodible localities. In such sites the need for forest cover is dictated by purely protective physical considerations, such as prevention of erosion, conservation of moisture, and control of rushing torrents and floods. The role of such forests in saving the soil from being washed away, and when maintained in catchment areas, in the prevention of floods a maintenance of stream-flow, cannot the overemphasized. On flat country with loose sandy soil, especially under dry conditions, forests, whether natural or artificial, perform an essential function in minimizing wind erosion, fixing the soil and preventing the formation of sand dunes, and mitigating the desiccation of agricultural crops leeward of the free cover. The *National Forest Policy* requires, therefore, and immediate and speedy programme for the reconditioning of the mountainous regions, river valleys, and coastal lands by establishing protective forests over larger areas, and preserving the existing ones. The primary object of management of such forests should be to utilize in full their protective influence on the soil, the water regime, and the physical and climatic factors of the locality, and the interests to be thus protected should for outweigh those which it may be necessary to restrict. The scientific management of such 'protection forests', wherever possible, should include the production and exploitation of timer within the limits of safety.

(b) National Forests: 'National forests' constitute the basis of India's strength and wealth, for they comprise valuable timber bearing regions, the produce of which is indispensable for defence, communications and vital industries. They have to be managed chiefly in the interest of the nation as a whole, and their organization and development is one of the most important function of the States. Their management on scientific and commercial lines is essential for maintain a sustained supply of wood for industry and of large timbers for defence, communications and other national purposes. The basic policy, so far as such forests are concerned, must be to attain national self-sufficiency in these vital supplies. Future development should, therefore, be direct4ed to that end. Cultivation should not be permitted to encroach upon these valuable timber bearing tracts. The solution of the food problem of as ever increasing population must be sought primarily in intensive cultivation an d not in weakening the very basis of national existence by encroaching upon such forests.

(c) Village Forests: 'Village forests', popularly termed fuel forests, are intended in the main to serve the needs of the surrounding villages in respect of small timber for housing and agricultural implements, firewood, leaves for manure and fodder, fencing thorns, grazing and edible forest products. The supply for such requirements should be made available at non-competitive rates, provided they are utilized by the villagers themselves and not traded in. The management of such village forests should aim at meeting the present as well as the future needs of the local population. Removal of

the produce in excess of its annual growth should not therefore, be permitted. Restrictions should be imposed in the interests not only of the existing generation but also of posterity. These considerations render the entrusting of the management of village forests to panchayats, without appropriate safeguards, a hazardous undertaking as has been demonstrated in some of the States. The cooperation of panchayats should be enlisted in the protection and creation of village forests, and in the distribution of forest produce assigned to meet the needs of the local population, but not at the cost of economy and efficiency. While the profit motive in the management of these forests should be relegated to the background, there is not justification for allowing them to because a burden on the general tax-payer, the expenses for development and maintenance of such forests must come from their own income.

(d) Tree-lands: Although 'tree-lands' are not part of regular forests in a country like India where their increase, management, and development are vital to the needs of the people, they cannot well be left out of any well considered policy. The Land Transformation programme of the Government of India envisages the planting of 30 crores of trees in ten years, but this number is very far from about 2000 crores of trees, which would be necessary to restore the hydrological nutritional balance of the country. The creation of foresters by State Forest Departments on such an elaborate scale is ruled out at present by lack of funds and trained personnel. The only was in which some progress can be achieved is by making the whole nation 'tree conscious'. Such consciousness will stimulate private efforts at tree planting as has been demonstrated by the success of the *National Vana Mahotsava Movement.* It will also arrest the vandalism which feels no scruples in cutting down valuable trees, and create among the populace an urge to secure the protection of trees, a virtue as much to be desired as it is rare.

(4) PROTECTGIONS OF WILDLIFE: The *National Forest Policy* emphasizes the need for affording protection to the animal kingdom and particularly to rare species such as the lion and the great one-horned rhinoceros, which are fast disappearing. While the damage caused by such predators as wild pigs, game and porcupine cannot be denied, the elimination of their natural enemies tends to multiply them. It is necessary, therefore, that bird and animal life should be controlled by special laws and rare fauna preserved by setting up sanctuaries and large-scale national parks. For this purpose, a *Central Board for Wild Life* has been constituted by the Government of India in the ministry of Food and Agriculture.

(5) PROBLEM OF GRAZING: The controversial question of grazing in State forests calls for a clear definition of policy. Speaking generally, all grazing in forests, particularly unlimited or uncontrolled grazing is incompatible with scientific forestry. At the same time, grazing does take place in forests and must be accepted as a hard fact. There are indeed circumstances in many regions where a moderate amount of grazing does little direct harm, and may even do a great deal of indirect good in reducing the risk of fire and in suspending regression at a desirable stage. But efficient forest management requires that grazing should be regulated as regards the

time and place, as also the number of cattle admitted. The formulation of the grazing policy should be based on the following cardinal principles :

(a) Continuous grazing on the same area by larger herds in destructive of the better strains of grasses and leads to deterioration of the grass complex. Wherever, it is permitted and is in great demand, efforts should be made to introduce rotational grazing, the benefits of which should be explained and demonstrated to the villagers.

(b) Cheap forest grazing has a demoralizing effect and leads to the vicious spirl of reckless increase in the number of cattle, inadequate forest grazing reduced quality of the herds and further increase in the numbers to offset the fall in quality. Free and indiscriminate forest grazing is, therefore, a serious diseases to cattle breeding. The notion that a farmer's wealth must be reckoned in terms of the number of cattle he owns, regardless of quality is one of the causes of India's uneconomical cattle wealth and must be combated.

(c) Grazing should not be looked upon primarily as a source of revenue. But the simple and obvious way of regulating and controlling grazing as also improving the quality both of grazing and cattle themselves, is to institute a reasonable fee for the privilege of grazing.

(d) Grazing must not be allowed in regeneration areas and young plantation during such periods as the seedlings require for establishment, otherwise they stand in danger of being browsed or trampled upon.

(e) Grazing incidence should be kept at a minimum in 'Protection Forests'.

(6) SHIFTING CULTIVATION: The damage caused to forests by shifting cultivation in certain area must be3 guarded against. To wean the aborigines, who eke out a precarious living from axe-cultivation moving from area to area, away from their age-old and wasteful practices, requires persuasion, not coercion; a missionary, not an authoritarian approach. Possibilities of regulating shifting cultivation by combining it with forests regeneration (Taungya) to the benefit of both should be fully explored. Success in this direction largely depends on enlisting the cooperation of the cultivators and gaining their confidence and in showing consideration to the consideration to their needs and wishes.

(7) SUSTAINED YIELDS: With a view to conserving forest resources in perpetuity, the new forest policy requires scrupulous regard for sustained yield in the management of all classes of forests. The fluctuations in the annual out-turn of forests upset State budgets, industries, and other national enterprises; all working plans, therefore, should aim at confining them within the narrowest limits. This aspect assumes even greater significance in case where private owners manage their own forests. The compilation of all sound working plans, therefore, requires; (a) The preparation of the pams, and investigations on the propagation and tending of various species, their increment, the optimum condition of their growth and the regulation of

yield. (b) Carefully planned afforestation schemes to replace interior free growth by valuable species of commercial importance.

Each State, therefore, should set up a permanent organization to deal with working plans, their compilation, and revision and deviations from them, research and statistics, as well as to conduct detailed surveys of available forest resources which are a *sine qua non* for a sound forest management. While the discretion of State Governments to regulate the details of forest administration in their respective territories is left unfettered, the general principles of the above forest policy should, in paramount national interests, be observed by them in framing their policies and legislation for the conservation of their forest resources. The forest policy of every State should be so framed as not to impinge adversely upon the general economy and physical balance of an adjoining State.

NEED FOR A NEW NTIONAL FOREST POLICY: ***(i) Objectives of National Forest Policy***: The following are the objectives national forest policy: **1. To Maintain Ecological Balance**: The principal aim of forest policy must be to ensure environmental stability and maintenance of ecological balance including atmospheric equilibrium which is vital for sustenance of all life forms-human, animal and plant. The derivation of direct economic benefit must be subordinated to this principal aim. **2. Conservation of Forest Resources**: Conserving the natural heritage of the country by preserving the remaining natural forests with the vast variety of flora and fauna, which represent the remarkable biological diversity and genetic resources of the country. **3. Involvement of Women**: Creating a massive people's movement with the involvement of women for achieving these objectives and to minimize pressure on existing forests. **4. Forests and Tribal People**: The following measures are needed to uplift the lives of tribal people in the country; Meeting the requirements of fuel wood, fodder minor forest produce and small timber of the rural and tribal population. Increasing the productivity of forests to meet essential national needs. Encouraging efficient utilization of forest produce and maximum substitution of wood. **5. Forest Management** : The following measures are needed for sound forest management in the country : (a) checking soil erosion and denudation in the catchment areas of rivers, lakes, reservoirs, in the interest of soil and water conservation, for mitigating floods and droughts and for the retardation of siltation of reservoirs. (b) Checking the extension of sand-dunes in the desert of Rajasthan and along the coastal tracts. (c) Increasing substantially the forest/tree cover in the country through massive afforestation and social forestry programmes, especially on all denuded, degraded and unproductive lands.

(ii) STREATEGY OF NATIONAL FOREST POLICY (1988) : The strains and stresses experienced during the National Forest Policy of 1952 urged the planners to adopt a new strategy. This was ; ***(a)Strategy of Afforestation***: A massive need-based and time-bound programme of afforestation and tree planning, with particular emphasis on fuel-wood and fodder development, on all degraded and denuded lands in the country, whether forest or non-forest land, is a national imperative.

(b)Strategy of Urban Forestry: It is necessary to encourage the planting of trees alongside of roads, railway lines, rivers and streams and canals, and on other unutilized lands under State/corporate, institutional or private ownership. Green belts should be raised in urban/industrial areas as well as in arid tracts. Such programme will help to check erosion and desertification as well as improve the micro–climate.
(c) Common Lands: Village and community lands, including those on foreshores and environs of tanks, not required for other productive uses, should be taken for the development of tree crops and fodder resources. Technical assistance and other inputs necessary for initiating such programmes should belong to the Panchayats where the lands are vested in them; in all other cases, such revenues should be shared with local communities in order to provide an incentive to them. The vesting in individuals, particularly from the weaker sections (such as landless labour, small and marginal farmers, Schedule castes, tribals, women) of certain ownership rights over tree, could be considered, subject to appropriate regulations; beneficiaries would entitled to usufruct and would in turn be responsible for their security and maintenance.
(d)Effective Land Laws: Land laws should be so modified wherever necessary so as to facilitate and motivate individuals and institutions to undertake tree-farming and grow fodder plants, grasse, and legumes on their own land. Wherever possible, degraded land should be made available for this purpose either on lease or on the basis of the tree-patta scheme. Such leasing of the land should be subject to the land grant rules and land ceiling laws. Steps necessary to encourage them to do so must be taken, Appropriate regulation should govern the felling of trees on private holding.
(e) Wildlife Conservation : Forest management should take special care of the needs of wildlife conservation, and forest management plans should include prescriptions for this purpose. It is specially essential to provide for 'corridors' linking the protected areas in order to maintain genetic continuity between artificially
(f) Shifting Cultivation: Shifting cultivation is affecting the environment and productivity of land adversely. Alternative avenues of income, suitable harmonized with the right land use practices, should be devised to discourage shifting cultivation.
(g)Prevention from Fires and Encroachments: encroachment on forest lands has been on the increase. This trend has to be arrested and effective action taken to prevent its continuance. The incidence of forest fires in the country high. Standing trees and fodder are destroyed and large scale.

(iii) Forest Management: Existing forests and forest lands should be fully protected and their productivity improved. Diversion of good and productive agricultural land s to forestry should discouraged in view of the need for increased food productions. For the conservation of total biological diversity, the network of national parks, sanctuaries, biosphere reserves and other protected area should be strengthened and extended adequately. Provision of sufficient fodder, fuel and pasture, specially is areas adjoining forest, is necessary in order to prevent depletion of forests beyond the sustainable limit. Minor forest produce provides sustenance to tribal population and to other communities residing in and around the forests. Such produce should be protected.

(iv) Tribal People and Forests: Having regard to the symbiotic relationship between the tribal people and forests, a primary task of all agencies responsible for forest management including the forest development corporations, should try to associate the tribal people closely in the protection, regeneration and development of forests as well as to provide gainful employment to people living in and around the forest. **1)Protection of Forests**: (a) One of the major causes for degradation of forest is illegal cutting and removal by contractors and their labour. In order to put an end this practice contractors should be replaced by institutions such as tribal co-operatives, labour co-operatives, government corporations, etc. as early as possible. (b) Protection, regeneration and optimum collection of minor forests produce along with institutional arrangements for the marketing of such produce; (c) Development of forest villages on par with revenue villages; (d) family oriented schemes for improving the status of the tribal beneficiaries; and (e) Undertaking integrated are development programmes to needs of the tribal economy in and around the forest areas.

(v) Forest Based Industries: The main considerations governing the establishment of forest-based industries and supply of raw materials to them should be as follows; (a) As far as possible, a forest-based industry should raise the raw material needed for meeting its own requirements, preferably by establishment of a direct relationship between the factory and the individuals who can grow the raw material by supporting the individuals with inputs including credit, constant technical advice and finally harvesting and transport services. (b) No forest-based enterprise, except that at the village or cottage level, should be permitted in future unless it has been first cleared after a careful scrutiny with regard to assured availability of raw material. (c) Forest based industries must not only provide employment to local people on priority but also involve them fully in raising trees and raw-material. (d) Natural forests serve as a gene pool resource and help to maintain ecological balance. (e) Farmers, particularly small and marginal farmers, would be encouraged to grow, on marginal/degraded lands available with them, wood species required for industries. (f) The practice of supply of forest produce to industry at concessional prices should cease.

(vi) Financial Support For Forestry: The objectives of this revised policy cannot be achieved without the investment of financial and other resources on a substantial scale. Such investment is indeed fully justified considering the contribution of forests in maintaining essential ecological processes and life-support, systems and in preserving genetic diversity. Forests should not be looked upon as a source of revenue. Forests are a renewable natural resource. They are a national assets to be protected and enhanced for the well being of the people and the Nation.

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Dr.K.Ushakumari,
Assistant Professor of Economics,
K.N.Govt. Arts College for women (A), Thanjavur.

I-M.A. ECONOMICS

ENVIRONMENTAL ECONOMICS

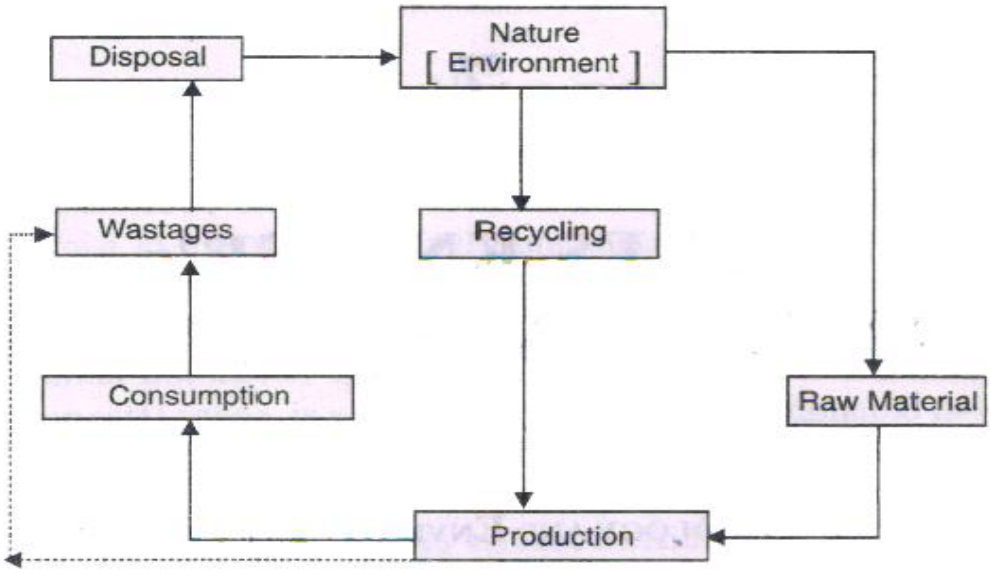
UNIT - I COURSE CODE: 18KP1ECELEC1

MATERIAL BALANCE PRINCIPLE:

The functions of an economy are related to production, consumption and distribution and distribution activities. These activities have a direct relation with nature, Nature provides raw materials to the economy for its production and consumption activities. Residuals from both the product ion and consumption processes usually remain and and they usually render disservices like killing fish, reducing public health, soiling and deteriorating buildings due to industrial pollution. Some wastes (residuals) from production and consumption activities are ultimately returned to nature. Remaining wastages are recycled. Further, all emission of residuals do not cause pollution damage because of assimilative capacity of the environment.

Ayres and Kneese[1], "If waste assimilative capacity of the environment is scarce, decentralized voluntary exchange process cannot be free of uncompensated technological external diseconomies unless all inputs are fully converted into outputs, with no unwanted material residuals along the way and all final outputs are utterly destroyed in the process of consumption. The model is explained in the Material Flow Diagram.

Material Flow Diagram



The material flow diagram implies that mass inputs must equal mass outputs for every process. Moreover, all resources extracted from the environment must eventually become unwanted wastes and pollutants. This means, among other things, externalities (market failures) associated with production and consumption of materials are actually pervasive an d they tend to grow in importance as the economy itself grows. Materials recycled can help but recycling is energy intensive and imperfect, so it cannot fully compensate.

Economics of the environment may be defined as a study which concerns allocation of resources among alternatives uses in such a way that there is an efficient reduction of the waste or residuals in the environment, which lead to an increase in social welfare.

ITS IMPLICATIONS

The material balance model has important implications.

1. Disposal activities may affect both consumers and producers. The environment can act as a conduit for carrying the disposal activities. Business firms generally smoke into the air and this may affect the consumer's welfare.
2. The environment has a large waste assimilation capacity, but this is not infinite. Too much wast entering the environment rather than being recycled or reused will put too much stress on the assimilative capacity of the environment to handle such waste safty.

3. With the application of the laws of thermodynamics, economics production and consumption activities always generate some pollution and waste, If requires proper disposal.
4. In a general sense, policy makers can weigh up the social benefits of various productive activities and compare them with the social costs (including disposal) imposed by these activities.
5. If a balance can be reached between acceptable levels of materials flows, there will be an increase in output and improvement in environmental quality.
6. From the policy point of view, this approach emphasizes recycle process and less residual generating production process. It is only possible by modifying an environmental medium through investment in control facilities so as to improve its assimilative capacity.
7. It is important to develop not only measures for the external costs resulting from different concentrations and duration of residuals in the environment but more systematic methods for forecasting emissions of extern al cost-producing residuals, technical and economic trade-offs between them, and the effects of recycle on environmental quality.
8. The application of the law of thermodynamics to the problem of waste is an important event in integrated residuals management. Residuals are generated by all production and consumption activities.
9. The importence of the materials balance principle lies in the fact that it provides a coherent frame work in which an economic analysis of resources use and its implications for the environment can be placed.

Conclusion : As suggested by **S.Beker**, to emprove the analysis of environmental economy interactions, the empirically relevant and up-to-date knowledge of ecological and natural sciences needs to be used and integrated into environmental economics in a more systematic way.

Resilience and Carrying capacity: Carrying capacity and ecosystem resilience The environmental resource base upon which all economic activity ultimately depends includes ecological systems that produce a wide variety of services. This resource base is finite. Furthermore, imprudent use of the environmental resource base may irreversibly reduce the capacity for generating material production in the future. All of this implies that there are limits to the carrying capacity of the planet.

RIt is, of course, possible that improvements in the management of resource systems, accompanied by resource-conserving structural changes in the economy, would enable economic and population growth to take place despite the finiteness of the environmental resource base, at least for some period of time. However, for that to be even conceivable, signals that effectively reflect increasing scarcities of the resource base need to be generated within the economic system.

Carrying capacities in nature are not fixed, static, K. Arrow et al. / Ecological Economics (1995) 91-95 93 or simple relations. They are contingent on technology, preferences, and the structure of production and consumption. They are also contingent on the everchanging state of interactions between the physical and biotic environment. A single number for human carrying capacity would be meaningless because the consequences of both human innovation and biological evolution are inherently unknowable. Nevertheless, a general index of the current scale or intensity of the human economy in relation to that of the biosphere is still useful. For example, Vitousek et al. calculated that the total net terrestrial primary production of the biosphere currently being appropriated for human consumption is around 40%. This does put the scale of the human presence on theplanet in perspective.

A more useful index of environmental sustainability is ecosystem resilience. One way of thinking about resilience is to focus on ecosystem dynamics where there are multiple (locally) stable equilibria .

Resilience in this sense is a measure of the magnitude of disturbances that can be absorbed before a system centered on one locally stable equilibrium flips to another .

Economic activities are sustainable only if the life-support ecosystems upon which they depend are resilient. Even though ecological resilience is difficult to measure and even though it varies from system to system and from one kind of disturbance to another, it may be possible to identify indicators and early-warning signals of environmental stress. For example, the diversity of organisms or the heterogeneity of ecological functions have been suggested as signals of ecosystem resilience. But ultimately, the resilience of systems may only be tested by intelligently perturbing them and observing the response using what has been called "adaptive management".

The loss of ecosystem resilience is potentially important for at least three reasons. First, the discontinuous change in ecosystem functions as the system flips from one equilibrium to another could be associated with sudden loss of biological productivity, and so to a reduced capacity to support human life.

Second, it may imply an irreversible change in the set of options open both to present and future generations (examples include soil erosion, depletion of groundwater reservoirs, desertification, and loss of biodiversity.) Third, discontinuous and irreversible changes from familiar to unfamiliar states increase the uncertainties associated with the environmental effects of economic activities. If human activities are to be sustainable, we need to ensure that the ecological systems on which our economies depend are resilient. The problem involved in devising environmental policies is to ensure that resilience is maintained, even though the limits on the nature and scale of economic activities thus required are necessarily uncertain.

3. Economic growth and environmental policy We conclude that economic liberalization and other policies that promote gross national product growth are not substitutes for environmental policy.

On the contrary, it may well be desirable that they are accompanied by stricter policy reforms. Of particular importance is the need for reforms that would improve the signals that are received by resource users. Environmental damages, including loss of ecological resilience, often occur abruptly. They are frequently not reversible. But abrupt changes can seldom be anticipated from systems of signals that are typically received by decision-makers in the world today. Moreover, the signals that do exist are often not observed, or are wrongly interpreted, or are not part of the incentive structure of societies. This is due to ignorance about the dynamic effects of changes in ecosystem variables (for example thresholds, buffering capacity, and loss of resilience) and to the presence of institutional impediments, such as lack of well-defined property rights. The development of appropriate institutions depends, among other things, on understanding ecosystem dynamics and on relying on appropriate indicators of change. Above all, given the fundamental uncertainties about the nature of ecosystem dynamics and the dramatic consequences we would face if we were to guess wrong, it is necessary that we act in a precautionary way so as to maintain the diversity and resilience of ecosystems.

Economic growth is not a panacea for environmental quality; indeed, it is not even the main issue. What matters is the content of growth--the composition of inputs (including environmental resources) and outputs (including waste products). This content 94 K. Arrow et al. /Ecological Economics 15 (1995) 91-95 is determined by, among other things, the economic institutions within which human activities are conducted. These institutions need to be designed so that they provide the right incentives for protecting the resilience of ecological systems. Such measures will not only promote greater efficiency in the allocation of environmental resources at all income levels, but they would also assure a sustainable scale of economic activity within the ecological life-support system. Protecting the capacity of ecological systems to sustain welfare is of as much importance to poor countries as it is to those that are rich.

It is also widely used as an indicator of environmental sustainability. Carrying capacity often serves as the basis for sustainable development policies that attempt to balance the needs of today against the resources that will be needed in the future.

Carrying capacity into six categories: physical, economic, perceptual, social, ecological and political.

Carrying capacity is defined as the "maximum population size that an environment can sustain indefinitely." For most species, there are four variables that factor into calculating carrying capacity: food availability, water supply, living space, and environmental conditions.

In a population at its carrying capacity, there are as many organisms of that species as the habitat can support. ... If resources are being used faster than they are being replenished, then the species has exceeded its carrying capacity. If this occurs, the population will then decrease in size.

When we will reach our carrying capacity (I hope we will not see anytime), water, food, shelter and resources will be very limited (per capita). People will be unhappy due to hunger (or maybe due to other reasons). ... The Earth will be fine but will have no trees and a lot of polluted water in the ocean.

As a result of the loss of their main predator, the deer population began to boom. ... Eventually, deer began to starve because their large numbers depleted their main source of food; they had reached their carrying capacity.

There are limits to the life-sustaining resources earth can provide us. In other words, there is a carrying capacity for human life on our planet. Carrying capacity is the maximum number of a species an environment can support indefinitely. Every species has a carrying capacity, even humans.

Many scientists think Earth has a maximum carrying capacity of 9 billion to 10 billion people.

Some examples: Some examples of limiting factors are biotic, like food, mates, and competition with other organisms for resources. Others are abiotic, like space, temperature, altitude, and amount of sunlight available in an environment. Limiting factors are usually expressed as a lack of a particular resource.

While food and water supply, habitat space, and competition with other species are some of the limiting factors affecting the carrying capacity of a given environment, in human populations, other variables such as sanitation, diseases, and medical care are also at play.

In general, any increase in the carrying capacity of the environment for one species will negatively affect other species. ... The degradation of Earth's carrying capacity for humans is associated with two integrated factors: (1) overpopulation and (2) the intensity of resource use and pollution.

The size of the population then fluctuates slightly above or below the carrying capacity. Reproductive lag time may cause the population to overshoot the carrying capacity temporarily. Reproductive lag time is the time required for the birth rate to decline and the death rate to increase in response to resource limits.

Carrying capacity can be defined as a species' average population size in a particular habitat. The species population size is limited by environmental factors like adequate food, shelter, water, and mates.

To find carrying capacity on a graph, you need to locate the point on the graph where the population line is horizontal. Alternatively, the carrying capacity may be

explicitly marked with a dotted horizontal line or a horizontal line of a different color. Thus, the carrying capacity is the maximum number of individuals of a species that an environment can support. Population size decreases above carrying capacity due to a range of factors depending on the species concerned, but can include insufficient space, food supply, or sunlight.

The resources in any given habitat can support only a certain number of wildlife. As seasons change, food, water, or cover may be in short supply, causing damage to the animals or the habitat. Carrying capacity is the number of animals the habitat can support all year long.

As competition increases and resources become increasingly scarce, populations reach the carrying capacity (K) of their environment, causing their growth rate to slow nearly to zero. This produces an S-shaped curve of population growth known as the logistic curve (right).

Carrying capacity is the maximum population size that an ecosystem can sustainably support without degrading the ecosystem. ... Disease, competition, predator-prey interaction, resource use and the number of populations in an ecosystem all affect carrying capacity.

In human ecology, the concept of 'carrying capacity' implies an optimum level of development and population size based on a complex of interacting factors - physical, institutional, social, and psychological.

Externalities and market inefficiency: An externality stems from the production or consumption of a good or service, resulting in a cost or benefit to an unrelated third party. ... Externalities lead to market failure because a product or service's price equilibrium does not accurately reflect the true costs and benefits of that product or service.

Market failure arises when the outcome of an economic transaction is not completely efficient, meaning that all costs and benefits related to the transaction are not limited to the buyer and the seller in the transaction. ... Producers do not consider those costs to others in their decisions

The four types of market failures are public goods, market control, externalities, and imperfect information. Public goods causes inefficiency because nonpayers cannot be excluded from consumption, which then prevents voluntary market exchanges.

There are four types of externalities considered by economists. Positive consumption externalities, negative consumption externalities, positive production externalities, and negative production externalities.

A positive externality exists if the production and consumption of a good or service benefits a third party not directly involved in the market transaction. For example, education directly benefits the individual and also provides benefits to society as a whole through the provision of more…

Market failure

Air pollution is an example of market failure, as the factory is imposing a negative external cost on the community.

Central to environmental economics is the concept of market failure. Market failure means that markets fail to allocate resources efficiently. As stated by Hanley, Shogren, and White (2007):[4] "A market failure occurs when the market does not allocate scarce resources to generate the greatest social welfare. A wedge exists between what a private person does given market prices and what society might want him or her to do to protect the environment. Such a wedge implies wastefulness or economic inefficiency; resources can be reallocated to make at least one person better off without making anyone else worse off." Common forms of market failure include externalities, non-excludability and non-rivalry.

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. In the absence of private property rights, there is no path to a solution that satisfies all parties

Markets are efficient at producing private goods, largely because producers and consumers have the right of ownership of the resources exchanged in an economic transaction involving a private good. However, markets are less efficient when property rights do not exist.

Secure property rights allow landowners to travel from their land for employment, and to let their land work for them. Property rights formalization is, appropriately, often linked with economic prosperity.

The Constitution protects property rights through the Fifth and Fourteenth Amendments' Due Process Clauses and, more directly, through the Fifth Amendment's Takings Clause: “nor shall private property be taken for public use without just compensation.”

In short, the stronger the private property rights system, the better the economy is at efficiently allocating resources and expanding wealth creating opportunities. ... A private property system gives the exclusive right to individuals to use their resources as they see fit and to voluntarily transfer them.

In economics, non-convexity refers to violations of the convexity assumptions of elementary economics. Basic economics textbooks concentrate on consumers with convex preferences (that do not prefer extremes to in-between values) and convex budget sets and on producers with convex production sets; for convex models, the predicted economic behavior is well understood When convexity assumptions are violated, then many of the good properties of competitive markets need not hold: Thus, non-convexity is associated with market failures where supply and demand differ or where market equilibria can be inefficient Non-convex economies are studied with nonsmooth analysis, which is a generalization of convex analysis

Contents :1 Demand with many consumers 2. Supply with few producers 3. Contemporary economics 3.1. Optimization over time 3.2. Nonsmooth analysis 4. See also 5. Notes 6. References 7.External links.

Demand with many consumers

If a preference set is non-convex, then some prices determine a budget-line that supports two separate optimal-baskets. For example, we can imagine that, for zoos, a lion costs as much as an eagle, and further that a zoo's budget suffices for one eagle or one lion. We can suppose also that a zoo-keeper views either animal as equally valuable. In this case, the zoo would purchase either one lion or one eagle. Of course, a contemporary zoo-keeper does not want to purchase half of an eagle and half of a lion. Thus, the zoo-keeper's preferences are non-convex: The zoo-

keeper prefers having either animal to having any strictly convex combination of both.

Supply with few producers

Non-convexity is important under oligopolies and especially monopolies.[8] Concerns with large producers exploiting market power initiated the literature on non-convex sets, when Piero Sraffa wrote about on firms with increasing returns to scale in 1926,[31] after which Harold Hotelling wrote about marginal cost pricing in 1938.[32] Both Sraffa and Hotelling illuminated the market power of producers without competitors, clearly stimulating a literature on the supply-side of the economy.

Pareto optimal provision of public goods: What Is Pareto Efficiency? Pareto efficiency, or Pareto optimality, is an economic state where resources cannot be reallocated to make one individual better off without making at least one individual worse off. The optimal quantity of a public good occurs where the demand (marginal benefit) curve intersects the supply (marginal cost) curve. The government uses cost-benefit analysis to decide whether to provide a particular good.

The first condition for Pareto optimality relates to efficiency in exchange. The required condition is that “the marginal rate of substitution between any two products must be the same for every individual who consumes both.”

An allocation is Pareto efficient if there is no other allocation in which some other individual is better off and no individual is worse off. Example. Consider an economy that contains only one good, which everyone likes. Then every allocation is Pareto efficient: the only way to make someone better off is to give them more of the good, in which case someone else will have less of the good, and hence be worse off.

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 recognise that this is the socially optimal outcome achieved by a perfectly competitive market referred to above.

Pareto efficiency is important because it provides a weak but widely accepted standard for comparing economic outcomes. ... A policy or action that makes at least

one person better off without hurting anyone is called a Pareto improvement. The term is named for an Italian economist, Vilfreo Pareto.

Environmental economics is distinguished from ecological economics in that ecological economics emphasizes the economy as a subsystem of the ecosystem with its focus upon preserving natural capital.[2] One survey of German economists found that ecological and environmental economics are different schools of economic thought, with ecological economists emphasizing "strong" sustainability and rejecting the proposition that human-made ("physical") capital can substitute for natural capital.

An externality exists when a person makes a choice that affects other people in a way that is not accounted for in the market price. An externality can be positive or negative but is usually associated with negative externalities in environmental economics. For instance, water seepage in residential buildings occurring in upper floors affect the lower floors.[6] Another example concerns how the sale of Amazon timber disregards the amount of carbon dioxide released in the cutting.[7][better source needed] Or a firm emitting pollution will typically not take into account the costs that its pollution imposes on others. As a result, pollution may occur in excess of the 'socially efficient' level, which is the level that would exist if the market was required to account for the pollution. A classic definition influenced by Kenneth Arrow and James Meade is provided by Heller and Starrett (1976), who define an externality as "a situation in which the private economy lacks sufficient incentives to create a potential market in some good and the nonexistence of this market results in losses of Pareto efficiency".[8] In economic terminology, externalities are examples of market failures, in which the unfettered market does not lead to an efficient outcome.

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If property rights are not well-defined, four different types of goods can exist: private goods, public goods, congestible goods, and club goods.

Buyers do not directly pay for public goods (although they often pay for them indirectly, such as through taxes) nor do sellers provide them, since they receive nothing for the provision, so there is a market failure by private markets in allocating resources to produce public goods.

An allocation is Pareto efficient if there is no other allocation in which some other individual is better off and no individual is worse off.

Example. Consider an economy that contains only one good, which everyone likes. Then every allocation is Pareto efficient: the only way to make someone better off is to give them more of the good, in which case someone else will have less of the good, and hence be worse off.

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Pareto efficiency is important because it provides a weak but widely accepted standard for comparing economic outcomes. ... A policy or action that makes at least one person better off without hurting anyone is called a Pareto improvement. The term is named for an Italian economist, Vilfreo Pareto.

The Pareto Principle, named after esteemed economist Vilfredo Pareto, specifies that 80% of consequences come from 20% of the causes, asserting an unequal relationship between inputs and outputs. This principle serves as a general reminder that the relationship between inputs and outputs is not balanced.

The terms "Pareto optimality" and "Pareto efficiency" are used interchangeably in the literature, even though the former is often used as a normative criterion indicating

desirable situations, while the latter implies a more neutral description in positive economics (Berthonnet and Delclite, 2014) .

Graaf, is free from making any interpersonal comparisons. It is based on a very broad ethical positive view that 'one should always do well to all'. But it has its weaknesses. (1) There can be an infinite number of Paretian Optima, each with a different level of welfare.

Definition:

Pareto's efficiency is defined as the economic situation when the circumstances of one individual cannot be made better without making the situation worse for another individual. Pareto's efficiency takes place when the resources are most optimally used.

Thus someone who does not buy the good values a unit more than the marginal cost of producing it. ... It follows that a monopoly equilibrium is not Pareto efficient: someone can be made better off without making anyone worse off.

Pareto efficiency, also referred to as allocative efficiency, occurs when resources are so allocated that it is not possible to make anyone better off without making someone else worse off. Context: ... Pareto optimality is sometimes used interchangeably with Pareto efficiency

For example, he observed that 80% of the peas in his garden came from 20% of his pea plants. The 80:20 ratio of cause-to-effect became known as the Pareto Principle. Definition: Pareto Principle. Pareto principle is a prediction that 80% of effects come from 20% of causes.

This “universal truth” about the imbalance of inputs and outputs is what became known as the Pareto principle, or the 80/20 rule. While it doesn't always come to be an exact 80/20 ratio, this imbalance is often seen in various business cases: 20% of the sales reps generate 80% of total sales.

A Pareto Chart is a graph that indicates the frequency of defects, as well as their cumulative impact. Pareto Charts are useful to find the defects to prioritize in order to observe the greatest overall improvement

UNIT - II.

THEORY OF ENVIRONMENTAL POLICY:

A Pigovian (Pigouvian) tax is a tax assessed against private individuals or businesses for engaging in activities that create adverse side effects for society. Adverse side effects are those costs that are not included as a part of the product's market price. These include environmental pollution, strains on public healthcare from the sale of tobacco products, and any other side effects that have an external, negative impact. Pigovian taxes were named after English economist, Arthur Pigou, a significant contributor to early externality theory.

A Pigouvian tax is a government cost on any activity that creates socially harmful externalities.1 An externality is an activity that creates a negative effect on others in a society but not necessarily the person who does that activity.

Pollution is an externality, for example. Drivers of non-compliant vehicles don't suffer immediately from their exhaust, but everyone behind them does. Their exhaust also increases pollution for everyone in the community.

The government imposes Pigouvian taxes on non-compliant vehicles to impose a higher cost on the drivers to compensate for the suffering they cause. The revenue from the tax is often used to ameliorate the external cost.

Ideally, a Pigouvian tax will cost the producer the amount equivalent to the harm it causes others.

British economist Arthur Pigou developed the concept of externalities.2 He argued that the government should intervene to correct them by taxing activities that harm the economy as a whole and subsidizing activities that help society as a whole.

Key Takeaways

A Pigouvian tax is placed on any activity that creates socially harmful externalities. Pigouvian taxes shift the costs from society to the producers of these externalities. Gas, carbon, and noise taxes are examples of Pigouvian taxes.Pigouvian taxes can increase the burden on low-income earners.

Examples of Pigouvian Tax

Let's imagine a manufacturer poisoned the groundwater in its first five years of operations.2 The manufacturer emitted 100,000 gallons of waste during that period, and it cost the nearby town $1 million to clean it up. The town would impose a $1 million fine for past behavior.

The town would also impose a Pigouvian tax of $10 a gallon going forward. That would cover the cost of future pollution. If it was worth it to the firm to continue making its toxin-producing product, then it would pay the fine. If not, then it would go out of business. Either way, the town will have clean water.

Gas Taxes

A gasoline tax is an example of a Pigouvian tax. It raises the driver's cost to cover the negative externalities created by driving automobiles. In the United States, the federal gas tax was $0.183 per gallon in 2019.3 The average state gas tax was $0.2868 per gallon. The revenue goes into the federal Highway Trust Fund to pay for roadway maintenance.

Noise Taxes

France levies a Pigouvian noise tax on airplanes at its nine busiest airports.4 It ranges from 2 euros to 35 euros depending on the airport and the weight of the aircraft. The government uses the revenue to soundproof houses that are exposed to noise levels beyond 70 decibels.5

Carbon Taxes

About 40 countries impose carbon taxes on companies that burn coal, oil, or gas, which produce greenhouse gas emissions. These emissions cause climate change, which can bring about more natural disasters, raise sea levels, and increase droughts.

Although Pigouvian taxes may work in one sense, they can have some unanticipated or unintentional negative effects.

Pigouvian taxes are regressive when they impose a harsher burden on the populations with lower incomes compared to those with higher incomes.

Important :Some Pigouvian taxes, such as the gas tax or cigarette tax, are regressive because they're flat, or the same for everyone. They end up taking take a greater percentage of income from people who make less money.

Externalities problem : Pigouvian Tax is a tax on economic activities that generate negative externalities, which create costs that are borne by unrelated third parties. ... The main purpose of Pigouvian taxes is to oppose market inefficiencies by increasing the marginal private cost by the amount generated by the negative externality.

A Pigovian tax is intended to tax the producer of goods or services that create adverse side effects for society. Economists argue that the cost of these negative externalities, such as environmental pollution, are borne by society rather than the producer.

Definition of Positive Externality: This occurs when the consumption or production of a good causes a benefit to a third party. For example: ... (positive consumption externality) A farmer who grows apple trees provides a benefit to a beekeeper. The beekeeper gets a good source of nectar to help make more honey.

Examples of negative externalities

Loud music. If you play loud music at night, your neighbour may not be able to sleep.

Pollution. If you produce chemicals and cause pollution as a side effect, then local fishermen will not be able to catch fish. ...Congestion. ...Building a new road.

Market failure: An externality stems from the production or consumption of a good or service, resulting in a cost or benefit to an unrelated third party. ... Externalities lead to market failure because a product or service's price equilibrium does not accurately reflect the true costs and benefits of that product or service.1

Marketable Pollution permits and mixed instruments : In environmental law and policy, market-based instruments (MBIs) are policy instruments that use markets, price, and other economic variables to provide incentives for polluters to reduce or eliminate negative environmental externalities. MBIs seek to address the market failure of externalities (such as pollution) by incorporating the external cost of production or consumption activities through taxes or charges on processes or

products, or by creating property rights and facilitating the establishment of a proxy market for the use of environmental services. Market-based instruments are also referred to as economic instruments, price-based instruments, new environmental policy instruments (NEPIs) or new instruments of environmental policy.

Examples include environmentally related taxes, charges and subsidies, emissions trading and other tradeable permit systems, deposit-refund systems, environmental labeling laws, licenses, and economic property rights. For instance, the European Union Emission Trading Scheme is an example of a market-based instrument to reduce greenhouse gas emissions.

Market-based instruments differ from other policy instruments such as voluntary agreements (actors voluntarily agree to take action) and regulatory instruments (sometimes called "command-and-control"; public authorities mandate the performance to be achieved or the technologies to be used). However, implementing an MBI also commonly requires some form of regulation. Market based instruments can be implemented in a systematic manner, across an economy or region, across economic sectors, or by environmental medium (e.g. water). Individual MBIs are instances of environmental pricing reform.

According to Kete (2002), "policymaking appears to be in transition towards more market-oriented instruments, but it remains an open-ended experiment whether we shall successfully execute a long-term social transition that involves the private sector and the state in new relationships implied by the pollution prevention and economic instruments rhetoric.

Transferable permits A market-based transferable permit sets a maximum level of pollution (a 'cap'), but is likely to achieve that level at a lower cost than other means, and, importantly, may reduce below that level due to technological innovation.

When using a transferable-permit system, it is very important to accurately measure the initial problem and also how it changes over time. This is because it can be expensive to make adjustments (either in terms of compensation or through undermining the property rights of the permits). Permits' effectiveness can also be affected by things like market liquidity, the quality of the property right, and existing

market power. Another important aspect of transferable permits is whether they are auctioned or allocated via grandfathering.

An argument against permits is that formalising emission rights is effectively giving people a license to pollute, which is believed to be socially unacceptable. However, although valuing adverse environmental impacts may be controversial, the acceptable cost of preventing these impacts is implicit in all regulatory decisions.

Market-based vs command and control

An alternate approach to environmental regulation is a command and control approach. This is much more prescriptive than market-based instruments. Command and control regulatory instruments include emissions standards, process/equipment specifications, limits on input/output/discharges, requirements to disclose information, and audits. Command and control approaches have been criticised for restricting technology, as there would be no incentive for firms to innovate.[3] Empirical studies have shown the opposite; external price changes can induce innovation as companies are forced to address the market failure of under-investment.

Market-based instruments do not prescribe that firms use specific technologies, or that all firms reduce their emissions by the same amount, which allows firms greater flexibility in their approaches to pollution management. However, command and control approaches may be beneficial as a starting point, when regulators are faced with a significant problem yet have too little information to support a market-based instrument. Command and control approaches can also be preferred when regulators are faced with a thin market, where the limited potential trading pools mean the gains of a market-based instrument would not exceed the costs (a key requirement for a successful market-based approach).

Market-based instruments may also be inappropriate in dealing with emissions with local impacts, as trading would be restricted to within that region. They may also be inappropriate for emissions with global impacts, as international cooperation may be difficult to attain.

For a variety of reasons, environmental advocates initially opposed the use of market-based instruments except under very constrained conditions. However, after

the successful use of freely traded credits in the lead phasedown in the U.S. environmental advocates recognized that trading markets has benefits for the environment as well.[5] Thereafter, beginning with the proposal of the acid rain allowance market, environmental advocates have supported the use of trading in a variety of contexts.

The Coase theorem is central to understand the policy implications of externalities. It does this through indicating those situations in which market activities will eliminate the effects of externalities and suggests new perspectives on why market solutions to externalities may fail and appropriate policy responses.

The Coase Theorem offers a potentially useful way to think about how to best resolve conflicts between competing businesses or other economic uses of limited resources.

But the "Coase Theorem," a term coined by Coase's University of Chicago colleague George Stigler, took on a life of its own. Economic policy analysts on the political right began treating "zero transaction costs" not as a heroic simplifying assumption, but as a plausible policy goal.

Coasean market solutions in the context of common entitlements

Taking part in market transactions is where common ownership turns out to be “the largest impediment”. For multiple parties, co-owners of resources, to enter a market deal, they should first agree on the value of their resources, the value of each share, whether the exchange is worthwhile, and numerous further details. Consent is a major issue not only for communities and informal associations, but also for collective and stock companies, partnerships and any other collective entities.

Coase refers several times to the standard example of a factory with a smoky chimney, but only twice mentions that it affects “a vast number of people engaged in a wide variety of activities” . These seem to be the only occasions when he refers specifically to situations in which multiple victims are affected by an externality, and he does not go into detail. But these situations are so prevalent in reality that the implications of the Coasean approach in such circumstances merit in-depth investigation.

I begin by analysing the activities involved in a Coasean solution to externalities that affect multiple victims by elaborating on Bass v. Gregory, in which there were two plaintiffs – the owner and the tenant of a public house. They acted as a single party in the court case, because they both had a common interest in preserving “the free passage of air from [the] cellar upwards through the well”. Still, obviously, the interest of the owner was greater than the interest of the tenant, because if they lost the case, the tenant could move to another public house, whereas the owner would still have a cellar with no ventilation. Hence, the difference in their interests is a reason for them to define in advance how the solicitor’s honoraria and the court expenses, as well as the eventual gains or losses, would be allocated between them. This agreement is by nature a Pigovian measure, if only because it is made before the litigation. Yet the Pigovian nature of the agreement between multiple third parties is much more evident when the number of third parties is larger. Consider the case of the straying cattle.

As noted in the second section, Coase investigates in detail the options for allocating the costs of erecting a fence between a single cattle-raiser and a single neighbouring farmer; however, the situation he envisions seems improbable – it is more likely that the cattle-raiser would be surrounded by several farms. In that case, there would be no point in erecting a fence only between the cattle-raiser and one of the neighbouring farmers, and if there were several neighbours, the calculation of the costs would be overly complicated. Whether this complicated allocation of costs will be feasible depends on the existing legal system.

The fencing issue is widely recognized by the legal systems of the United States, for instance. Because Pigovian and Step 1 Coasean solutions are connected (see the previous subsection), there are no purely Pigovian or purely Coasean legal provisions. Still, some laws may be considered more Pigovian (i.e. liabilities are more strictly defined by legal rules), and some are more Coasean (i.e. liabilities are to some extent negotiable). If specific fencing duties are not strictly defined or detailed, but owners bear general civil or criminal liability, Coasean negotiations are a likely solution, especially when the law recognises the costs and benefits of fencing (e.g. freedom from intrusion by livestock and trespassing neighbours, increased land value by virtue of fostering agriculture, and diminution of lawsuits; Tidgren 2016). However, when multiple farmers bargain with a cattle-raiser about the costs of

fencing or take the case to court, collective action has key advantages but is also quite expensive. To reduce the cost of negotiating, collective action would benefit from centralised Pigovian rules.

But this is possible only on one key condition – that the farmer is the exclusive/private owner of the air above her farm. Otherwise, she may not negotiate on her own. This is obviously a wrong assumption, because the air over different farms is constantly moving and intermingling. Ignoring this problem and pursuing a Coasean approach results in a 'market' process with obvious deficiencies.

The market price of pollution would, therefore, remain unknown; hence, such one-by-one negotiations can hardly qualify as a genuine market process. But there is an even greater problem. Suppose the polluter has paid 16 of the 30 farmers (more than 50% of them). Has he really bought their polluting rights? Can he pollute the air if he has bought the rights of two-thirds or three-quarters of the farms? Obviously, even if he has paid 29 farms for the rights to pollute the air above their land, the polluter still is not entitled to pollute the air of the area, because volumes of air are constantly exchanging and he is also polluting the air of the 30th farm, which he has not paid for. Clearly, for the Coasean solution to work – for the market mechanism to function – the polluter must pay all co-owners of the air in the area. Thus to carry out 'genuine' Coasean bargaining over a common resource, the polluter must bargain with all co-owners together.

Negotiations generally incur high transaction costs; collective negotiations are much more expensive, and so are collective Coasean bargains. Alternative institutional arrangements may be used to reduce transaction costs as examined in the following paragraphs; however, certain general considerations apply. First, although collective bargaining with 30 co-owners is expensive, 30 individual bargains no doubt incur much higher costs. Hence, organization saves transaction costs, especially if one takes into account the cost of risk to negotiate successfully with 29 farmers and fail with the 30th. Second, even if farmers are organized, negotiating with all 30 of them may still be prohibitively costly. Electing "a small management group" (Demsetz 1967, 355) to conduct the negotiations will reduce the costs substantially, despite all the drawbacks of collective management. Thirdly, establishing a system of

centralized (actually Pigovian) rules is in fact a basic mechanism for cost reduction in organizations.

The following paragraphs examine four possible arrangements that allow the farmers to negotiate over air pollution. Two of these arrangements involve individual entitlements, and two involve shared/common entitlements. The latter two unavoidably employ Pigovian measures.

The first solution involves organising either a formal or informal association of farmers. As already shown, the farmers need to bargain with the factory owner collectively, but it is too expensive for all 30 of them to take part in the negotiations, so, as explained, they should organise and elect “a small management group” to bargain with the polluter. Any form of collective management of property rights is associated with difficulties, such as organisation problems, possible misuse of central powers, etc., yet this is the least expensive way for the farmers to defend their common air. What is particularly important for this research is that organisation necessarily involves Pigovian measures. First of all, the management group should acquire powers and a central position. To establish a mandate for the management group to bargain, the farmers should organise a meeting and define their main terms of the negotiations. Thus some aspects of the negotiations’ results are defined the bargaining parties may choose only between the limited alternative options of the mandate. Some smaller details will be determined in the course of the bargain, and then the management group will exercise its central powers. However, all expenses associated with the bargain should be covered by all farmers. For that purpose each one should pay his or her contribution, which is similar to taxing. Hence, if an association is a party involved in solving an externality problem, it employs Pigovian measures to carry out Coasean bargaining.

I next examine the second alternative solution, establishing a private company. There are two options for this company – it can be an individual property if one person buys up all “adjoining properties”, or it can be in collective ownership. The first option has two sub-options: the person who buys up all properties in the area may be the owner of the factory, or it may be one of the farmers. If the factory owner buys all properties in the area, this is the solution defined by Coase as the “firm” solution that internalises the externalities. Alternatively, if one of the farmers buys the

properties of her neighbours, then this will facilitate Coasean bargaining between one buyer and one seller. Thus both outlined options result in ‘pure’ Coasean solutions – either through internalisation of the externalities or through Coasean.

Establishing a collective company will solve the externality issues, but only insofar as the producer of the negative externality will have one legal entity to bargain with and negotiations will be facilitated. To the factory owner the new company will be a private entity, but to the farmers it will be a collective body. In fact, as in the first case of an association, many of the externality issues will be transformed into issues of collective management with all associated organizing costs and drawbacks, such as possible misuse of management powers and corruption, public choice problems and agency problems. Yet, because the organisation of the company is based on its own private statutes, as well as on private contracts between the shareholders and the management, and between the management and the employees, many of the problems will be solved, but others will remain.

Coase theorem is the idea that under certain conditions, the issuing of property rights can solve negative externalities. For example, a Forrester will manage their forest to ensure its longevity and protect it from fires. It is their incentive to do so in order for them to be able to sell logs in future years.

Environmental Monitoring

Environmental monitoring refers to systematic sampling of air, water, soil, and biota in order to observe and study the environment, as well as to derive knowledge from this process.

At its core, environmental monitoring is designed to help us understand the natural environment and protect it from any negative outcomes of human activity. The process is an integral part of environmental impact assessments and results can directly determine whether or not projects are given the all clear.

Environmental Monitoring Benefits

Validation and verification of cleaning and sanitation programs. ...

Provides data of the overall effectiveness of your sanitary program, personnel practices, and operations procedures. ...

Provides data about indicator organisms, spoilage organisms, and pathogens to prevent outbreaks.

Environmental economists perform studies to determine the theoretical or empirical effects of environmental policies on the economy. This field of economics helps users design appropriate environmental policies and analyze the effects and merits of existing or proposed policies

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.

Environmental economics is a sub-discipline of economics that aims to understand, and influence, the. economic causes of human impacts on the non-human world, such as atmospheric pollution. It seeks. to apply the main concepts and methods of economic thought to environmental goods

Environmental economics will help you understand some important and controversial issues – such as climate change policy, nuclear power, recycling policy, and traffic congestion charging. ... In very broad terms, environmental economics looks at how economic activity and policy affect the environment in which we live.

Environmental economics deals with the exploitation, allocation and use of renewable and fixed natural resources. Environmental policy refers to sets of safe rules of conduct that organisations have to implement in order to address various environmental issues.

Environmental economists study the economics of natural resources from both sides - their extraction and use, and the waste products returned to the environment. They also study how economic incentives hurt or help the environment, and how they can be used to create sustainable policies and environmental solutions.

Environmental economics is a sub-field of economics concerned with environmental issues. ... Environmental economics is distinguished from ecological economics in that ecological economics emphasizes the economy as a subsystem of the ecosystem with its focus upon preserving natural capital.

The aim of E.V.S.(environmental studies) is to develop a world population that is aware of and concerned about the environment and its associated problems and which has the knowledge ,Skills, attitudes ,motivations and commitment to work individually and collectively towards solutions of current problems and prevention ..

Environmental protection is the practice of protecting the natural environment by individuals, organizations and governments. Its objectives are to conserve natural resources and the existing natural environment and, where possible, to repair damage and reverse trends.

The goals of environmental education are: to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment; to create new patterns of behavior of individuals, groups, and society as a whole towards the environment.

This is because people generally exhibit an endowment effect, in which they value something more once they actually have possession of it. Thus, the Coase Theorem would not always work in practice because initial allocations of property rights would affect the end result of the negotiations.

The Coase theorem states that when transaction cost are low, two parties will be able to bargain and reach an efficient outcome in the presence of an externality. In practice, private parties often fail to resolve the problem of externalities on their own.

Economic carrying capacity takes the form of maximum global economic welfare derivable from the sustainable throughput flows of the ecosphere. ... The shape of this curve is determined by the rising costs associated with the ecosystemic impact of increasing throughput rates as required by a growing economy.

Coasian bargaining

Coasian bargaining is based on the ideas of Ronald H. Coase who earned the 1991 Nobel Prize in economics ‘for his discovery and clarification of the significance of transaction costs and property rights for the institutional structure and functioning of the economy’. In his article, The Problem of Social Cost (1960), he proposes that well-defined property rights can overcome the problems of externalities, because many environmental problems arise from poorly defined, or a lack of, property rights.

Assuming that property rights are held by the polluter and that transaction costs are zero, the Coase theorem states that a polluter and a victim can reach a mutually beneficial bargain if the damage from pollution is higher than the polluter's net return from the sale of the good generating the pollution. In this case, a payment from the affected party to the polluter would reduce the pollution.

Thus, the Coase theorem states that the most efficient solution to resolving interdependent uses of the environment, including pollution cases, is a bargaining process among relevant property holders. If property rights are given to polluters, victims can pay them not to pollute, creating a market-like solution akin to a scheme for payments for ecosystem services. Alternatively, if property rights are given to the victims, the polluters may compensate the victim or buy the right to pollute. Thus, the cost of the negotiated outcome is shared between the parties without any external intervention

As an example, consider a chemicals factory producing useful products but also polluting smoke. If the initial legal framework gives people the right to breathe clean air, they could make the factory produce less or nothing at all. However, assume that the factory is willing to pay up to USD 5 per unit for the right to pollute enough to produce its output. If this amount is considered of greater value than that of clean air, people will take the money and put up with (the economically optimal level of) pollution. On the other hand, if the right to pollute lies with the firm, people can bribe the firm to pollute less.

The Coasian bargaining approach is an attractive one to some: an economy may be able to achieve Pareto-efficient resource allocation (that is, no individuals can be made better off without making someone else worse off) without pervasive government regulation. Moreover, Coasian bargaining solutions can be particularly interesting for international externalities, since there is no supranational environmental protection agency with the necessary authority to impose abatement directives or pollution taxes.

However, the number of situations for which Coasian bargaining is feasible and desirable is limited. First, Coasian bargaining does not eliminate the role of government in assigning initial property rights. This process will be subject to special interest group lobbying and rent seeking. In addition, because many environmental

externalities are indirect, cumulative and uncertain and because resorting to the legal system involves inefficiency, the costs of enforcing or striking a Coasian bargain may be large. Moreover, as many externalities are intertemporal, future generations are simply not present in any bargain.

Another limit to Coasian markets comes from the fact that many environmental externalities, like car emissions or noise in the vicinity of airports, or global effects such as climate change and ozone layer destruction, involve a large number of people. For example, a farmer who pollutes his water supply may be one of numerous upstream farmers affecting thousands of downstream neighbors'. Bringing all the relevant agents to the negotiating table would be difficult and expensive. The transaction costs (of aggregating the interests of all the affected parties, hiring lawyers, negotiating an optimal abatement level, and enforcing a market agreement) will prevent a private bargain even with a clear allocation of rights. Moreover, individuals will be tempted to act as free riders in negotiations, undermining the negotiations themselves. Individuals would treat the outcome of negotiations as beyond their control and therefore, be unwilling to bear any transaction costs (Baumol and Oates, 1988). Thus, when externalities take place in future, or when transaction costs are important and when the number of participants is large, Coasian solutions to environmental externalities must be ruled out.

Tradable pollution -Characteristics

Ensuring good water quality is an essential step towards water security. Consequently, pollution control is a big part of water resource management. Tradable pollution permits are so-called cap and trade schemes. They give companies a legal right to pollute a certain amount per fixed time span. Firms that pollute less can then sell their leftover pollution permits to firms that pollute more. The point of this is that polluting firms and public agencies differ in their ability to abate their pollution – some can do it easily and cheaply, for others it would be more difficult and costly. Consequently, tradable pollution permits can be a cost effective way to achieve a reduction in overall pollution.

The freedom to trade pollution "entitlements" gives an incentive for polluters to consider abatement (since they can sell their surplus quotas) while others face the cost of having to purchase permits. For society, the existence of tradeable permits

enables pollution abatement to be achieved in the least costly manner. Over time, pollution standards can be tightened, increasing the value of the permits and the pressure on market participants. Credits are traded within defined trading areas.

Trading in pollution permits arises in the following situations: Permits to discharge into specific water bodies issued to local firms and wastewater treatment plants (e.g. Fox River, USA);

Nutrient trading (e.g. in parts of the USA, Canada, Netherlands, and Australia). Transactions listed under some schemes include “bubble licensing” (in which several wastewater treatment plants are considered together in applying nitrogen and phosphorous load discharge limits) and “diffuse source offsets” (in which a water authority can purchase offset credits from external sources using much cheaper ways of reducing overall nutrient pollution).

A number of these schemes in water pollution are still in the pilot phase, and experience is still accumulating. Mainly, tradeable permits are used to manage air pollution.

There is a need for a mechanism for initial allocation of rights (whether for water or pollution discharges) which should be seen to be fair, and be equitable and effective. Initial prices can be set by governments or determined through public auctions.

The decision on how long permits are valid is important if ever governments want to change the price for a pollution unit. If permits are valid indefinitely, companies can “bank” unused pollution certificates which means that later price corrections will be less effective.

In order to be effective, monitoring systems need to be put in place to keep track of the pollution discharges of companies and/or other users so their actual discharge can be determined and fines imposed if companies surpass the pollution levels allotted through their permits.

A system that relies on pollution permits as opposed to mandatory pollution cuts or limits set by the government allows companies that are wealthy enough to keep polluting.

It is also possible to set up a system in which credits are not just sold or given out, but also generated through environmental services or water treatment. An example of such a system is the Maryland Nutrient Trading System, where farmers can produce credits in the trading system by installing riparian buffers or covering crops. To qualify as credits, these practices must be certified and inspected by appropriate authorities.

Environmental in WTO regime:

The WTO came into existence in 1995 and the Committee on Trade and Environment was established as per a decision adopted during the Uruguay Round. Its main aim was to identify the relationship between trade and environment to promote sustainable development. The agenda was an extention of the GATT 1991. Its preamble include : (a) the Agreement on Technical Barriers to Trade (TBT) and the Agreement on the Application of Sanitary and Phytosanitary (SPS) Measures: (b) It also recognized the importance of furnishing technical assistance to developing country members; and (c) Transfer of Technology.

TECHNICAL BARRIERS TO TRADE (TBT)

A technical regulation is defined in the TBT Agreement as “Document which lays down product characteristics or their related processes and production methods. It may also include or deal exclusively with terminology, symbols, packaging, marking or labeling requirements as they apply to a product, and its process.”

Agreement Sanitary and Phytosanitary (SPS) Measures

Sanitary or Phytosanitary Measures include all relevnt laws, decrees, regulations, requirements and procedures including, inter alia, end product critera, process and production methods, testing, inspection, certification, relevant requirements associated with the transport of animals or plants, methods of risk assessment packaging and labeling requirements directly related to food safety.

GENERAL AGREEMENT ON TRADE IN SERVICES (GATS)

According to WTO committee on Trade and Environment (CTE), GATS contains a commitment to progressi ve liberalization and to increasing the participation of developing countries. It will improve the environmental protection in these countries.

The environmental services include sewerage services, refuse disposal services and sanitation services. Further sub-classification includes clean9ing of eshaust gases, noise abatement services, and la ndscape protection serviceds.

THE DOHA DEVELOPMENT AGENDA:

After the pronounced failure of WTO members to agree opon an agenda for further multilateral trade negotiations at the Seattle Ministerial Meeting of 1999, a new round of multilateral trade negotiations was initiated at the WTO'S Forth Ministerial conference in Doha, Qoatar in November 2001.

The 4th WTO Ministerial Conference ended and country to many predictions, members did manage to put together a declaration in the true WTO tradition of give and take consensus while some may argue that most of the statements in various declarations are innocuous and ambiguous, which will lead to different interpretations and new problems related to developing countries.

Sustainable development and protection and preservation of the environment are fundamental goals of the WTO. They are enshrined in the Marrakesh Agreement, which established the WTO, and complement the WTO's objective to reduce trade barriers and eliminate discriminatory treatment in international trade relations. While there is no specific agreement dealing with the environment, under WTO rules members can adopt trade-related measures aimed at protecting the environment provided a number of conditions to avoid the misuse of such measures for protectionist ends are fulfilled.

The WTO contributes to the protection and preservation of the environment through its objective of ensuring sustainable development and avoiding protectionism, through its rules and enforcement mechanism, and through work in different WTO bodies.