



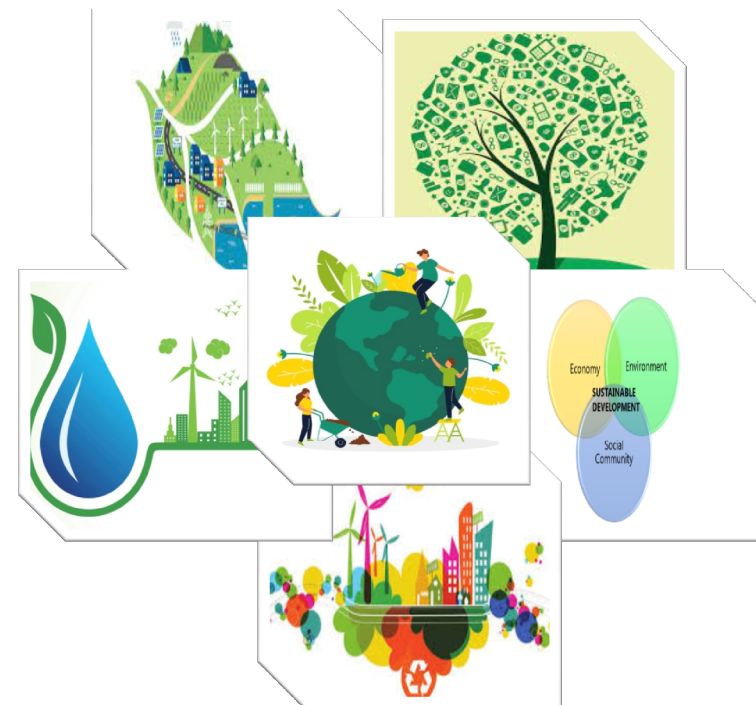
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EVS 508

**Environmental Economics and
Sustainable Development**

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Environmental Economics and Sustainable Development



**Department of Forestry and Environmental Science
School of Earth and Environmental Science**



**Uttarakhand Open University
Haldwani, Nainital (U.K.)**

Environmental Economics and Sustainable Development



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Unit-1: Basics of Welfare Economics

Unit Structure

1.0 Learning objectives

1.1. The producer consumer surplus and Market Failure

1.1.1. Demand, Supply and Efficiency

1.1.2. Consumer Surplus, Producer Surplus, Social Surplus

1.1.3. Market failure

1.2. Externalities

1.2.1. Types of Externalities

1.2.2. Pigovian Fees

1.2.3. Multiple Polluters

1.2.4. Pigovian Subsidies

1.3. Public goods

1.3.1. Public Goods are Non Rival and Non Excludable

1.3.2. Supply of Public Goods

1.3.3. Demand of Public Goods

1.3.4. Pareto Optimal Provision for Public Goods

1.4. Pareto optimality

1.4.1: Feasibility of Pareto Improvement with compensation

1.5. The Law of diminishing returns

1.6. National income

1.7. Summary

1.0 Learning objectives

After studying this unit you will be able to understand about:

- The producer consumer surplus
- Market failure
- Externalities and public goods
- Understand the attributes of Public Goods
- Know about the demand and supply of public goods.
- Know about Pareto Optimality in Public goods.
- Distinguish between Merit goods and Environmental goods.
- The law of diminishing returns and National income

1.1. The producer consumer surplus and Market Failure

1.1.1. Demand, Supply and Efficiency

The familiar demand and supply diagram holds within it the concept of allocative efficiency. One typical way that economists define efficiency is when it is impossible to improve the situation of one party without imposing a cost on

another. Conversely, if a situation is inefficient, it becomes possible to benefit at least one party without imposing costs on others.

Efficiency in the demand and supply model has the same basic meaning: the economy is getting as much benefit as possible from its scarce resources and all the possible gains from trade have been achieved. In other words, the optimal amount of each good and service is being produced and consumed.

1.1.2. Consumer Surplus, Producer Surplus, Social Surplus

Consider a market for tablet computers, as shown in Figure 1. We usually think of demand curves as showing what quantity of some product consumers will buy at any price, but a demand curve can also be read the other way. If we choose a quantity of output, the demand curve shows the maximum price consumers would be willing to pay for that quantity. According to the demand curve in Figure 1, if producers wanted to sell a quantity of 20 million tablets, some customers are willing to pay \$90 each (see point J.) In other words, a tablet is worth \$90 to those customers.

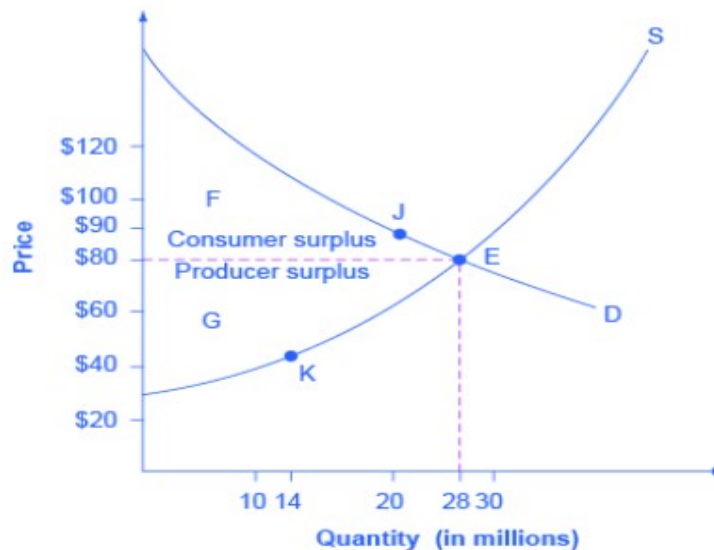


Figure 1. Consumer and Producer Surplus. The somewhat triangular area labeled by F in the graph shows the area of consumer surplus, which shows that the equilibrium price in the market was less than what many of the consumers were willing to pay. The somewhat triangular area labeled by G shows the area of producer surplus, which shows that the equilibrium price received in the market was more than what many of the producers were willing to accept for their products.

However, that doesn't mean that those customers will end up paying \$90. Figure 1 shows that the equilibrium price is \$80 and the equilibrium quantity is 28 million tablets. At that price, each customer who would have been willing to pay \$90 for a tablet is getting a good deal. We all know what a good deal is—it's when you get something for less than you think it's worth. We don't have to stop there. If suppliers chose to produce only 14 tables (as shown in point K), we can look at Figure 1 and up to the demand curve to see that some customers would have been willing to pay about \$115 for a tablet at this quantity produced. What that means is that this subset of customers got an even better deal at the equilibrium price.

The demand curve shows what consumers are willing to pay for any given quantity of tablets. In other words, the height of the demand curve at any quantity shows what some consumers think those tablets are worth. We can formalize this idea of how good a deal consumers get on a transaction using the concept of consumer surplus.

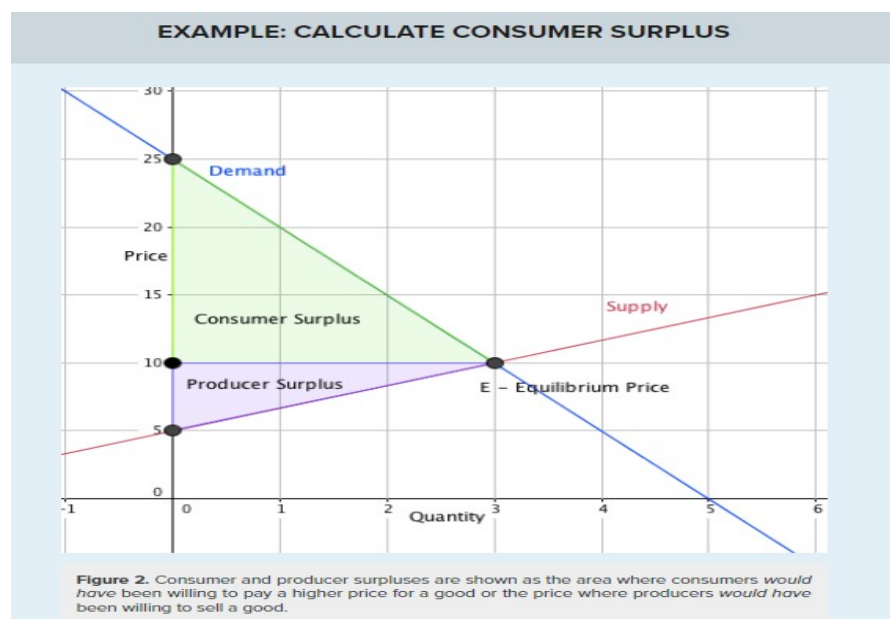
Since a demand curve traces consumers' willingness to pay for different quantities, we can define the gain to consumers as the difference between what they would have been willing to pay and the price that they actually paid. At point J, consumers were willing to pay \$90, but they were able to purchase tablets at the equilibrium price of \$80, so they gained \$10 of extra value on each tablet. This is exactly analogous to the "profit" Bill earned from buying apples that we described in the previous page of reading. If we add up the gains at every quantity, we can measure the consumer surplus as the area under the demand curve up to the equilibrium quantity and above the equilibrium price. In Figure 1, the consumer surplus is the area labeled F.

The supply curve shows the quantity that firms are willing to supply at each price. For example, point K in Figure 1 illustrates that firms would have been willing to supply a quantity of 14 million tablets at a price of \$45 each. Those producers were instead able to charge the equilibrium price of \$80, clearly receiving an extra benefit beyond what they required to supply the product. The amount that a seller

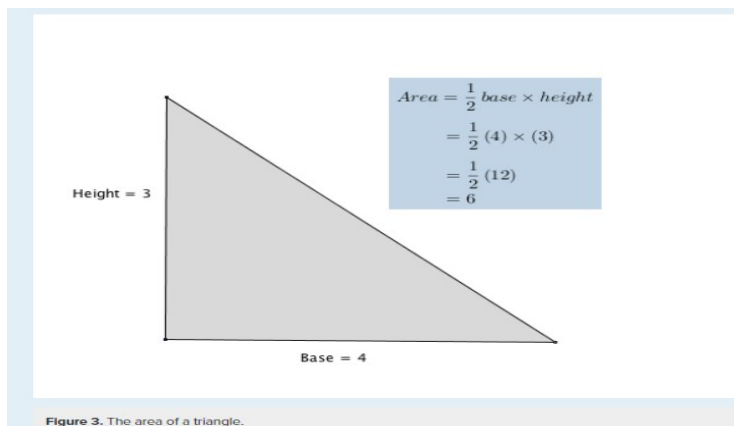
is paid for a good minus the seller's actual cost is called producer surplus. In Figure 1, producer surplus is the area labeled G—that is, the area between the market price and the segment of the supply curve below the equilibrium.

To summarize, producers created and sold 28 tablets to consumers. Both producers and consumers benefited. The value of the tablets is the area under the demand curve up to the equilibrium quantity. The cost to produce that value is the area under the supply curve. The new value created by the transactions, i.e. the net gain to society, is the area between the supply curve and the demand curve, that is, the sum of producer surplus and consumer surplus. This sum is called social surplus, also referred to as economic surplus or total surplus. In Figure 1 we show social surplus as the area $F + G$. Social surplus is larger at the equilibrium quantity and price than it would be at any other quantity. This is what economists mean when they say that market equilibrium is (perfectly) allocatively efficient. At the efficient level of output, it is impossible to produce greater consumer surplus without reducing producer surplus, and it is impossible to produce greater producer surplus without reducing consumer surplus. In other words, the consumer and producers gains from exchange are maximized at the equilibrium point.

Examples for calculating Consumer Surplus:



In the sample market shown in the graph, equilibrium price is \$10 and equilibrium quantity is 3 units. The consumer surplus area is highlighted above the equilibrium price line. This area can be calculated as the area of a triangle. Recall that to find the area of a triangle, you will need to know its base and height. Refer to the following example if you need a refresher.



Let's apply the calculation for the area of a triangle to our example market to see the added value that consumers will get for this item at the equilibrium price in our sample market.

Step 1: Define the base and height of the consumer surplus triangle.

The base of the consumer surplus triangle is 3 units long. Be careful when you define the height of this triangle, it is tempting to say it is 25, can you see why it isn't? The height is determined by the distance from the equilibrium price line and where the demand curve intersects the vertical axis. The height of the triangle begins at \$10 and ends at \$25, so it will be $\$25 - \$10 = \$15$

$$b = 3$$

$$h = 15$$

Step 2: Apply the values for base and height to the formula for the area of a triangle.

$$A = \frac{1}{2} b \times h$$

$$A = \frac{1}{2} 3 \times 15$$

$$A = \frac{1}{2} 45$$

$$A = \frac{45}{2} = 22.5$$

1.1.3. Market failure

Every country has limited resources to fulfill unlimited wants of its populace. Though it is not possible to fulfill all the wants of everyone but the efficiency in

production and allocation can help to maximize the fulfillment of wants for present and future generations. Sometimes markets may fail to produce and allocate goods among consumers, in most efficient way. This inefficiency in production or allocation is known as market failure.³ Before a detail discussion on market failure and environmental economics let's imagine a lonely island where only a single human being 'A' is living. There is a small pond, the only source of water on the island. 'A' is depending on milk cattle for his livelihood as he knows no other work. There is no conflict of interest with anyone in decision making as he is alone. Now another person 'B' came to this island. 'B' wants to grow vegetables for his livelihood. For growing vegetables and raising animals, pond is the only source of water.

Now there may or may not be a conflict of interest between A and B depending on the quantity of water in the pond. If water is sufficient for both of them there will not be any rivalry between them because the consumption of one is not going to affect the consumption of another one. We may say that here pond water is non rival good.⁴ Now third person 'C' comes to the island. C wants to use the pond water for making fruit juice for his livelihood. But the pond is not big enough to provide sufficient water for all of them. Now there is conflict of interest among all of them as the congestion has started. Assuming that there does not exist any rule regarding the use of pond water so that anyone can use it or we may say that pond water is an open access good.

Similar is the situation with most of the open access goods around us like unrestricted highways, fishes in the sea, forests etc. Because of increasing population the burden on natural resources is increasing and most of these resources are overburdened. We may say that the congestion has started everywhere and in absence of well defined property rights the congestion leads to overuse of the resource and hence the market failure.⁵

Coming back to our example, suppose that A's animals start bathing in pond making water dirty for fruit juice. In the absence of property rights C has no option but to put a water filter system. A has created a negative externality for C as he has to bear the cost of water filter system.

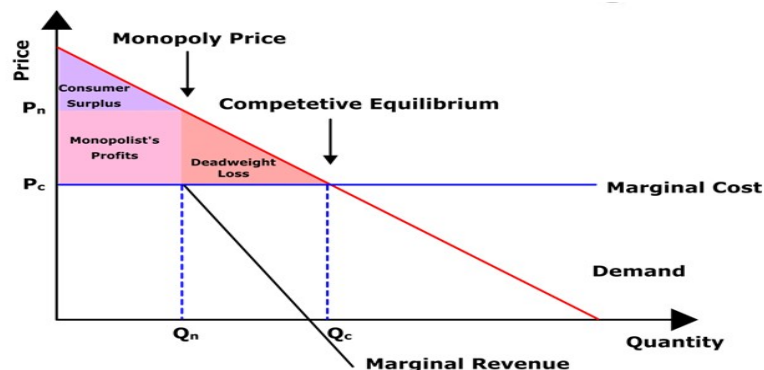
Explanation 3 An externality exists if the third party is affected by the act of production or consumption of a commodity. The externality becomes negative if it

generates cost for the third party and becomes positive it generates benefit for third party. Markets fail in the presence of externalities as the prices do not reflect cost or the benefit accrued by third party. There are six forms of market failure.

1. Failure of Competition: Pareto efficiency/ microeconomic efficiency requires presence of perfect competition—large number of firms that cannot exert a force on prices. However, in reality there are a large number of industries where only firms have the market autonomy, that is, there is presence of monopoly/ oligopoly or monopolistic competition. These forms of competition violate the first welfare theorem that the competitive equilibrium is Pareto efficient. It requires that there should be perfect competition and the firms and the households believe that they don't have any impact on prices, that is, that they act as price takers.

Limited presence or absence of competition may be due to the presence of large firm with cost advantages compared to other firms — a case of natural monopoly, imperfect information on the part of few firms and high transportation costs making it difficult for goods to be sold at many locations. Firms also engage in strategic competition to threaten entry of new firms. Monopoly power is also gained through government action such as the grant of patents, copyrights etc.

We also know that imperfectly competitive firms set their marginal cost equal to marginal revenue to arrive at equilibrium setting unlike under perfect competition where prices are set to equate marginal costs. Since under imperfect competitive marginal revenue is less than the price, equilibrium output is less than the socially desirable/ competitive output. It denies consumers the benefit of choices, impedes competition and restricts production to create artificial scarcity and higher prices. This dead weight loss is loss to the society and is a social waste.



2. Public Goods: Public goods have two properties- non-exclusion and non-rivalry. Non-exclusion implies it is impossible to exclude others from enjoyment/ consumption of a good or service. For example. Streetlight, defense, roads etc. Non-rival consumption implies consumption of a good does not affect the consumption of it by someone else. Such goods can be consumed/ enjoyed by many at the same time at no additional cost. Private goods completely lack these properties and markets can achieve efficient resource allocation only to private goods as private property rights are well established. Moreover, because of free ridership problem involved in the provision of public goods, private producers will not find it profitable to produce them. Under free ridership, there is the absence of voluntary payment for the consumption of the goods. Individuals refrain from payment assuming that other consumers will pay for the goods. Thus, Markets fail to efficiently supply public goods and it provides a strong rationale for government provision of such goods.

3. Externalities: Markets fail in presence of externalities. Externalities occur when production or consumption by an individual/ firm affects the production or consumption of others either positively or negatively and there is no compensation involved. For example, a chemical plant discharges pollutants in the river stream imposing costs for downstream users of the rivers such as fishermen. They may have to spend considerable cost on cleaning up the water. When such externalities are present, resource allocation by the market will not be efficient. Since producers do not take into account the full costs of negative externalities associated with their production, they tend to overproduce than the socially optimum. In the case of positive externalities, individuals do not enjoy the full benefits of activities generating positive externalities and, thus, engage in too little of these. Thus, government intervention is required to correct such market failures.

4. Incomplete markets:

It refers to the market failure that occurs when private markets fail in the provision of goods and services even though the cost of providing them is less than what individuals are willing to pay.

Insurance and Capital markets: The prime example of such market failure relate to markets for insurance and loans. In insurance market, there are not many private players because of certain important risks involved. In many countries, the

government has taken active participation in the insurance sector. There are three important factors due to which such markets are imperfect.

- **High transactions cost**— costs of running the market, enforcing of contracts, costs associated with the introduction of new product.
- **Innovations**— The constant innovation of new policies, new products, new markets.
- **Asymmetries of information and enforcement costs**— Large gaps of information between the buyers and sellers on the qualities of a product, the risks involved.

When there are asymmetries of information and enforcement problems, markets may not exist or the transactions may be smaller than the socially optimum. Hence, the government has to intervene in such markets to increase the quality of information to the market participants.

Complementary markets: Governments intervene when there is an absence of coordination between different market players. For example, in developing countries, large-scale coordination is required between different agencies-businesses and policy makers etc.

5. Information failures: The welfare theorems assumes that market equilibrium price reflects all the information related to the relative scarcity of resources involved in the production of the products and the relative value placed on these products by the buyers. It is also assumed that all market participants have complete access to information. When this is the case, market prices plus the market environment reflect all the information needed to make socially optimal choices. However, we know that information is not equally available to all markets participants. For example, Consumers may not be fully aware of the relative merits of competing goods such as financial products. The insurance market is particularly prone to such information failures. The problem of adverse selection where it is difficult to differentiate between high-risk and low-risk borrowers causes such market failures. Thus, government intervention is required so that information is completely disseminated.

6. Unemployment and other macroeconomic disturbances: Relative high rates of unemployment, inflation are signs of problems with the market system. Economists such as Keynes argue that unemployment is an evidence of market

failure and advocate government intervention for ensuring economic stability. Moreover, it has an important role in ensuring income equality and social security because the market as a system can ensure economic efficiency but at the same time can lead to unequal income distribution. The Public policy becomes a necessity to secure objectives of high employment, price stability and economic growth.

It is also argued that individuals may not always act in their best interest and may result in welfare losses. For example, people who smoke, are aware of the ill effects of smoking, yet continue to smoke. Thus, government intervention becomes necessary in this regard, for example, imposing heavy taxes on cigarettes. Such goods fall in the category of merit goods. It calls for the public provision of some goods and restrictions on consumption of other goods.

1.2. Externalities

An externality is present whenever some individual's utility or production relationships include real variables whose values are chosen by others without particular attention to the effects on that person's welfare. Alternatively: Actions of individual A affect utility or production function of individual B, but the effects are not expressed in terms of prices. The real variables could be in the form of shift in production or consumption possibilities of individual A due to externalities generated by actions of say Individual B. The decision taken by individual B does not consider the interests of Individual A and that generates externalities. As the result of which, there exist a difference private and social costs.

1.2.1. Types of Externalities

Externalities cause private and social costs to differ from each other. Externalities can be expressed in terms of a utility function in the following way. Consider a production function given by

$U = f(X_1, \dots, X_n, Z)$ where X_1, \dots, X_n are market-valued goods and services and Z is some measure of environmental quality. Z is attributed to a condition in an individual's utility function which can be affected by the actions of (other firms, other consumers).

A similar concept can be viewed in the production function as well. Consider a production function where

$Q = f(L, K, Z)$ is L is labour, K is capital and Z is some environmental input which the firm uses. Here again the state of Z , (though a part of the production function of individual's firm) depends upon the actions of others. A few examples of Z could be waste-disposal capacity of the various resources (air, water, land) for a factory, clean water for a whisky distiller etc.

The effect of the externality can both be positive and negative. Some of the examples of positive externalities are benefits from education and telephone connection. The negative external effects includes costs of environmental pollution, traffic jams etc. Individuals take into consideration only their private benefits/costs. Thus with the presence of negative (positive) external effects, it is not possible to account for all marginal social costs (benefits). This generates inefficiency. We will focus on negative external effects, in particular environmental pollution. Production generates pollution and it can be seen as a linear function of output. Thus pollution increases as output rises. In the analysis that follows, we assume increase in pollution is proportional to increase in production. However, the damages from pollution rise at an increasing rate. We also assume that output sells at a constant price and marginal private costs are continuously increasing.

4. Graphical Analysis

a) Gross Domestic Product(GDP)

Figure 1 depicts marginal private production cost (MC_P) and marginal social production cost (MC_S). Production costs rises with the output(Q). The difference between these two curves is the negative external effect of pollution which causes irreversible environmental damage.

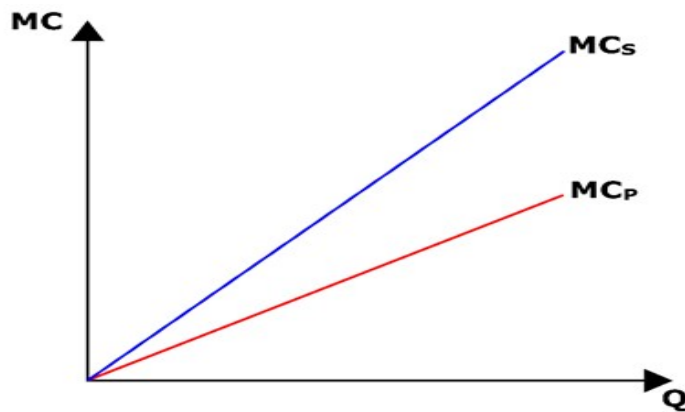


Figure 1: Social and Private Marginal Cost

Suppose MD is marginal damage due to the external effect then $MC_s = MC_p + MD$. However, production also generates benefits which can be viewed in the form of MB (marginal benefits from production). Consider figure 2, where MB is a downward sloping curve. It is because as the output increases the benefit accruing from each successive unit of output tends to be lower. The socially optimum level of output is (Q_s) where marginal benefit is equal to the marginal social production cost. The social optimum Q_s generates economic surplus (welfare) abc.

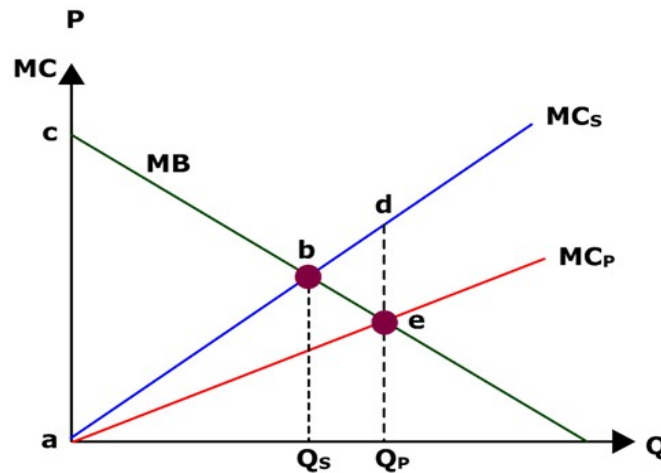


Figure 2: Efficiency loss due to negative externality

The private optimal level of output is (Q_p) where marginal benefit is equal to the marginal private production cost. At Q_p welfare is given by the region $aec - aed$. It is interesting to observe that there is an additional loss of welfare given by region bde in this case. Thus, we can infer that welfare with output level Q_p is smaller than socially optimal level of output Q_s [$abc - bde < abc$]. Efficiency loss at Q_p equals to the region bde .

It is important to note that optimal pollution cannot be zero as this would mean that output has to be driven down to zero. However, in this scenario optimal pollution is less than that generated by the market.

The social optimum condition is $MB = MC_s = MC_p + MD$. The socially optimal output is Q_s but seldom free market forces result in this level. The reason could be that the firm only takes account of its own private costs and does not consider the marginal damage from pollution. However, if the government can intervene and restrict output upto Q_s , we might have a plausible solution to the problem of environmental pollution.

Negative externalities can be internalized using the following policy alternatives

- Taxation
- Subsidies

An emission fee is a price or fee paid by a polluter to a regulatory entity for every unit of emissions a polluter emit. A tax rate equal to the marginal damage will help the economy reach socially optimum level of production. Consider Figure 3. A tax equal to the size of (br) may prompt the firm to reduce production from Q_p to Q_s .

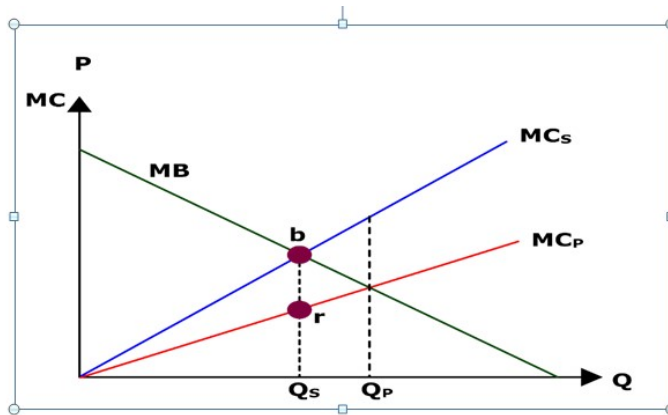


Figure 3: Emission fees

At the output level of Q_s the marginal social cost of production (MCS) is equal to marginal private cost of production (MCP) plus the tax size of (br). If Q is less than the social optimum level of output (Q_s), the marginal benefit is greater than the marginal private cost of production plus the size of tax (br).

$$Q < Q_s \Rightarrow MB > MCP + br$$

However if Q is more than Q_s but less than Q_p , marginal benefit will be less than the than marginal private cost of production plus the size of tax (br).

$$\text{If } Q_s < Q < Q_p \Rightarrow MB < MCP + br$$

At the level Q_s , the marginal benefit equals the marginal social cost of production such that

$$MB = MCP + br = MCS$$

Thus if the government sets the tax rate equal to marginal damage calculated at the socially optimal level of output, Q_s , the firm may be forced to produce at the socially optimal level of output. Production at this level of output also ensures that the firm's private costs come into line with social costs of output.

For an alternate explanation consider a firm producing some good along with pollution, call it x . If the emission fee is p and the polluter emits x units of pollution, the payment from the polluter to regulator is px . To determine how much the polluter emits, let $C(x)$ be the production costs associated with emitting x units of pollution, holding goods output fixed. Costs will decline as the pollution increases thereby implying that the polluter saves money by emitting pollution. Total costs for the firm can be given as $TC(x) = C(x) + px$

The total cost is minimized with respect to x , we obtain $p = -MC(x) = MS(x)$

The equation states that the firm operates until a point where the marginal cost of reducing pollution by one unit (which is same as marginal savings from emitting one more unit of pollution) is equal to the price of pollution. In other words, in the case of emission fees the firms will reduce pollution upto a point where firm's marginal cost of abatement is equal to the emission fee.

In the case of multiple firms, each firm abates till the point where marginal cost of abatement is equal to the emission fee. As all the firms equate their MACs to the same fees, they satisfy the equimarginal principle and hence maintain efficiency. The equimarginal principle states that in controlling emissions from several polluters, all emitting the same pollutant, effectively requires that the marginal cost of emission control be the same for all polluters.

1.2.2. Pigovian Fees

A pigovian fee is an emission fee exactly equal to the aggregate marginal damage caused by the emissions when evaluated at the efficient level of pollution. It is a special kind of emissions fee- an emission fee that is set at the marginal damage of pollution in an attempt to restore pareto optimality to a situation of market failure. Two cases have been discussed in the module Single Polluter

Suppose there is a factory generating pollution of the amount x at a cost $C(x)$, with marginal costs $MC(x)$. Since cost declines as x increases, marginal costs are actually negative.

Suppose there are N people surrounding the factory and that pollution causes damage to who cannot use the locational choice to change the amount of pollution they face.

For any person, the damage from pollution is $D_i(x)$ which is positive and increases in x . The aggregate damage for pollution can be written as

$$D(x) = \sum_i D_i(x)$$

The efficient amount of pollution that minimizes total costs and damages x^* minimizes $[C(x) + D(x)]$

thus

$$MC(x^*) + MD(x^*) = 0$$

As the marginal savings is the negative of marginal costs, we obtain

$$MS(x^*) = \sum_i MD_i(x^*)$$

In other words, we target at a level of pollution such that marginal savings to the firm is equal to the marginal damage from pollution over the entire pollution. The aggregate marginal damage ($\sum_i MD_i$) is the vertical sum of individual marginal damages (MD_i). Figure 4 illustrates this situation in the case of one polluter and two victims. The marginal damage increases with emissions whereas the marginal savings (negative of marginal cost) decreases with emissions.

The marginal damage functions of two victims of pollution are vertically summated to obtain the aggregate marginal damage. The optimal amount of pollution is the level at which the aggregate marginal damage curve intersects the marginal savings curve. The optimal level of pollution is x^* and the corresponding pigovian fees is given by p^* .

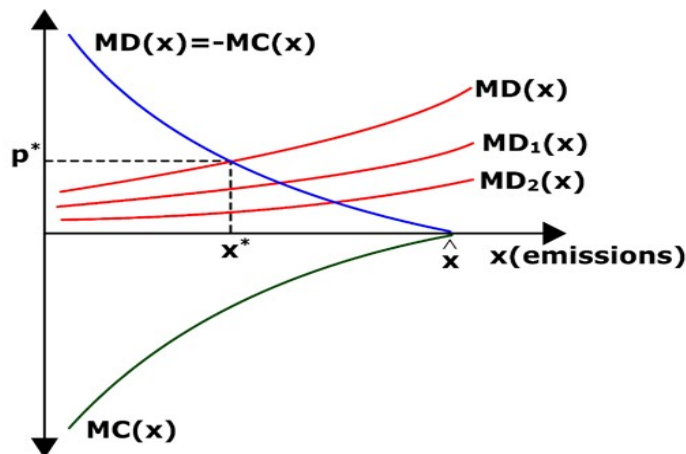


Figure 4 Pigovian fee with single polluter

A Pigovian fee is defined as the marginal savings from pollution generation at the optimal level of pollution. It is different from emission fees. It can be used to generate the efficient amount of public bad.

1.2.3. Multiple Polluters

Now consider the case of two polluters. Figure 5 shows the aggregate marginal damage function of all victims. Also shown is the marginal savings to each polluter (two in this case). Aggregate marginal savings is calculated by horizontal summation of marginal savings function of polluting firms. An aggregate marginal savings function indicates the change in marginal savings with the change in one unit of pollution. For any level of fee, $MS(x)$ tells us how much pollution (x) in total will be emitted and each $MS_i(x)$ tells us how much each firm will contribute to the total.

The efficient amount of pollution is where the marginal savings curve (MS) intersects the marginal damage curve (MD). The optimal amount of pollution is (x^*) and the marginal savings to polluters is (p^*). Thus, the pigovian fee is (p^*). At this fee level firm 1 will emit (x_1^*) level of emissions, whereas firm 2 will generate (x_2^*). Each firm's marginal savings from polluting is set equal to the pigovian fee.

$$MS_i(x_i^*) = p^*$$

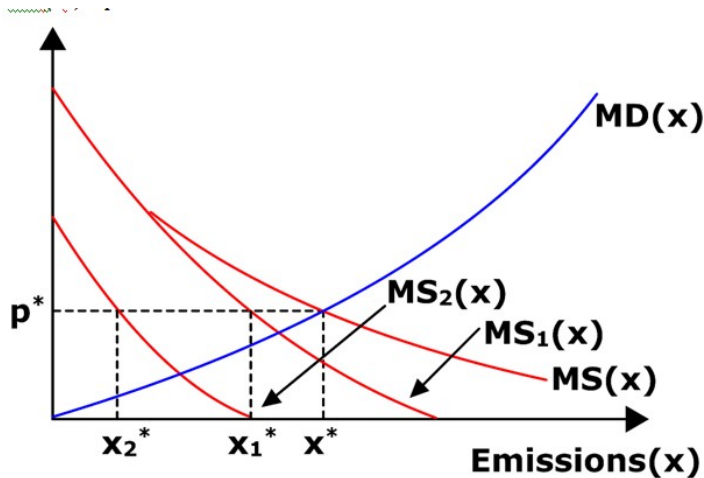


Figure 5 Pigovian fee with multiple polluter.

Furthermore it may be clear that $MS(x^*) = p^*$

The above property ensures that all the firms will control pollution at the same level of marginal costs. As marginal costs of pollution is equated across all polluters. The cost minimizing way of appropriating the abatement responsibility is to equate marginal cost of abatement or in other words marginal savings (from polluting) among firms.

1.2.4. Pigovian Subsidies

Payments made to the individuals or firms by the government are called subsidies. They are generally used to correct externalities / problems associated with natural

resources and their use. Market failures lead to externalities. Pollution is a negative externality generated during production of goods and services.

Arthur Pigou proposed that if externalities can be internalized and the producers of the externality are made to face the true price, the problems arising out of externalities may be solved. A producer generating negative externalities (pollution) may face tax per unit on emissions (as discussed above). Similarly, producers generating positive externalities (for example using green technologies) can be given subsidy to reach the social optimum. For negative externalities (e.g. pollution), the subsidy is levied per unit of abatement of emissions. It can be shown that if the subsidy rate and tax rate are equal, it will result in same amount of pollution. However, the distribution of the costs and revenue in each case differs. Taxes generate revenues for the government whereas the subsidies involve costs. Issues regarding the distribution of costs or revenues concern the policy maker, however, the choice of the instrument does not affect the efficiency and overall level of the pollution. But in certain cases where the firms can enter or exit the industry in response of such policy actions, the equivalence between taxes and subsidies might not hold. It is worth noting that in the short run when there is no time for new firms to enter the industry, pigovian fees and subsidies might yield the same outcome.

Let us consider a competitive industry, where all firms in industry are identical. Under a pollution tax(t), the production cost of a typical firm would be

$$C(y,e) = V(y,e) + t e + FC \quad (1)$$

where y = the amount of the good being produced, e = emissions

$C(y,e)$ = costs of production $V(y,e)$ = variable costs

t = tax rate

FC = fixed cost of production

Suppose emissions are related to output such that $e=ay$ where a is the constant

$$C(y,ay) = V(y,ay) + t ay + FC \quad (2)$$

We may rewrite the above equation as

$$TC(y) = VC(y) + t ay + FC \quad (3)$$

The marginal production costs would be

$$MC(y) = MVC(y) + ta \quad (4)$$

Under subsidy e , with no regulation the firm will produce emissions at the level say e^* . With the subsidy the firm will be paid to reduce emissions. So if the firm reduces emissions to e , the subsidy payment will be $s(e^* - e)$. This means that cost will be

$$TC(y) = VC(y) + FC - s(e^* - e) \quad (5)$$

$$TC(y) = VC(y) + say + [FC - se^*] \quad (6)$$

The term in the bracket is a figure consisting of standard fixed cost plus a lumpsum transfer of se^* which is independent of y or e .

$$\text{Consequently } MC(y) = MVC(y) + ta \quad (7)$$

The above equation is same as equation 4 with the difference of t and s

Thus in case of identical firm in short run, pigovian fees and subsidies give the same result. In the long run, there will be more firms in the industry with a subsidy than a tax. Subsidy, hence might result in the overuse of certain environmental resources which are used as inputs. Also subsidy might be undesirable because it does not allow the market to communicate the true costs of the product.

1.3. Public goods

Generally speaking, public goods include all those goods and services provided by the public sector and all those goods left to be provided by the private market are categorized as private goods. In order to understand the difference between these goods, we need to know the underlying characteristics of them.

1.3.1. Public Goods are Non Rival and Non Excludable

The basic nature of public goods, non-rival and non-excludable, make them different from private goods. For example, if there is a loaf of bread with a shopkeeper and two consumers want to purchase it then both of them can't purchase it. The consumption by one person will reduce the amount available for another person. That is why if person 'A' has purchased it then it will not be available for person 'B'. It means that there is rivalry for consumption between both of them. In another example of a beautiful flower garden if two people 'A' and 'B' want to enjoy the beauty of the garden and 'A' is enjoying the beauty of the garden before 'B' then there is no change in the availability of garden for 'B'. The act of

consumption by one person does not reduce the availability of good for another person that is why there is no rivalry in consumption among them. In case of non-rival goods, no cost is associated with additional consumption while a cost is associated for rival goods with additional consumption.

Explanation: A good is a rival if the consumption of the good by a person prevents other possible consumers to consume it and it is non rival if the consumption by one person does not prevent other possible consumers to consume it.

Like rival and non-rival goods there are also rival and non-rival bad. Pollution is a non-rival bad because inhaling of polluted air by one person will not reduce the pollution level for others. Garbage is a rival bad as the consumption of garbage by one person will reduce the availability of garbage for others.

People are ready to pay the price for the consumption of a good only if they can be prevented to consume a good without paying the price. If they can't be prevented to consume a good they will not pay any price. We don't pay for the oxygen which we inhale because nobody can stop us to use it. People pay for swimming in the pool where entry is controlled by boundary wall but they do not pay for swimming in the sea when there is no way to prevent them from swimming. Here swimming pool with restricted entry is excludable good while sea without any restricted entry is non excludable. Non excludable goods are also open access goods where the good is available for everyone to use without paying any price for it.

If there are N number of people consuming a private good then the total quantity of the good Q will be divided among all the N consumers. Assuming that C represent the consumption of each individual, then

$$C_1 + C_2 + \dots + C_N = Q \quad \dots\dots 1$$

While in case of a public good the quantity of good available for each individual is same and that is equal to the total quantity of the public good. If G is the total quantity of public good then each individual from 1 to N has the same quantity available:

$$G_1 = G_2 = \dots = G_N = G \quad 2$$

To make a good excludable the specific technology or method is required. Entry into a swimming pool may be restricted by boundary wall and the gates. The signals from a mobile tower may be restricted by a particular frequency of the signals. In all such cases people are ready to pay because they may be restricted

to use with the help of available technology. But in many cases no such technology is available to prevent the people to use it. In case of air pollution the government can impose a fine if someone found polluting the air but technically can't restrict the polluting gases to enter the environment. In many cases the technology is available but the cost of exclusion is higher than the benefits of exclusion. The cost of fencing a grazing land may be much higher than its benefits. A good is made excludable after the availability of technology if the benefits of exclusion are more than the costs. The costs and technology of exclusion both are two important factors for exclusion.

1.3.2. Supply of Public Goods

Supply curve for most of the public goods is just like the supply curve of a private good. If a city requires ten bridges then each bridge will be built separately just like private houses which is a private good. But after the completion or the supply private house will be used by individuals as rival good but the bridges will be used by all the people of the city as non-rival good. The market supply (X) of such public goods will be the horizontal summation of individual supply (x) curves.

$$X = \sum x_i \quad \dots\dots 3 \text{ (Summation)}$$

There are two exceptions to this standard summation formula. The weakest-link rule and the best shot rule. In case of disaster every member becomes equally important and the supply of the public good will be measured according to the weakest chain. The protection from the flood due to a nearby dam will depend upon the strength of weakest point of the boundary of the dam. The supply of such public goods depends on the minimum strength of boundary wall of the dam. Therefore the aggregate supply becomes the minimum of all the supplies by all the producers.

$$X = \min(x_i) \quad \dots\dots 4 \text{ (weakest-link)}$$

In case of best shot goods the best result will determine the aggregate supply of the public good. A large number of researchers are working for treatment of HIV. The supply of treatment will not depend on the results of all the researchers added together but it will depend on the best result of all the researchers.

$$X = \max(x_i) \quad \dots\dots 5 \text{ (best-shot)}$$

1.3.3. Demand of Public Goods

The derivation of market demand curve for a public good is different from a private good because of its non-rival nature. The consumption of a public good by one consumer doesn't affect the availability for others. We don't require making the bridge or the park separately for each individual, therefore we do not take the horizontal summation to derive the market demand curve from individual demand curves but take the vertical summation. The vertical axis measures the marginal willingness to pay by the consumer (MWTP). As all the consumers can simultaneously consume a non rival good we don't require to add the quantity but to add their MWTP. If Anish is ready to pay Rs. 5000 and Babita Rs. 6000 for making one park in the town then aggregate demand curve shows Rs.11000 as MWTP and one as quantity. Assume that the demand equations for public good X of Anish and Babita are given by inverse demand functions:

$$P_a = A - BX \dots\dots 6 \text{ (Anish's demand)}$$

$$P_b = C - DX \dots\dots 7 \text{ (Babita's demand) Adding eq. 6 and 7 we get}$$

$$P_a + P_b = (A+C) - (B+D)X \dots\dots 8 \text{ (Aggregate demand) Fig. 1 shows the}$$

derivation of aggregate demand curve for a public good.

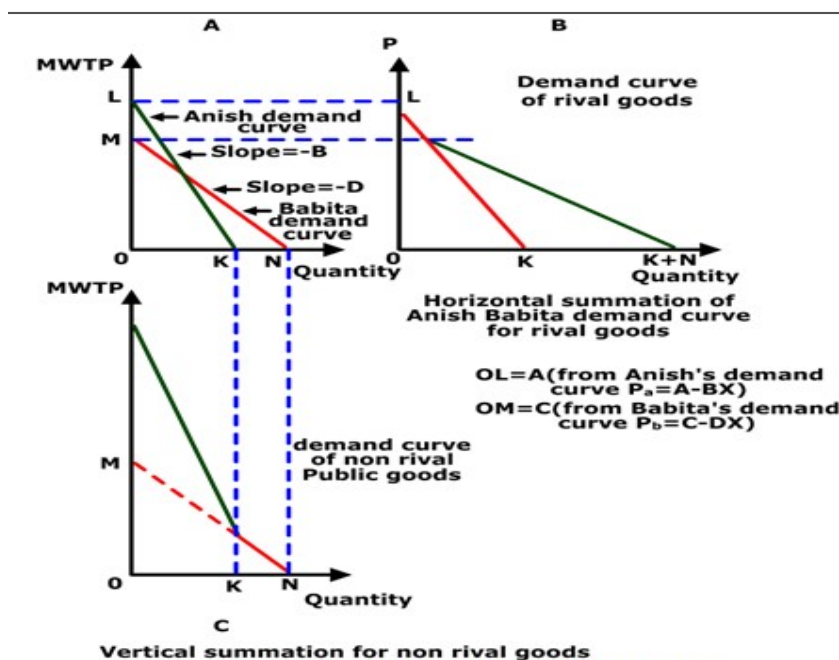


Fig. 1: Aggregate demand curves for rival and non-rival goods.

1.3.4. Pareto Optimal Provision for Public Goods

The question to find the efficient quantity of public goods or the bad to be provided may be resolved using the Pareto optimal criterion. The same Pareto optimal criterion discussed earlier or used for various private goods in standard microeconomics textbooks may be developed for public goods or the bad. From consumers perspective an allocation is Pareto optimal if the marginal rate of substitution is same among all the N consumers, i.e. $MRS_1 = MRS_2 = \dots MRS_N = MRS$. From producers perspective the marginal rate of transformation should be same among all the Z producers, i.e. $MRT_1 = MRT_2 = \dots MRT_Z = MRT$. Simultaneously for the economy as a whole the Pareto optimality requires the equality $MRS = MRT$.

Let us modify these conditions for the pure public good which is non rival in nature. Now suppose that the consumers and the producers have a choice between a public good and the numeraire good¹. If we have two consumers Anish and Bina and Anish is ready to sacrifice 5 units of numeraire good for the public good (Anish's MRS is 5) and the Bina is ready to sacrifice 7 units of numeraire good for the public good (Bina's MRS is 7) then the value of this public good is 12 times the numeraire good for all the consumers taken together. The efficiency requires producing this public good at a cost

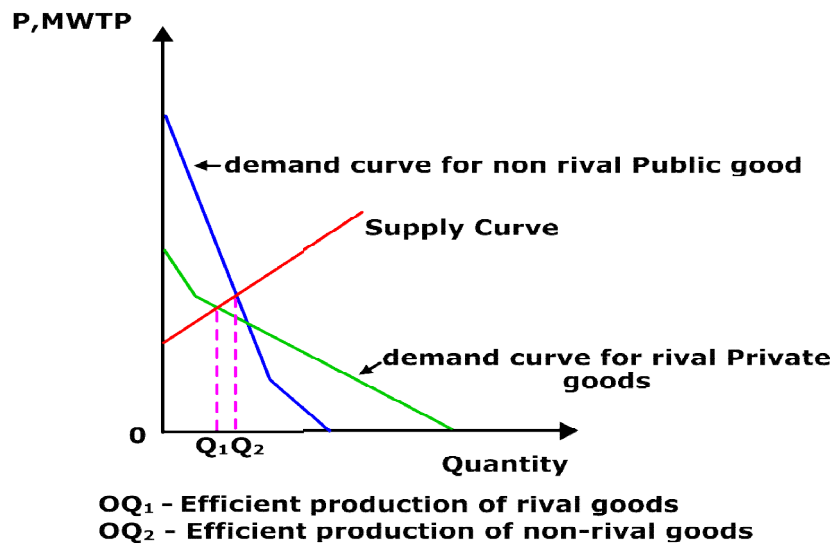
12 times higher to the numeraire good. Therefore the modified Pareto optimal condition for a pure public good G for consumer i is:

$$\sum_i MRS_i(G) = MRT(G) \quad \dots\dots 9$$

For efficiency this condition must be fulfilled. The left hand side of the eq.9 represents the value of public good to the consumers and the right hand side represents the cost of the public good for the producers. In case the left hand side is greater than the right hand side, the value of public good is more than the cost of its production, therefore we should produce more till the value and the cost does not become the same. Similarly if right hand side is greater than the left hand side we are producing lesser value at higher cost we must reduce the production for the efficiency. In both of these two cases Pareto improvement is possible in the absence of equality but no improvement is possible with this equality hence the condition in eq. 9 provides the Pareto optimal condition for a public good.

The same modified condition may be used for a public bad. Pollution is a public bad. The marginal rate of substitution between pollution and the numeraire good for all the consumers added together will represent the marginal damage to all of them. This MRS must be equal to the MRT which will measure the marginal cost of pollution abatement.

We can also find the efficient provision for public good using the demand and supply analysis. From this perspective, the efficient provision requires that we should produce the public good up to the point where demand curve intersects the supply curve. Before this point the value (represented by the demand curve) is greater than the cost (represented by the supply curve) therefore efficiency requires to produce more and vice versa after this point.



Efficient Production of Public good and Private good

In previous section we discussed the Pareto optimal provision for public goods. The equality of equation 9 requires the MRS of the consumer and similarly if we are using the equality of demand and supply curves again we require the demand by the consumers. In most of the public goods where the consumers have experienced them so they can value them. On the bases of these values we can find the MRS and the demand curve. But in case of Merit goods often consumers undervalue them. Merit goods generate positive externality. When with positive externalities marginal private benefit curve lies below marginal social benefit curve

and the smaller quantity is produced than the efficient level. Education is a merit good and generally we underestimate its benefit. Normally we underestimate its long term benefit which goes generation after generation. Similarly Demerit goods generate negative externality and we overproduce them. Cigarette is a demerit good and generally we underestimate its harmful effect on the health of nonsmokers.

Environmental goods do not enter the market and it is very difficult for the consumer to find its value. Most of the public goods are available around us and the consumer is aware of their benefits. Because of this awareness they know their value and can evaluate or put a price tag to its benefits. But the environmental goods have a different case. Most of the people are not aware of its benefits and they find it very difficult to put a price tag to its benefit and generally they underestimate them. In both the cases, merit goods and the environmental goods when we underestimate their benefits we are not achieving the efficiency in their production. Generally we underestimate them as most of the people fail to understand the benefits of positive externality.

1.4. Pareto optimality

When the people are facing the tradeoff between market goods and the environmental goods, the collective decision making for the whole society becomes more difficult and complicated. The individual can choose about her consumption of market goods only. She may decide to help in protecting the environment but can't decide a different consumption level of environmental goods for herself as compared to other people around her. A redistribution of market goods among the people of a society is possible by changing their relative prices but the same is not possible for environmental goods. We may increase or decrease the quantity of environmental good by changing the production of market goods. The same quantity of environmental good may have different utility for different individuals depending upon their income level, philosophical thoughts, level of information, education etc.

Assume that different levels of market goods being produced are x' , x'' etc. for the society as a whole, then the associated levels of environmental goods for the society are e' , e'' etc. respectively. Now the societal consumption bundles may be represented as $a'=(x', e')$; $a''=(x'', e'')$;and so on. When x' quantity of market

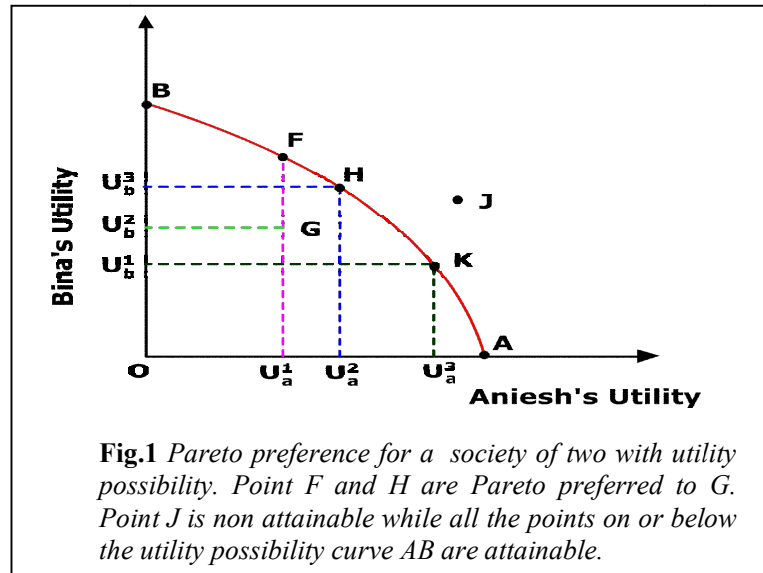
goods is being produced, all the N consumers will be consuming x_1', x_2', \dots, x_N' respectively. Similarly for x'' quantity of market goods they will be consuming $x_1'', x_2'', \dots, x_N''$ respectively.

Now we face the question of societal choice. Which consumption bundle should society choose a' or a'' , if there are only two societal bundles? If every individual prefers a' over a'' the society will also prefer a' over a'' . Similarly even if every individual, except one who prefers a' over a'' , equally prefers a' and a'' , society will also prefer a' over a'' . In both of these two cases there is no controversy. We can say that a' is Pareto preferred to a'' if we use Pareto optimality criterion.

The Pareto Optimality Criterion states that an economic outcome is said to be Pareto optimal if any reallocation of resources can't make someone better off without making another worse off.

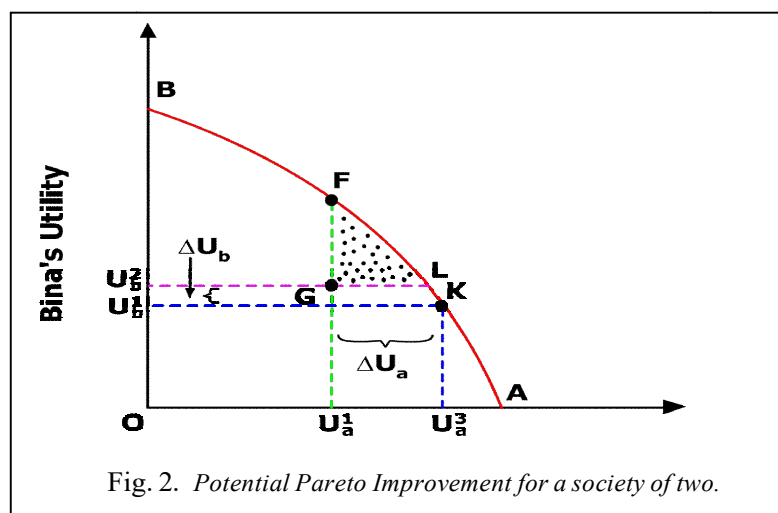
Explanation 1: For a group of people consisting of N members ($i=1, 2, \dots, N$) with their respective utility function U_i , decided by their consumption bundles, assume we have two societal consumption bundles $a'=(x', e')$ and $a''=(x'', e'')$. Then a' is Pareto preferred to a'' for the whole group if for every individual $U_i(a') \geq U_i(a'')$ and at least for one individual $U_i(a') > U_i(a'')$.

Suppose a society consists of only two individuals, Anish and Bina. Their respective utilities are represented by $U_a(x_a, e)$ and $U_b(x_b, e)$. Fig.2 shows their possible utility combinations in the utility space with limited available resources. The attainable utility combinations lie either on or below the Utility Possibility Frontier AB. Let's compare two points G and H. Utilities of both is higher at point H as compared to point G. Hence H is Pareto preferred to G. Similarly F is also Pareto preferred to G as Anish's utility remains unchanged but Bina's Utility increases when we move from point G to point F. While comparing points K and H we can't conclude that one point is Pareto preferred as compared to another point. To make Anish better off we have to make Bina worse off or to make Bina better off we have to make Anish worse off. There will not be a unanimous choice between points K and H for Bina and Anish. But the unanimity is possible between both of them while comparing points G and H or G and F.



1.4.1: Feasibility of Pareto Improvement with compensation

In Fig. 2 a unanimous choice for the society (this two member example may be extended to N members of the society) between point G and K is not possible. Moving from point G to K will be acceptable for Anish but not for Bina. Bina may accept only if she is being compensated by Aneesh and that compensation should be able to offset her loss of utility while shifting from point G to K. This compensation is possible only through market goods as environmental good can't be exchanged between two consumers.



As shown in Fig. 3, the shaded area of triangle FGL shows all the points which are Pareto preferred to point G. But we can't say for other points which are lying

outside this triangle in attainable area. Comparing a shift from point G to K, the gain of utility for Anish is ΔU_a and the loss of utility for Bina is ΔU_b . If Anish compensates Bina by giving her y units of market goods, then both will agree only when for Anish $\Delta U_a \geq U_a(y)$ and for Bina $\Delta U_b \leq U_b(y)$. In case when compensation can make unanimity among the individuals for a particular societal bundle, we may say that there is feasibility for Pareto improvement. In our example of point G and K Bina who was loser got compensated from Anish and both agreed for this compensation of y goods we may say that K is potential Pareto improvement to G. The same example may be generalized for N number of people in societal group.

Explanation 2 For a group of people consisting of N members ($i=1, 2, \dots, N$) while comparing two societal bundles a' and a'' if there exists a vector of transfers from individuals such that the sum total of all the transfers is zero, $y=(y_1, y_2, \dots, y_N)$; $\sum y_i=0$ and $(a', y)=(x'_1+y_1, x'_2+y_2, \dots, x'_N+y_N, e')$ becomes Pareto preferred to a'' , then we can say that a' is a potential Pareto improvement over a'' .

With a large number of people in the society the feasibility of implementation of Pareto improvement criterion becomes very difficult. Nicolas Kaldor and John Hicks have suggested an alternative in Kaldor-Hicks compensation Criterion. Suppose that the Government wants to install sewerage treatment plant. Some people will gain because of the availability of clean water, while a few will lose because of bad smell in their surroundings. According to this compensation criterion if government asks the gainer whether they are ready to compensate the losers and their answer is yes then building of this plant is Pareto improvement hence good idea for the society.

1.5. The Law of diminishing returns

Society has limited resources (e.g., labor, land, capital, raw materials) at any point in time, there is a limit to the quantities of goods and services it can produce. Suppose a society desires two products, healthcare and education. This situation is illustrated by the production possibilities frontier in Figure 1.

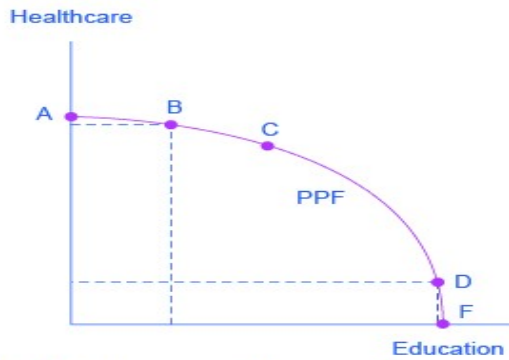


Figure 1. A Healthcare vs. Education Production Possibilities Frontier. This production possibilities frontier shows a tradeoff between devoting social resources to healthcare and devoting them to education. At A all resources go to healthcare and at B, most go to healthcare. At D most resources go to education, and at F, all go to education.

The graph shows that a society has limited resources and often must prioritize where to invest. On this graph, the y-axis is "Healthcare," and the x-axis is "Education." In Figure 1, healthcare is shown on the vertical axis and education is shown on the horizontal axis. If the society were to allocate all of its resources to healthcare, it could produce at point A. But it would not have any resources to produce education. If it were to allocate all of its resources to education, it could produce at point F. Alternatively, the society could choose to produce any combination of healthcare and education shown on the production possibilities frontier. In effect, the production possibilities frontier plays the same role for society as the budget constraint plays for Alphonso. Society can choose any combination of the two goods on or inside the PPF. But it does not have enough resources to produce outside the PPF.

Most important, the production possibilities frontier clearly shows the tradeoff between healthcare and education. Suppose society has chosen to operate at point B, and it is considering producing more education. Because the PPF is downward sloping from left to right, the only way society can obtain more education is by giving up some healthcare. That is the tradeoff society faces. Suppose it considers moving from point B to point C. What would the opportunity cost be for the additional education? The opportunity cost would be the healthcare society has to give up. Just as with Alphonso's budget

constraint, the opportunity cost is shown by the slope of the production possibilities frontier. By now you might be saying, “Hey, this PPF is sounding like the budget constraint.” If so, read the following Clear It Up feature.

What’s the difference between a budget constraint and a PPF?

There are two major differences between a budget constraint and a production possibilities frontier. The first is the fact that the budget constraint is a straight line. This is because its slope is given by the relative prices of the two goods. In contrast, the PPF has a curved shape because of the law of the diminishing returns. The second is the absence of specific numbers on the axes of the PPF. There are no specific numbers because we do not know the exact amount of resources this imaginary economy has, nor do we know how many resources it takes to produce healthcare and how many resources it takes to produce education. If this were a real world example, that data would be available. An additional reason for the lack of numbers is that there is no single way to measure levels of education and healthcare. However, when you think of improvements in education, you can think of accomplishments like more years of school completed, fewer high-school dropouts, and higher scores on standardized tests. When you think of improvements in healthcare, you can think of longer life expectancies, lower levels of infant mortality, and fewer outbreaks of disease. Whether or not we have specific numbers, conceptually we can measure the opportunity cost of additional education as society moves from point B to point C on the PPF. The additional education is measured by the horizontal distance between B and C. The foregone healthcare is given by the vertical distance between B and C. The slope of the PPF between B and C is (approximately) the vertical distance (the “rise”) over the horizontal distance (the “run”). This is the opportunity cost of the additional education.

The Shape of the PPF and the Law of Diminishing Returns

The budget constraints presented earlier in this chapter, showing individual choices about what quantities of goods to consume, were all straight lines. The reason for these straight lines was that the slope of the budget constraint was

determined by relative prices of the two goods in the consumption budget constraint. However, the production possibilities frontier for healthcare and education was drawn as a curved line. Why does the PPF have a different shape?

To understand why the PPF is curved, start by considering point A at the top left-hand side of the PPF. At point A, all available resources are devoted to healthcare and none are left for education. This situation would be extreme and even ridiculous. For example, children are seeing a doctor every day, whether they are sick or not, but not attending school. People are having cosmetic surgery on every part of their bodies, but no high school or college education exists. Now imagine that some of these resources are diverted from healthcare to education, so that the economy is at point B instead of point A. Diverting some resources away from A to B causes relatively little reduction in health because the last few marginal dollars going into healthcare services are not producing much additional gain in health. However, putting those marginal dollars into education, which is completely without resources at point A, can produce relatively large gains. For this reason, the shape of the PPF from A to B is relatively flat, representing a relatively small drop-off in health and a relatively large gain in education.

Now consider the other end, at the lower right, of the production possibilities frontier. Imagine that society starts at choice D, which is devoting nearly all resources to education and very few to healthcare, and moves to point F, which is devoting all spending to education and none to healthcare. For the sake of concreteness, you can imagine that in the movement from D to F, the last few doctors must become high school science teachers, the last few nurses must become school librarians rather than dispensers of vaccinations, and the last few emergency rooms are turned into kindergartens. The gains to education from adding these last few resources to education are very small. However, the opportunity cost lost to health will be fairly large, and thus the

slope of the PPF between D and F is steep, showing a large drop in health for only a small gain in education.

The lesson is not that society is likely to make an extreme choice like devoting no resources to education at point A or no resources to health at point F. Instead, the lesson is that the gains from committing additional marginal resources to education depend on how much is already being spent. If on the one hand, very few resources are currently committed to education, then an increase in resources used can bring relatively large gains. On the other hand, if a large number of resources are already committed to education, then committing additional resources will bring relatively smaller gains.

This pattern is common enough that it has been given a name: **the law of diminishing returns**, which holds that as additional increments of resources are added to a certain purpose, the marginal benefit from those additional increments will decline. When government spends a certain amount more on reducing crime, for example, the original gains in reducing crime could be relatively large. But additional increases typically cause relatively smaller reductions in crime, and paying for enough police and security to reduce crime to nothing at all would be tremendously expensive.

The curvature of the production possibilities frontier shows that as additional resources are added to education, moving from left to right along the horizontal axis, the original gains are fairly large, but gradually diminish. Similarly, as additional resources are added to healthcare, moving from bottom to top on the vertical axis, the original gains are fairly large, but again gradually diminish. In this way, the law of diminishing returns produces the outward-bending shape of the production possibilities frontier.

1.6. National income

National income is the sum of a country's final output of all new final goods and services produced in one year by the productive system of an economy.

Factors affecting National Income

I. Resource Allocation: This is based on the physical capacity of factors of production and the given technology. The more efficient and effective factors of production leads to better National Income as the total productivity of the nation increases. Hence every nation strives to get better factors of production.

1) Land Resources: The geographical location of the natural resources also affects the level of National income. That is the areas rich in coal, iron and other such essential items affect the level of GNP of the nation.

2) Labor: The quality of human resource today affects the standard of a nation today. The productivity of labor is more important than quantity

3) Capital: Capital is generally determined by investment which in turn depends on other factors like profitability, political stability etc.

4) Technology: In addition to natural resources and labour the level of invention and innovation in production affect the productivity of the factors of production. Thus, the per capita output grows with the help of technology.

II. Government

Government is the key resource to provide a favorable business environment and hence it affects the productivity of the nation and in turn affects the National Income of an economy. Although, Classical's believe that the government is an impediment to growth in output.

III. Political Stability

The political system of a nation affects the stability of an economy. A stable economy in turn increases the productivity and the national income of a nation. Unfavorable business environment encourages problems like wars, strikes and other social unrests which discourage economic development.

4. National Income Accounting

a) Gross Domestic Product(GDP)

GDP is the total value of goods and services produced within the country during a year. This is calculated at market price and is known as GDP at market prices. There are 3 methods to calculate GDP at market price:

1. The income method, under this method all incomes received by the factors of production generated in the economy during a year are added together. It includes payment for wages on both employment and self-employment, profits, interest to lenders on capital or rents to owners of land.
2. The output method/product method, under this method the combined amount of the new and final output produced in different sectors of the economy, including manufacturing, financial services, transport, leisure and agriculture is taken into account.
3. The expenditure method, under this method all spending of the economy by households and firms on new and final goods and services by households and firms are added together to calculate the national income of an economy.

National Income Aggregates:

Value of Gross output = Price * Quantity of all goods and services produced in the country (not adjusted for bought out inputs)

Since prices differ:

$$\text{Gross output} = \sum n \quad P_i Q_i$$

Net output = Gross output – Value of bought out input (like value of raw materials purchased)

Net output = Gross output. Therefore, Net National Output = Gross national product.

If GNP is adjusted for income earned from abroad:

GNP – Net income earned from abroad = Gross domestic Product (measured at market prices = GDP_{mp})

b) Gross Domestic Product at Factor Cost (GDP_{fc})

c) Net Domestic Product (NDP)

d) Nominal and Real GDP

When GDP calculated on current price, is called GDP at current prices or nominal GDP. While, when GDP is calculated on the basis of fixed prices in some previous year, it is called GDP at constant prices or real GDP. It measures the value of goods and services by ignoring the changes in the price level.

To find out the real GDP, a base year is chosen when the general price level is normal, i.e., it is neither too high nor too low. The prices are adjusted on 100 (or 1) in the base year.

Real GDP (at base year prices) = GDP for the current year * *Base Year index*(=100)

Current Year Index

Suppose 2000-01 is the base year and GDP for 2014-15 is Rs. 6, 00,000 crores and the price index for this year is 300 (2014-15 index).

Thus, Real GDP for 2000-01 = Rs. 6, 00,000 x 100/300 = Rs. 2, 00,000 crores.

Thus, real GDP (at constant prices) = GDP (at current prices)/GDP Deflator

GNP is the total difference in the flow of goods and services at market value resulting from current year's production of a country. It also includes the net income from abroad.

4.1 GNP includes the following final goods and services

- (1) Consumers' goods and services which satisfies the wants and demand of people;
- (2) Gross investment in capital goods consisting of total capital formation, household construction and inventories of finished and unfinished goods;
- (3) Goods and services manufactured by the government and its organizations;
- (4) Net exports of goods and services, i.e., the difference between value of exports and value of imports of goods and services, known as Net Income from abroad (NIA).

There is a difference between National Income Accounting and National Income Estimation. Accounting tells us how to derive one NI aggregate from the other. National Income Estimation tells us how to calculate NI. But we do not use the term calculation because very often the enumerators who calculate national income have to use methods of estimation (or even guess estimates) for assessing the production or income generated during one year.

Precautions in National Income Estimation

The factors to be taken into consideration while estimating National Income:

- 1) **Money value considered:** GNP is the sum of money, in which all kinds of goods and services manufactured in a country during one year are measured in terms of money at current prices and then added together. But in this manner, due to the fluctuations in the prices, the GNP is increased or declined, which may not be real. To guard against erring on this account, a particular year (base year) when prices are normal is taken and the GNP is adjusted in accordance with the index number for that year.
- 2) **Avoid double counting:** In estimating GNP, the market price of only the final products should be considered. Many of the products pass through different number of stages before they are ultimately purchased by consumers. If these products are counted and calculated at every stage, they would be included many a time in the national product. Consequently, the GNP would increase too much. To avoid double counting, therefore, only the final products and not the intermediary goods should be taken into account.
- 3) **Avoid non-market value:** Goods and services given free of cost are not included in the GNP, because it is not difficult to have a correct estimation of their market value or price. For example, the bringing up of a child by the mother, giving instructions to his son by a teacher, recitals to his friends by a musician, etc.
- 4) **The transactions which do not arise in the current year** or which do not contribute in any way to production are not included in the GNP. The sale

and purchase of second hand goods, and shares, bonds and assets of existing companies are not included in GNP because these do not make any addition to the national product, and the goods are simply transferred.

5) **The payments received under social security**, e.g., unemployment insurance allowance, old age pension, and interest on public loans are also not included in GNP, because the recipients do not provide any service in lieu of them. But the depreciation on machinery, other capital goods is not deducted from GNP.

6) **The profits earned or losses incurred** due to fluctuations in market prices in the value of capital assets are not included in the GNP if they are not responsible for current production or economic activity.

g) GNP at Market Prices

To convert gross domestic product into national product, we must add the total income from abroad in to a nation.

$$\text{GNP at Market Prices} = \text{GDP at Market Prices} + \text{Net Income from Abroad.}$$

h) GNP at Factor Cost

GNP at factor cost is the sum of the money value of the income produced by and accruing to the various factors of production in one year in a country.

$$\text{GNP at Factor Cost} = \text{GNP at Market Prices} - \text{Indirect Taxes} + \text{Subsidies.}$$

i) Net National Product (NNP)

NNP is sum total of output on consumption goods and investment goods. But this process of production uses certain amount of fixed capital and the fixed equipment wears out with time, or other components are damaged or destroyed, and still others are rendered obsolete through technological changes.

$$\text{NNP} = \text{GNP} - \text{Depreciation.}$$

j) NNP at Market Prices

Net National Product at market prices is the sum total of final goods and services evaluated at market price in a country.

value of final goods and services evaluated at market prices in a country.

NNP at Market Prices = GNP at Market Prices—Depreciation.

k) NNP at Factor Cost

Net National Product at factor cost is the total output evaluated at factor prices. It includes income earned by factors of production through participation in the production process such as wages and salaries, rents, profits, etc. It is also called National Income.

NNP at Factor Cost/ National Income = NNP at Market Prices – Indirect taxes+ Subsidies

6. Uses of National Income Statistics

1) Standard of living

One can easily compare the standard of living of different nations with the help of GNP. Hence National income statistics can be used for analyzing the standard of living of a nation.

2) Policy Formulation

The National income statistics are used to compile GNP statistics of the economy. The Government then uses this data for policy formulation.

3) International comparison

The standard of living of different nations can be compared with national income statistics which in turn helps to show the rate of growth or development of different nations.

4) Business Decisions

The level of development of different industries and sectors respectively of an economy is analyzed with national income statistics.. It in turn helps the business to plan for production and planning.

7. Limitations of National Income Statistics

GNP is used to measure the overall flow of goods and services, and also to show the general welfare of the people. It aims to get the standard of living of a nation. There are certain limitations of GNP statistics, which are as follows:

1) Price Changes

A high GNP may not necessarily mean that the standard of living of the nation is also good. With an increase in GNP at a high rate, real GNP may even fall.

2) Omission or wrong estimation

It may happen that the national income statistics be affected by wrong estimation like that of double counting, etc. Due to which it may mislead the other supplementary statistics too.

3) Voluntary services

Some voluntary services also have an influence on the national income. But the statistics may or may not accommodate them.

4) Illegal Activities

Some illegal activities are always prevalent in an economy, but national income statistics ignore the income and productivity generated from such activities. Illegal activities may affect the actual standard of living of an economy.

5) Undesirable effects of production

Factors like pollution, traffic congestion do have an influence on the standard of living of the economy. This is again not taken into account for national income statistics.

6) Problem of Comparison

National Income statistics are a bit difficult to compare as the method adopted by different nations are different. To bring in complete similarity in the methodology is a difficult task.

7) Output Composition

Nations having the same GNP may even have different living standard because their output composition may be different.

8) Distribution of National Income and wealth

The GNP of a nation may be generated by a small group or rate of people in a nation. So in that case even with a high National Income the standard of living of the nation will be low, as it is not evenly distributed income or GNP.

9) Population Size

The population level of a nation does not hold any significance with the standard of living. So the per capita income is a better measure to compare the growth of two nations.

10) National Defense

If a nation has spent a lot of resources in the production on national defense like in weapons and so on, its living standard may not be improved.

11) Time

Technology is improved and improvised with time, but these statistics do not depict these parameters and hence are not the true indicators of the standard of living of a nation.

1.7. Summary

An externality is present whenever some individual's utility or production relationships include real variables whose values are chosen by others without particular attention to the effects on that person's welfare. The effect of the externality can both be positive and negative. Arthur Pigou proposed that if externalities can be internalized and the producers of the externality are made to face the true price, the problems arising out of externalities may be solved. Externalities can be internalized either to imposition of tax or grant of subsidies. A Pigovian fee is defined as the marginal savings from pollution generation at the optimal level of pollution. It is different from emission fees as it a price or fee paid (fixed by the regulatory body) by a polluter to a regulatory entity for every unit of emissions a polluter emit. Payments made to the individuals or firms by the government are called subsidies. A subsidy for pollution control and a tax on pollutant emissions both result in the same marginal conditions for pollution emissions. However, the subsidy in both short run and long run results in excess production in polluting industry.

- Markets fail in the presence of externalities as the prices do not reflect cost or the benefit accrued by third party
- The basic nature of public goods, non-rival and non-excludable, make them different from private goods.

- The derivation of market demand curve for a public good is different from a private good because of its non-rival nature. The consumption of a public good by one consumer doesn't affect the availability for others.
- Environmental goods do not enter the market and it is very difficult for the consumer to find its value. Most of the public goods are available around us and the consumer is aware of their benefits.
- Merit goods and the environmental goods when we underestimate their benefits we are not achieving the efficiency in their production

To summarize in this paper we have understood the meaning of National Income/GNP. We have also studied the procedure to compute national income of a nation, which can be computed through their methods namely income method, expenditure method and output method. Different economies use different procedures to calculate their national income. The national income over a period of time creates a statistics which is used for economic evaluation.

Unit- 2 Environmental Economics II

Unit Structure

2.0 Learning objectives

2.1: The concept of environmental Economics

2.1.1. Why Environmental Economics?

2.1.2. Importance of Environment for the economy

2.2. Basics of Economics

2.2.1. Methods of Analysis

2.3. Economic Concepts, Tools and Models

2.3.1. Economic Models

2.3.2. Economic Laws

2.4. The Basic Economic Problem – the Problem of Choice

2.5. Market

2.5.1. Markets in Micro and Macro Theory

2.5.2. Market and Capitalism

2.5.3. The Working of the Market -Price Mechanism- Demand and Supply

2.5.4. The Market Mechanism (Price Mechanism) and Social Welfare

2.5.5. Market Failure or Malfunctioning of the Market Mechanism (Price mechanism)

2.6. The Price Mechanism and the forces of Demand and Supply

2.6.1. Demand

2.7. Supply

2.8. Summary

2.0 Learning objectives

After studying this unit you will be able to understand about:

- The concept of environmental Economics
- Basics of Economics
- Emerging issues of Environmental economics

2.1: The concept of environmental Economics

2.1.1. Why Environmental Economics?

The nature has gifted us a variety of renewable and non renewable resources. These scarce resources can't satisfy all of our unlimited wants. But the efficient use of resources may provide all the necessities for present and future generations. Untreated sewerage waste drained into the river will pollute it which may affect the availability of drinking water, aquatic life and many more. A factory situated near a laundry shop, dirtying the air, will affect the launderer's production of clean linen. A brick manufacturing unit near a mango farm will badly affect the quality of mango. All these examples illustrate the type of problems we consider in environmental

economics. They have both positive and normative aspects of study. From a positive point of our area of interest may be to understand how the existing structure of institutions will lead the self interested factory owner, the institution responsible for the management of sewerage system and the owner of brick manufacturing unit, to undertake an action against their harmful impact on others. From a normative perspective one might be interested in suggesting policy interference for mitigation of these harmful consequences.

Origin of environmental economics is related with the concept of market failure. Repairing of market failure needs government intervention. A policy interference by the government need the suggestions from environmental economists.

2.1.2. Importance of Environment for the economy

We have to understand the importance of environment for the economy. Our economic system provides us the desired material goods and services for all our needs. This economic system can't survive without the support of environment around us which includes various communities of insects, plants, animals and different other natural resources. The interrelationship and influence in a community of organisms and natural resources on each other is called an ecosystem. A pond ecosystem is an example of a very small ecosystem where everything from shallow water to various plants, fishes, frogs, rocky or muddy bottom, various insects etc. are interrelated and interdependent. This pond may provide so many things like water, fishes, algae, other plants etc. for the economy to be used for various purposes. If water charging in the pond or the aquatic life or anything else is badly affected it will also inversely influence economic activities of the people depending upon this pond. Similarly environment provides us the raw materials which are transformed into numerous commodities through various economic processes. Simultaneously it also provides direct services to all of us, by providing oxygen, air, water, sunlight, scenic beauty etc. The uninterrupted supply of these environmental goods and services is necessary for the existence of our economic system. But the conventional economics textbooks often ignore the economy-environment interrelationship¹, without considering this relationship an economic model or the picture is incomplete and misleading.

The basic economic processes of extraction (for example mining of iron ore from iron mines), processing/fabrication (converting iron ore into steel and automobile) and consumption (using the automobile), all involve the generation of waste product that ultimately goes back into the environment (air, water or onto the land).

In most of our economic models and hence the textbooks, markets try to solve the problems of finding the efficient and right amount of production and consumption in terms of minimization of costs directly involved in the process of production and maximization of utilities in the consumption of market goods. But they do not try to find the right or of socially desirable amount of waste or the pollution. Our environment also acts upon the waste being produced by us. This natural process helps to clean up and

recycle the waste to be used again. But there is a capacity of nature to absorb the waste or the pollution. If the pollution crosses this capacity it starts affecting the producers as well as consumers by affecting the supply of environmental goods. As for the survival of present generations the production of market goods is necessary similarly for future generations the protection of environment is also necessary. Hence in environmental economics an important question is to find the right balance between protection and use of environment.

2.2. Basics of Economics

In 1980, Alfred Economics defined Economics as "a study of mankind in the ordinary business of life" In 1932, Lionel Robbins called Economics a study of "human behavior as a relationship between ends and scarce means which have alternative uses." Economics has evolved as a subject whose study assists individuals, groups, nations and even international organizations make important choices for material welfare, both short-term and long-term, under limitations or constraints of resources.

2.2.1. Methods of Analysis

In its study of human behaviour, Economics uses both deductive and inductive methods.

(1) Deductive

Deductive method is the process of arriving at a general conclusion from one or more general premises, by means of reasoning. If the premises are true, and the reasoning right, the conclusion is true as well. The following is an example: Every economy has a primary, secondary and tertiary sector. All the three sectors are dependent on infrastructural facilities. So for the growth of the economy, infrastructural growth is very important. Another example: A particular household has a monthly income of Rs 30 thousand. It has an average monthly consumption expenditure of Rs 23 thousand. It thus has the capacity to save Rs 7 per month.

(2) Inductive

Inductive method is the process of arriving at a general conclusion by means of a number of specific examples or observations. Example: When the price of wheat per kg came down, Khanna ji rushed to buy more wheat. So did Mrs Bose, Mr Subrahmanyam and numerous others. It can thus be induced or inferred that when the price of a commodity down, its quantity purchased goes up.

(3) Hypothetico-Deductive

The third method is the Hypothetico-Deductive method or Scientific Method. In this method, the economist frames an explanation/ Hypothesis for some economic phenomenon. A Hypothesis is not a theory. Only if a Hypothesis is verified or found to be true, can we call it a Theory. To be verified or falsified, that is tested, a hypothesis has to be framed in a certain way. Such a hypothesis is called a Scientific Hypothesis. Sometimes economists have no alternative but to take a certain hypothesis to be true, and proceed on the basis of it. Such a hypothesis is called a Working hypothesis. Statistics and Econometrics are the tools used in verifying a hypothesis. In case there are more than one hypothesis, there are statistical tests to compare their explanatory powers and judge which is more powerful as an explanation of the phenomenon concerned.

There are some hypotheses that could never be proven but have remained quite important in Economics. It is suggested that India had been industrially quite developed before the coming of the British/ India could produce fine textiles and metal ware of excellent quality. It is the British Rule that led to their de-generation or

destruction. This is known as the De-industrialization Hypothesis. Eminent scholars of Indian economic history have debated upon it but been unable to either prove or disprove it. It remains as a hypothesis.

2.3. Economic Concepts, Tools and Models

Variables, Constants, Parameters, Functions.

To abstract from the complex reality that Economics studies, Economists often use Mathematical concepts and tools. The basic Mathematical Concepts that Economics uses include: Variables, Constants and Parameters.

Variables are entities that take different values. They are usually symbolized by x , y , z . and take values positive and negative ranging from minus infinity to plus infinity.

Constants are entities that, for one particular analytical exercise, take one particular value. They are usually symbolized by a , b , c .. or alpha, beta, gamma. And again, they can take any value between plus-minus infinity but can take only one such value during a particular analysis.

Parameters are entities that can be assigned different values for different variants of an exercise but in any one particular variant, can take only one such value.

Variables can be dependent or independent. An Independent variable takes on values by itself. A Dependent variable takes on values according to or as per the Independent variable.

This relation of dependence between the Independent and the Dependent variable(s) is known as a functional relationship, or simply, a Function. It means that the Dependent variable functions according to the Independent variable. It is a most powerful tool in the study of Economics, both Micro and Macro.

The following functional relation $Y=f(X)$

Implies that Y behaves or functions as X does. As X takes on different values such as X_1, X_2, \dots, X_n , Y takes up different values Y_1, Y_2, \dots, Y_n .

This is the simplest form of a function which can actually be of very many complex forms.

2.3.1. Economic Models

In both Micro-Economics and Macro-Economics, economists sometimes put the complex mass of realities into simplified frameworks called Models. A Model is a theoretical construct that represents economic realities by a set of mathematical equations involving inter-related variables. These relationships can be logical or quantitative. But putting them in a Model helps economists to analyze realities better and even made future predictions. A famous model of Micro-Economics is the Cournot Model of Duopoly, named after Antoine Augustin Cournot (1801–1877). To exemplify what a model is, we outline it below.

The Cournot model depicts an industrial structure in which companies compete on the amount of output they will produce, which they decide on independently of each other and at the same time.

The model is based on the following assumptions.

- There is more than one firm and all firms produce a homogeneous product, i.e. there is no product differentiation;
- Firms do not cooperate, i.e. there is no collusion;
- Firms have market power, i.e. each firm's output decision affects the good's price;
- The number of firms is fixed;
- Firms compete in quantities, and choose quantities simultaneously;
- The firms are economically rational and act strategically, usually seeking to maximize profit given their competitors' decisions. This “not conjecture” assumption is crucial. Each firm aims to maximize profits, based on the expectation that its own output decision will not have an effect on the decisions of its rivals.

Price is a commonly known decreasing function of total output. All firms know $P(Q)$, the total number of firms in the market, and take the output of the others as given. Each firm has a cost function. Normally the cost functions are treated as common knowledge. The cost functions may be the same or different among firms. The market price is set at a level such that demand equals the total quantity produced by all firms. Each firm takes the quantity set by its competitors as a given, evaluates its residual demand, and then behaves as a monopoly. The outcome is known as the Cournot Equilibrium or Cournot solution. Another famous model of Micro-Economics is the

Stackelberg Model of Monopolistic Competition. Econometrics is widely used in the estimations involved in the testing of models.

2.3.2. Economic Laws

Earlier economists often used the term 'law' to describe their conclusions/theories, e.g., The Law of Demand, the Law of Diminishing Marginal Utility, the Law of Diminishing Returns. These are not laws in the sense of being inexorable, enforceable or universal laws, but merely general trends or tendencies arrived at by Deductive or Inductive methods as the case may be.

For example, the Law of Demand states that, all else being equal, as the price of a product increases, quantity demanded falls; likewise, as the price of a product decreases, quantity demanded increases.

In other words, quantity demanded and the price are inversely related, other things remaining constant. If the income of the consumer, prices of the related goods, and preferences of the consumer remain unchanged, then the change in quantity of good demanded by the consumer will be negatively correlated to the change in the price of the good.. However, there are exceptions to this rule and in modern textbooks this proposition is not presented as a law..

Again, the law of Diminishing Marginal Utility states that as a person increases consumption of a commodity while keeping that of others constant, there is a decline in the marginal utility that person derives from consuming each additional unit of that product. This, in the Neo-Classical analysis of Alfred Marshall, was the basis of the Law of Demand. Subsequent analysis has shown that the inverse relationship between quantity demanded and price can be derived without reference to any such 'law' of Diminishing Marginal Utility.

However, law in the usual sense of the term does have a close bearing on Economics. The existence of law and order in the country is a prerequisite for it to function well.

At the same time, too many restrictive laws hamper its smooth functioning. British rule introduced laws such as the Permanent Settlement Act of 1793 which introduced the Zamindari system in Indian agriculture, the Dekhan Agriculturalists' Relief Act 1879 which provided some relief to agricultural indebtedness in Maharashtra. There were

many other laws passed by the British which profoundly affected the pre-Independence Indian economy.

Soon after Independence, a new Constitution was established, some old laws were discarded and new ones passed. In agriculture, the Zamindari system was abolished and many Acts to the effect passed (The Uttar Pradesh Zamindari Abolition and Land Reforms Act, 1950. the Bihar Land Reforms Act, 1950, the West Bengal Estates Acquisition Act, 1953). In respect of industry too various laws were passed such as the Industries (Development and Regulation) Act 1951 followed by the Industrial Policy Resolution of 1956, the Monopolies and Restrictive Trade Practices Act of 1969).

By 1991 many of the above laws were considered to have become fetters upon the growth of the Indian economy. An era of 'Liberalization' was ushered in. Old laws were relaxed or removed. For example, the MRTP Act was repealed and replaced by the Competition Act, 2002, with effect from September 1.

All this points out to the close connection between Law and Economics in theory and practice.

2.4. The Basic Economic Problem – the Problem of Choice

The basic economic problem is that human wants are unlimited while the wherewithal, means or resources for fulfilling those wants are limited. Thus every society must face the three problems: What to Produce, How and For Whom, which are known as the problems of Allocation, Choice of Techniques and Distribution. It is this choice problem that Lionel Robbins had emphasized in his definition.

Economics studies this choice problem. One of the ways in which it does so is through the Production Possibility Curve or Frontier

The Production Possibility Curve (PPC)

This is a geometrical or graphical way of depicting this choice problem. It depicts the production possibilities or "menu" as Paul Samuelson had put it.

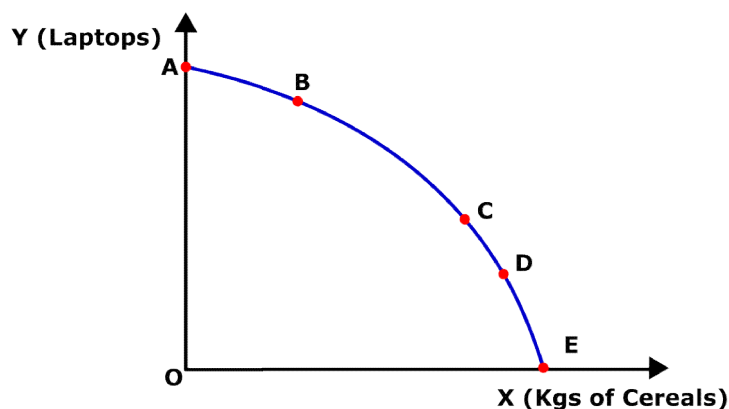
Let us say that a society or economy, using all its resources fully, has the option of producing any combination out of a maximum of , say, cereals (represented by the symbol X), and a maximum of automobiles (Y).

Let us represent cereals (X) on the horizontal axis and automobiles (Y) on the vertical. Each point on the X-Y plane would then represent a numerical combination of cereals and automobiles.

Let us have a table of alternative combinations of the maximum number of laptops (Y) that can be produced along with a certain amount of cereals (represented by X), or vice versa. That is, we have a table of alternative combinations of maximum Y's going with different X's (or, combinations of maximum X's going with different Y's). Each such combination can be represented as a point on the X-Y plane. Let us join them.

What we get is to get the Production Possibility Curve (PPC), also called Production Possibility Frontier.

Each point on the PPC (such as A,B,C) represents a maximum of X (at a certain Y) or a maximum of Y (at a certain X). All points below and including the PPC represents combinations of X and Y that are Attainable by the society concerned but only points on the PPC represent points of maximum X (given the Y's) or maximum Y (given the X's). Points below the PPC (including the two axes and so, the origin) represent what the society concerned can produce but without using its (scarce) resources fully.



Point A (on vertical axis and topmost left on the PPC) shows the maximum number of laptops that the country in question can produce if it produces no cereal at all!

Point B (south-east of A. lower down rightwards on the PPC) shows that the country can production. That is, there is a trade-off or choice between the productions of the two commodities.

Point C (south-east of B, further rightwards down on the PPC) shows a further trade-off. If less laptop are produced, the country's resources can produce more cereals. This would be better from the point of view of food consumption but computer use

would suffer. What should the policy-makers choose? Point D (south-east of C) shows a further trade-off. .

Point E (further south-east and the extreme right point on the PPC, on the abscissa, with zero ordinate) shows the maximum amount of cereals the country can produce if it decides to produce no laptops at all. Will that be the appropriate policy?

The PPC thus depicts an entire array of possible choices or trade-offs for the economy. Now, when we opt for one choice, we give up another. We forego an opportunity. The cost of opting for one choice is thus the opportunity of opting for the other. In Economics, this is given the name of Opportunity Cost. If the country moves down from point A to B, the number of laptops it does NOT produce is the Opportunity Cost of the number of kgs of cereals that it does produce. Again if the country moves from B to C, the further number of laptops that it does not produce is the Opportunity Cost of the additional number of kgs of cereals that it does produce.

The slope or gradient of the PPC reflects the Opportunity Cost.

Usually the PPC is bowed outwards, or concave. If the slopes of points A, B, and C, D are measured by tangents drawn to the PPC at those points, the tangents will be seen to get steeper and steeper

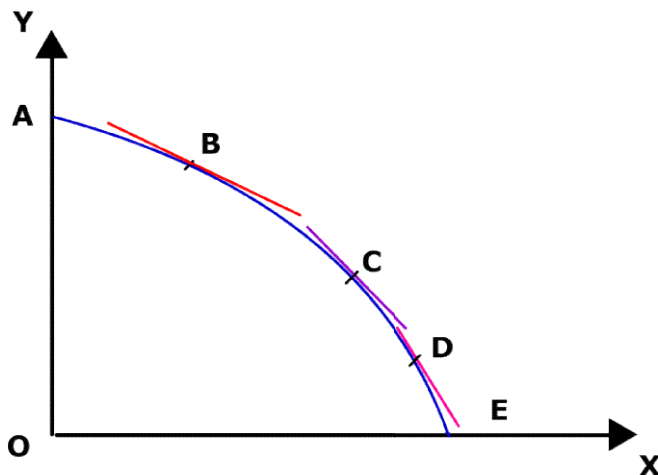
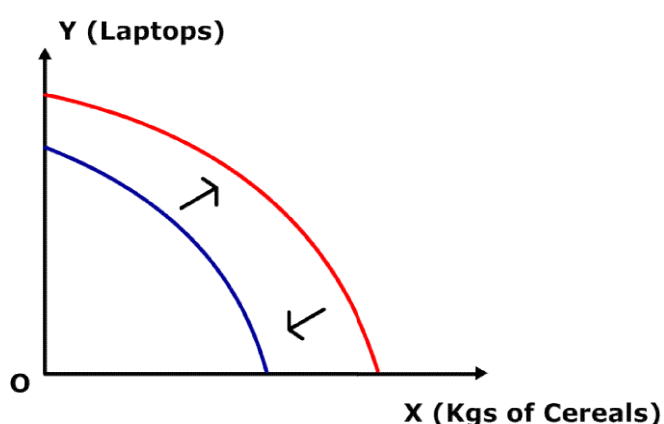


Fig.2

This happens because when the country moves from A to B, from the maximum number of laptops and no cereals, to fewer laptops but some cereals at least, some of the resources (say, workers) that were being used for making laptops are moved to the production of cereals. Those computer workers who are first disposed off were

probably not too efficient in the first place. So their reduction does not make too much of a dent the slope of the PPC (as measured by the tangent at, say, B) is relatively flat. When the country moves from B to C, let us say, computer workers who are relatively more efficient than the first lot disposed of, are now put to the production of cereals. Per additional unit of cereal production, the reduction in laptop production is more. The slope of the PPC at C is higher than at B. The slopes get higher as we move further down the PPC which thus has a bowed shape.

If for some reason or the other, the economy becomes capable of producing more of X (at every given Y) or more of Y (at every given X), there is a forward shift of the PPC,



reflecting Economic Growth. If the reverse happens, there is a backward shift of the PPC.

Fig. 3

Even if the economy becomes capable of producing more of X (at any given Y other than at the corner point of maximum Y) or more of Y (at any X other than the corner point of maximum X), there occurs a forward shift of the PPC, reflecting Economic Growth. If the reverse happens, there is a backward shift of the PPC.

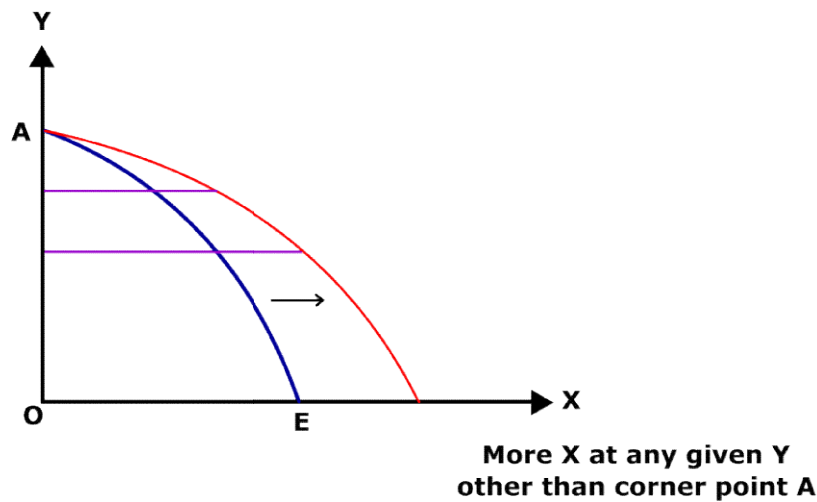


Fig 4A

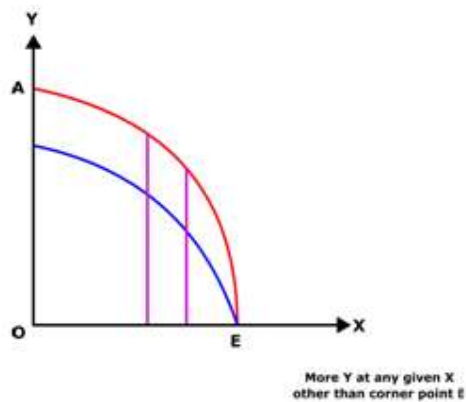


Fig 4B

This is how the PPC helps the study of human choice among alternative uses of scarce resources.

2.5. Market

The word Market comes from Latin mercatus which meant trading, buying or selling at an appointed time or place. A market is not necessarily a marketplace. It is a context or background where buying and selling is taking place. The haat, bazaar and mandi, the shop and the mall are markets. But on line or telephonic sale and purchase, which is quite common these days, are also market transactions. The distinguishing feature of the market is that market transactions are exchanges, usually performed through the medium of money.

The seller (who is sometimes though not always the producer) of certain commodities/ services brings them to the market and offers certain quantities of quantities of them at

a certain price. He thus supplies them in the market. The prospective) buyer comes to the market wanting to get certain commodities/ services at a certain price. He thus demands them in the market. If the demand of the buyer and the supply of the seller match at a certain configuration of price and quantity, the transaction takes place. If not, it does not. The transaction is thus both a sale and a purchase. It is sale from the point of view of the Seller (producer) , that is, from the Supply side. It is purchase from the point of view of the Buyer, that is, the Demand side.

The transaction has two aspects or dimensions to it, viz., a quantity and a price. For example, the seller is agreeable to selling 2 kegs of rice at the rate of Rs 50, and the buyer finds this offer reasonable. "Two kgs of rice at Rs 50" is then the description of the transaction. The total amount spent by the buyer/ consumer and received by the seller/supplier is thus Rs 100 (50×2), and this is called the Expenditure from the buyer's point of view and the Revenue from the seller's. The transaction configuration and the total expenditure/revenue are thus distinct concepts.

The transaction configuration is known as the Equilibrium configuration, or simply, Equilibrium. It is called so because it represents a matching or balancing of two aspects – the Buyer's and the Seller's, that is, the Demand side and the Supply side.

2.5.1. Markets in Micro and Macro Theory

There is an essential difference in the approach in which Micro-Economics and Macro-economics looks at markets. In Macro-Economics, the markets concerned are overall or aggregate in nature, e.g., the Goods market, the Money Market. But Micro-Economic looks at markets in the sense of individual buyers (consumers or households) and individual sellers (producers or firms) coming together to perform their respective roles in the market transactions. It is concerned with whether there are numerous buyers and sellers or just a few (or even one), whether the product (good, commodity, or service) is homogeneous or differentiated, whether there is perfect information about the products(output) and factors of production (input), whether the factors (inputs) can freely move between alternative uses, and such conditions. Depending upon the configuration of such conditions, the market takes different forms such as Perfect Competition, Monopolistic Competition, Monopoly, and so on. A large part of Micro-Economics is devoted to the study of these market forms.

2.5.2. Market and Capitalism

Market is a feature of the Capitalist system. In the Feudal era, tradition and social customs governed economic life. Peasants or serfs worked on the fields of the Kings or the Lords, and deposit the crops with him, keeping only what traditionally is their subsistence requirement. They offered tributes rather than perform exchange; In course of time, Feudalism gave way to Capitalism. Market exchange became the prevalent practice. No historian can ever say exactly how the market system came into being. "Nobody invented it" said Samuelson. : It just evolved." (Economics, Paul. A Samuelson, p 42)

Markets are not supposed to be there in a Socialist or Communist country. When the Bolshevik Revolution took place in 1917 and the USSR was born, there were experiments to do away with the market system altogether. Central Planning was developed to substitute for it. But there were many practical problems. After 1991, the USSR collapsed and with it, any experiments of economic life without markets.

Because of the importance of the market, Capitalism is also called Market Economy.

2.5.3. The Working of the Market -Price Mechanism- Demand and Supply

How does a Market work? It works through prices. This working of the market through the prices is known as the Market Mechanism or Price Mechanism. It is an all-important concept in Micro-Economics - an elaborate yet unconscious device to co-ordinate the information and actions of countless individuals and even organizations. In any economy that has developed from Feudalism to Capitalism, producers do not collect information directly about the wants of consumers and yet the consumers find all that they wish to Buy in the market. Consumers too do not get too bothered about their wants being satisfied. They find that they have more or less been produced and brought to the market. There exists a certain degree of information and organization in the market without any planner, market researcher or operator. How?

For each commodity, be it wheat or computers, textiles or medicines, there exists a market in which its consumers and producers, buyers and sellers have dealings with

one another which they settle in terms of a mutually agreed quantity at a mutually agreed price. That price brings the quantities demanded by buyers into equality with the quantities supplied by sellers. This it does because of its variability or flexibility.

Where prices are fixed or 'sticky', the price mechanism does not work so well.

2.5.4. The Market Mechanism (Price Mechanism) and Social Welfare

The Price Mechanism is supposed to lead to the best outcome for the individual as well as the society. In his book *An Enquiry into the Nature and Causes of the Wealth of Nations* (1776) Adam Smith stated that when everyone in a market economy acts in his individual self-interest, it is as if an Invisible Hand (like that of God's) ensured that social welfare is maximized, every individual necessarily labours to render the annual revenue of the society as great as he can. He generally, indeed, neither intends to promote the public interest, nor knows how much he is promoting it. By preferring the support of domestic to that of foreign industry, he intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention. Nor is it always the worse for the society that it was no part of it. By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it. I have never known much good done by those who affected to trade for the public good.

2.5.5. Market Failure or Malfunctioning of the Market Mechanism (Price mechanism)

The Market Mechanism can however fail and create chaos under circumstances like the following:

- (i) If there are market imperfections, e.g., under Monopoly and Monopolistic Competition (a market forms where the buyers are forced to buy from just one seller or a few), the price mechanism does not work well.
- (ii) If there are governmental restrictions, and prices are fixed or determined by the government (through Price Floors and Price Ceilings and Minimum Wage Laws), again the price mechanism does not work well.

- (iii) If the commodity concerned is 'indivisible' or very big (e.g., public utilities like parks, highways), price (which is a per unit concept) may not allocate it efficiently.

2.6. The Price Mechanism and the forces of Demand and Supply

It was Adam Smith in 1776 who first used the terms Demand and Supply as corresponding concepts. Later Alfred Marshall has compared them to the two blades of a pair of scissors. Indeed Demand and Supply are two most crucial concepts of Micro-economics.

2.6.1. Demand

The word Demand comes from Latin *demandare*, to claim or commission. Demand is desire backed by purchasing power. A buyer or consumer does not merely desire a commodity or good (or service) but has some power or wherewithal to purchase it at a price. Similarly, a seller or producer does not merely offer his commodity or good (or service) but offers them at a price.

There exists at any one time a definite relationship between the market price of a good and the quantity demanded of that good. This relationship between price and quantity demanded/bought is called the Demand schedule or Demand function or Demand curve. One usual form that the Demand curve can take is downward-sloping from left to right. That is, there is an inverse or indirect relationship between the quantity of a demanded of a commodity and its price. (It is this relationship which has often been called the Law of Demand.) The Demand schedule below depicts this as follows:

	Demand Schedule	
	Price (P) Rs per kg	Quantity Demanded (Qd) Kg
A	5	9
B	4	10
C	3	12
D	2	15
E	1	20

Demand Curve

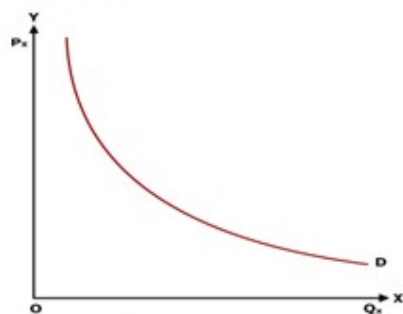


Fig. 5

Fig.5

Prices are measures on the vertical axis and the quantities demanded on the horizontal. Each pair of Q, P numbers from the Demand Schedule is plotted here as a point on the Q- P plane, and a smooth curve passed through the points to yield the Demand 'curve'. It slopes downwards from Left to Right, showing an Inverse or Negative relation between price and quantity.

2.7. Supply

Supply comes from Latin *supplere*, to fill up or complete. There exists at any one time a definite relationship between the market price of a good and the quantity the producers of that good are willing to offer or supply. This relationship between price and quantity supplied is called the Supply schedule, function and curve. Based on the Supply schedule below, a supply curve can be depicted. Usually it slopes upwards from left to right.

Supply Schedule		
	Price (P) Rs per kg	Quantity Supplied (Q _s) Kg
A	5	18
B	4	16
C	3	12
D	2	7
E	1	0

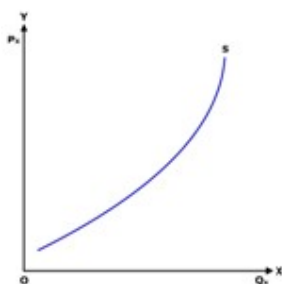


Fig. 6

Prices are measures on the vertical axis and the quantities supplied on the horizontal. Each pair of Q,P numbers from the Supply Schedule is plotted here as a point on the Q-P plane, and a smooth curve passed through the points to yield the Supply 'curve'. It slopes upwards from Left to Right, showing a Direct or Positive relation between price and quantity.

The above Demand and Supply are individual in nature, belonging to an individual person, household or firm. In Macro-Economics the corresponding concepts are Aggregate Demand and Aggregate Supply. They represent the total demand and supply of the economy as a whole.

2.8. Summary

- Economics is a social science that studies human choice among alternative uses of scarce resources. Its methodology is Deductive as well as Inductive.
- Earlier Economics was said to formulate 'Laws' of behaviour such as the Law of Diminishing Marginal Utility and the Law of Demand. Nowadays they are regarded as statements of general tendencies rather than laws. Actual laws too are integrally connected with the economic life of nations.
- Although Economics studies real-life problems or issues, it makes much use of Model-building, using abstract concepts and tools of advanced Mathematics.
- Every society faces three Central Problems: What to Produce, How and For Whom, which are known as the problems of Allocation, Choice of Techniques and Distribution

Economics studies these central problems of an economy through the Production Possibility Curve or Frontier.

- Economics makes a study of basic concepts like Market, Price and Quantity, Demand and Supply, and Equilibrium.
- The Market mechanism or Price Mechanism is a most important concept of Micro-Economics.
- Demand and Supply of goods and services determine their Equilibrium Price and Quantity in the Market.
- Markets can be of various forms, ranging from Perfect Competition to Monopoly.

Unit-3: Environmental Economics (EE) II:

Unit Structure

3.0 Learning objectives

3.1: Introduction

3.2. National resource accounting

3.3. Green national accounts

3.3.1. Pollution Expenditure Accounting

3.3.2 Physical Accounting

3.3.3 Development of Green Indicators

3.3.4 Extensions of the SNA-type Systems

3.4. Policy issues

3.5. Enforcement of Environmental Policies

3.6. Environmental Asset Accounts

3.7. Calculating the Value of Gross Domestic Product

3.8 References

3.0 Learning objectives

After studying this unit you are able to understand about:

- The National resource accounting
- Green national account
- Major policy issues
- Environmental economics and valuation in development decision-making

3.1: Introduction

The measures like Gross Domestic Product (GDP) and Net Domestic Product (NDP) have been the key indicators in economic policy. They have become so much a part of our life that it is hard to remember that they are hardly fifty years old. They were first published in the United States in the year 1942. These measures are part of the national income accounts developed in each country whose objective is to provide a database for macroeconomic analysis. The aim of national income accounting is to provide an information framework suitable for analyzing the performance of the economic system.

These indicators were for a long time used as a measure of economic progress of a country and Environment country and also as a measure of standard of living. However, these

traditional measures of economic activity (such as GDP and NDP) are now recognized as inadequate as they cannot accurately measure the contribution of environment and the impact of economic activities on environment. The environment, as we all know, is a source of raw materials and energy, serves as assimilator of wastes of production and consumption, provides the context in which all human actions take place and sustains basic life-support systems. Hence, efforts should be made to incorporate environment/natural resources into the national income accounts so as to get a better indicator of economic progress and well-being. In the present unit a brief review of the existing system of national income accounts is presented explicitly pointing out the flaws in the system and how the drawbacks or deficiencies in the existing system can be rectified and better indicators of human well-being are constructed.

3.2. National resource accounting

The present system of national accounts (SNA) views the relationship between the environment and the economy from economic perspective only. It groups the national income accounts into three categories, viz., current accounts, asset accounts and balance sheets. Current accounts deal with the production or income and the use of income while asset accounts cover changes in assets and liabilities and changes in net worth. On the other hand, the balance sheets present stock of assets and liabilities, and net worth.

The most familiar of the three accounts is the current accounts (or the supply and use accounts). In the supply and use accounts income is computed in three different ways: 1) the sum of value added (revenue minus intermediate consumption) across all industries (i.e., the production account); 2) the sum of final consumption and savings (disposable income) (i.e., the use of income account), and 3) the sum of employee compensation and operating surplus (i.e., the distribution of income account). Production in SNA covers only those goods and services that are bought and sold in markets.

The supply and use accounts reflect three basic national accounts identities. These are as follows:

1) The supply-use identity

$$\begin{aligned} \text{Production} + \text{Imports} &= \text{Intermediate Consumption} + \text{Exports} + \text{Final} \\ \text{Consumption} + \text{Gross Capital Formation} \dots (7.1) \end{aligned}$$

2) The value-added identity

Net Value Added = Output - Intermediate Consumption - Consumption of Fixed Capital ... (7.2)

3) The domestic product identity

Gross Domestic Product = Final Consumption + Gross Capital Formation + (Export - Imports) ... (7.3)

-- . In addition to the supply and use accounts, there is also the asset accounts which "covers changes in assets and liabilities. The products of economic assets are generally valued in the market, either directly or indirectly. These assets are referred to in the SNA as economic assets. In the year 1993 the SNA was modified to include only those natural assets in the asset accounts whose ownership rights existed and those that can bestow economic benefits to their owners. Some examples of produced natural assets include the value of livestock for breeding, orchards, private plantations and timber tracts. The asset balances for produced assets and nonproduced natural assets include the opening and closing stocks of produced assets and the elements explaining the change between these two, viz., net capital formation, holding gains or losses of assets, other changes in the volume of produced assets and the closing stocks (i.e., opening stocks plus the sum of the preceding adjustments). Due to the inclusion of asset accounts into the national accounts we have one more set of identity, which explains the difference between the opening and closing stock of assets by flows during the accounting period.

For produced and non-produced assets, the balances are identified as:

Closing Stocks = Opening Stock + Gross Capital Formation - Consumption of Fixed Capital + Other changes in Volume of Assets + Holding Gains/Losses on Assets ... (7.4)

The gross capital formation consists of a) gross fixed capital formation, and b) changes in inventories in produced assets such as buildings, roads, machinery and stocks of commodities. The gross fixed capital formation may also include additions to the produced assets such as improvement of land, cost of transferring land and other non-produced assets between owners. The value of capital formation is added to the value of non-produced assets, but separately 'depreciated' as other changes in volume. Thus, the elements of the column related to non-produced economic assets, do not figure in the calculation of NDP, as all the changes in non-produced natural assets

between opening and closing stocks are explained in the SNA as holding gains or losses and other changes in the volume of assets. Hence, the elements under other changes in volume are the most relevant items to be reclassified for analysis in the natural resources accounting.

The present system of national accounts reflects the Keynesian macroeconomic model and like the Keynesian system it largely ignores the productive role of natural resources. The major aggregates of Keynesian analysis, viz., consumption, savings, investment, and government expenditures are carefully defined and measured. As Keynes and his contemporaries were preoccupied with the Great Depression and the business cycles, scarcity of natural resources was never given any importance. In fact, natural resource scarcity played little role in the 19th century neo-classical economics, from which the traditional Keynesian and most contemporary economic theories are derived.

The classical economists had regarded income as return on three kinds of assets: natural resources, human resources, and invested capital (land, labour, and capital). The neo-classical economists dropped natural resources from their model and concentrated on labour and invested capital only. When these theories were applied after World War I to problems of economic development in the developing economies, human resources were also left out on the grounds that labour was always surplus, and development was seen almost entirely as a matter of savings and investment in physical capital. As a result, there is a dangerous asymmetry today in the way we measure, and hence, the way we think about the value of natural resources.

3.3. Green national accounts

To measure the national income more accurately, two types of adjustments to the existing national income accounts are required. The first adjustment requires defining and valuing non-marketed environmental goods and services, while the other requires measuring and valuing the changes in the stock of natural resources. For example, to account for natural resources like forests, one should extend traditional NDP by including the non-marketed benefits associated with forests. Additionally, the traditional NDP should also be adjusted for the value of change in forest resources. Although there has been

wide consensus that greening the national accounts is important _ there has been little consensus on how to do it with different researchers advocating different approaches. Some are concerned with preserving the stock of environmental assets while others are concerned with the effect of environmental change on welfare. We can group these approaches to incorporating natural resources in national income accounting into four major categories. These are: 1) pollution expenditure accounting; 2) physical accounting; 3) development of green indicators; and 4) extension of the SNA type systems.

3.3.1. Pollution Expenditure Accounting

This has been the earliest reaction to overcome the weaknesses in the conventional economic accounts. It involves developing data series on pollution abatement and other environmental expenditures. However, there are some limitations of using this approach, which are mentioned below.

- a) These data refer to expenditure already incurred, either due to policy or **standard** business and household practices. Hence they should not be considered as additions to conventional economic accounts as they are a re-specification of the information already accounted for;
- b) The abatement expenditure data tend to overestimate the true opportunity costs. as they contain outlays on materials, which are already included in the value-added expression of the sector producing these materials. Thus there may be the risk of double counting;
- c) The practice of comparing pollution abatement expenditures with GDP is misleading since the GDP covers primary costs and is free from double counting. This can be addressed by using input-output techniques.

The use of pollution expenditure data has limited scope for policy. They can only give an indication of how various environmental policies may affect productivity.

3.3.2 Physical Accounting

The second approach to improve the conventional economic accounts is to supplement the conventional accounts with physical information about the natural environment and its status. We provide information on physical indicators for forests like the area under dense forests, open forests, volume of stock of timber, area disturbed by fire, etc. Also we can account for the quality of air in terms of CO₂ emissions, suspended

particulate matter, nitrogen oxide emissions, etc. Similarly, the quality of water using physical indicators like dissolved oxygen, BOD, COD and pH factor can be indicated. These types of information can also be arranged in conventional input-output type of matrices. For example, Netherlands has used such a complete input-output matrix system in their National Accounting **Matrix** including Environmental Accounts (NAMEA). The system fully integrates economic and physical environmental information. Development of such physical accounts is important as it can provide inputs for the construction of various environmental indicators and can thus be used for score keeping purposes'. However, it is very difficult to use these physical accounts for policy purposes for various reasons such as: (a) the choice of appropriate physical units of measure is not obvious; (b) there is incomparability of units; (c) difficulty in getting condensed description as the units are not similar; (d) involves development of huge data sets due to different quality indicators for forests, air, land and water without reaching general conclusions on their (economic and non-economic) significance; and (e) the potential severity of the environmental problem is not reflected and hence the decision-makers will not be able to set relative environmental priorities while taking various investment decisions.

The difficulties in using the physical accounts can be illustrated by an example, say forests. As you know, forests can be measured in terms of its area, volume of timber, number of species of flora and fauna, etc. Even the units of measuring forests are different. For instance, area is measured in hectares, volume in cubic meters and the species in number. Thus there is no common unit, which can be used to indicate all the three. Another choice that has to be made is which physical measure to choose. This once again depends on the policy objective in mind, i.e., should the forests be used for timber management or provision of firewood or preserving biodiversity. This results in developing huge data sets without reaching any conclusion for the policy. For instance, if a policy maker is faced with the dilemma of preserving hundred hectares of forest, which is a rich source of biodiversity, versus developing in multipurpose project. which provides numerous quantifiable benefits, the latter is favoured against the former as they cannot get the value of the benefits of preserving the forests.

3.3.3 Development of Green Indicators

A third approach is to construct a green GDP or some other economic index to replace the conventional GDP or NDP. Two approaches have been adopted for this. In the first approach, efforts have been made to construct entirely new indicators of well-being. This has been achieved by altering the conventional aggregates by subtracting out pollution expenditures from the GDP, adding the factors like negative effects of urbanization, etc. Some of the examples of this approach are the measure of economic welfare indicator by Nordhaus and Tobin, the net national welfare indicator developed for Japan and the index of sustainable economic welfare. The second approach does not involve replacement of conventional gross income aggregates but involves modifying the conventional measures of net product. Such approach has been provided by Repetto and others (Repetto et al., 1989). Essentially, their idea is to depreciate natural assets such as forests, mineral stocks, fish stocks and soils in order that man-made capital and natural capital receive equal treatment in the computation of net income. The main criticism of the approach is that while various indexes may indicate that society is worse off than might be suggested by the conventional GDP, they give the policy maker a little indication of what to do about it.

3.3.4 Extensions of the SNA-type Systems

The fourth group builds upon the existing SNA and covers all the sectors that interact with the environment rather than focusing on just one element of the conventional accounts such as depreciation or pollution expenditure accounting. Examples of such an approach are the United Nations Satellite System of Integrated Environmental and Economic Accounting (SEEA) and Environmental and Natural Resource Accounting Framework (ENRAP) (also referred to as Peskin framework). Both the approaches require sector-specific information on the use of environmental assets, and are concerned with the management and score-keeping functions of accounting. But the principal difference between these two lies in the extent of their adherence to SNA concepts. SEEA appears much more concerned with adherence to the principle of SNA than to economic theory. The ENRAP framework, on the other hand, stresses more on the consistency with economic theory than with the SNA (Peskin, 1998, page 387).

The SEEA attempts to overcome the limitations of the SNA by reclassifying the elements in other volume changes so as to include them in the calculation of NDP. In the absence of international consensus on how to incorporate environmental assets and the costs and benefits of their use into national accounts, the United Nations Statistical Division approved the "satellite" System of Integrated Environmental and Economic Accounting framework rather than modifying the core SNA itself. The satellite system becomes a link between the SNA and the accounts describing the natural environment. The main success of SEEA is because of its close integration with the SNA and also due to its ability to address various flaws of conventional national accounts by means of alternative versions or modules. The building block approach allows SEEA users to choose among different approaches according to their priorities and statistical capabilities. The main objectives of SEEA are:

- 1) Segregation and elaboration of all environment related flows and stocks of traditional accounts: The objective is to present separately environmental protection expenditures.' These expenditures have been considered as part of the costs necessary to compensate for the negative impacts of economic growth, in other words as defensive expenditures'.
- 2) Linkage of physical accounts with monetary environmental accounts and balance sheets. It consists of a description of the interrelationships between the natural environment and the economy in physical terms (like changes in total stock or reserves of natural resources and changes therein, even if those resources are not affected by the economic system). These accounts provide the physical counterpart of the monetary stock and flow accounts of the SEEA.
- 3) Assessment of environmental costs and benefits: The SEEA expands and complements the SNA with regards to assigning costs to a) the use of natural resources in production and final demand, and b) the changes in environmental quality, resulting from pollution and other impacts of production, consumption and natural events on the one hand, and environmental protection expenditures on the other.
- 4) Accounting for the maintenance of tangible wealth: The SEEA broadens the concept of capital to cover not only the man-made but also the natural capital. Natural capital includes scarce renewable resources such as marine or tropical forests, non-renewable resources like land, soil and subsoil assets (mineral deposits), and cyclical

resources of air and water. Capital formation is correspondingly changed into a broader concept of capital accumulation.

5) Elaboration and measurement of indicators of environment-adjusted product and income: Including the costs of depletion of natural resources and changes in environmental quality allows for the calculation of modified macroeconomic aggregates in SEEA. Indicators thus compiled include, in particular, an environment-adjusted net domestic product (EDP).

The third, fourth and fifth objectives mentioned above require valuation of environmental resources (discussed in Unit 8). In order to facilitate this, SEEA proposes three different versions based on different techniques of valuation. One version of SEEA applies a market valuation approach. The second uses a maintenance cost approach while the third version combines the market valuation with the contingent valuation approach. Of these three methods, the market valuation is the closest to the conventional CSNA. In the market valuation approach, the stocks of non-produced economic and environmental assets can be valued using either the net-price/discounted present value/user-cost methods. The net price of the asset is defined as the actual market price of the raw materials minus its marginal exploitation costs including the rate of return on the invested produced capital. In case of exhaustible resources SEEA proposes using the user-cost method to value the depletion. The idea behind this method is to convert a time-bound stream of (net) revenues from the sales of an exhaustible natural resource into a permanent income stream by investing a part of the revenues, that is, the 'user-cost allowance' over the lifetime of the resource. Only the remaining amount of revenues should be considered as 'true income'. The discounted present value of natural resources is obtained by using the discounted value of the goods extracted/services provided by those assets in the future reduced by the exploitation costs (net return). However, the limitation of market value approach is that it covers only those natural assets that have an economic value. As an alternative to market valuation, maintenance cost valuation is introduced. Maintenance costs are defined as the costs of using natural environment that would have been incurred if the environment has been used in such a way that its future use had not been affected. The maintenance costs concept implies that uses of the environment that have no impact on nature have a zero (monetary) value, i.e., if water is available in plenty, extracting water do not have any value.

Apart from the extension of the asset boundary in the SEEA, the information on 'other changes in volume' for non-produced economic and environmental assets is disaggregated into four categories (Bartelmus and Van Tongeren, 1994). These categories are:

- Depletion: reductions in the quantity of assets, due to economic uses (e.g., timber harvesting)
- Degradation: positive or negative changes in the quality of assets, due to economic decisions (e.g., soil erosion due to forest loss leading to loss of **land productivity**)
 - Other accumulation: additions or reductions in the quantity of assets due to economic decisions (e.g., additions due to afforestation or reduction due to transfer of forests to non-forest uses like agriculture, etc.)
 - Other volume changes: quantitative or qualitative changes in assets not caused by economic decisions (e.g., destruction of forests by natural fires, etc.)

3.4. Policy issues

India has taken a bold step to embrace environmental protection rights and duties in its Constitution. The Constitution of India stipulates that the Government shall attempt to protect and improve the environment and maintain the natural resources of the country. According to the Constitution of India, it is the fundamental duty of every citizen of India to protect and improve the natural environment and to have compassion for living beings. By hovering environmental concerns to the constitutional level, India has provided its people with a powerful policy tools to protect the environment.

National Policies:

Along with the Constitutional mandate, India has also started a number of national policies governing environmental management which includes the National Policy on Pollution Abatement (NPPA, 1992) and the National Conservation Strategy and Policy Statement on Environment and Development (NCS/PSED, 1992). However these policies serve as guiding principles for the central and state governments to follow as they are not judicially enforceable.

The NPPA enforces the traditional command-and control approaches to pollution abatement. The policy adopts the following guiding principles avoidance of pollution at

source, adopting the best available technology, the polluter pays principle and participation of the public in decision making.

The NCS/PSED provides a predominant policy framework on environmental management which includes conservation of natural resources and economic development. Its key instruments are assessing environmental impact, providing educational campaigns, and ensuring public participation. **The Ministry of Environment and Forests (MOEF) is responsible for implementing the NPPA and the NCS/PSED.**

3.4.1. National Environment Policy of 2006.

The National Environment Policy (NEP) of 2006 is the most recent pronouncement of the government's assurance to improve environmental conditions while promoting economic affluence nationwide. Its key environmental objectives include preservation of crucial environmental resources, intra-generational equity, incorporating environment in economic and social development, livelihood efficiency in environment resource use, environmental management, and enhancement of for environmental conservation. This policy encourages mainstreaming of environmental concerns into all development activities, advocates the important environmental principles and also identifies the regulatory and substantive reforms. With respect to regulatory reforms, the NEP recommends a policy framework to "develop synergies among relevant statutes and regulations, eliminate obsolescence, and amalgamate provisions with similar objectives." The NEP has developed a new framework for legal action that includes solicitation of a mix of civil and criminal sanctions, adoption of innovative economic instruments, and public-private partnerships in consolidation with environmental compliance and enforcement. The MOEF is responsible for implementing the NEP.

Legal Framework

India has an enormous laws relating to environmental protection. The main laws for the prevention and control of industrial and urban pollution include the following:

- **Water (Prevention and Control of Pollution) Act of 1974, amended in 1988**
- **Water (Prevention and Control of Pollution) Cess Act of 1977, amended in 1991**

- **Air (Prevention and Control of Pollution) Act of 1981, amended in 1987**
 - **Environment (Protection) Act of 1986 (EPA)**
 - **Public Liability Insurance Act of 1991**
 - **National Environmental Tribunal Act of 1995**
 - **National Environmental Appellate Authority Act of 1997**
- A) **The Water Act** vests supervisory authority in State Pollution Control Boards to establish and enforce effluent standards which facilitates discharging of pollutants into water bodies. The Central Pollution Control Board harmonizes activities between the states and performs these regulatory functions for the union territories. The central and state boards were accredited to control domestic and industrial discharge via consents to establish (CTE) and consents to operate (CTO). Also these boards advise state governments on siting of industrial projects.
- B) **The Air Act** offers for the prevention, control and abatement of air pollution. Its framework is similar to that of Water Act. The Air Act has the power to the state and central boards to issue consents to industries operating within entitled air pollution control areas. States also recommends emission standards for stationary and mobile sources.

Key Institutions

The key institutions responsible for the formulation and enforcement of environmental acts and rules include the Ministry of Environment and Forests (MOEF), the Central Pollution Control Board (CPCB), State Departments of Environment, State Pollution Control Boards (SPCBs) and Municipal Corporations.

- C) **Ministry of Environment and Forests:** The ministry of Environment and Forests is established in 1985. The MOEF is the central government Nodal agency. It is responsible for planning, promotion and coordination of all environmental activities, including formulation of national policies, standards and regulations. The objectives of the MOEF are:

- Preservation and survey of flora, fauna, forests and wildlife;
- Prevention and regulation of pollution;

- Afforestation and regeneration of degraded areas;
- Protection of the environment; and
- Welfare of animals and other living beings.

D) Central Pollution Control Board.

Under MOEF, the Central Pollution Control Board (CPCB) is the national board which have powers to oversight the state boards. The CPCB has a central office as well as a network of zonal offices located in New Delhi, Calcutta, Shillong, Kanpur, Bangalore and Vadodara. It is established in 1977 under the Water Act.

The CPCB has wide range of powers and responsibilities which includes:

- ✓ Recommending the central government on any matter related to the prevention of and control of water and air pollution and also the improvement of air quality;
- ✓ Planning programs among nations for the prevention, control and abatement of water and air pollution;
- ✓ Coordinating the activities of SPCBs and resolving dispute among them;
- ✓ Providing technical assistance and supervision to the State Boards,
- ✓ Carrying out and sponsoring investigations and research relating to problems of water and air pollution and for their prevention, control and abatement;
- ✓ Prosecuting polluting industries pursuant to the Water Act;
- ✓ Collecting, compiling and publishing technical data on air and water pollution and the measures recommended for their prevention, control and abatement;
- ✓ Organizing training of staff involved in environmental programs;
- ✓ Preparing manuals, codes and guidelines relating to industrial emissions and effluents;
- ✓ Organizing mass media awareness programs on environmental protection;
- ✓ Disseminating information on water and air pollution and their prevention and control; and
- ✓ Performing such other functions as prescribed by the central government.
- ✓ The total number of employees in the CPCB is approximately 500, out of which 100 have technical training. The CPCB has approximately 60 inspectors all over the nation.

E) State Pollution Control Boards

The SPCBs were established resulting the State Legislatures' adoption of the Water Act of 1974 and then the Air Act of 1981. At the State level, the SPCBs are attached either to the Environment Department, or to the Forest and Wildlife Department. In general, SPCBs perform the following functions:

- ✓ Advising the state governments on pollution related issues;
- ✓ Planning a widespread state-level pollution control/ prevention/ abatement program;
- ✓ Implementing and enforcing national standards by making them more stringent if warranted by local conditions;
- ✓ Granting consents to form and to function under the Air and Water Acts and authorize hazardous waste disposal per rules under the EPA; and
- ✓ Collecting water cess for the use of water.

Role of the Judiciary. Over the last twenty years, the Supreme Court of India and some High Courts of the states have directed the way in the implementation of environmental laws through citizen-led public interest litigation (PIL). Through this judicial activism, the courts have issued orders with specific implementation requirements that have set new policies and practices with extensive implications for the regulated community. Also all environment-related fines and imprisonment are provided under criminal law and must be imposed by lower courts.

3.5. Enforcement of Environmental Policies

Legal Enforcement Authority

The compliance monitoring and enforcement is mostly done by SPCBs. Few direct enforcement actions taken by the CPCB are generally done by the zonal offices. Under the Water Act, the Air Act and the EPA, these boards have the authority to issue and withdraw consents to operate, require self-monitoring and broadcasting, conduct sampling, inspection, require corrective action and propose compliance schedules. The enforcement powers given to these boards include emergency measures of disengaging water or power supply and facility closure and is widely used in some states. With CPCB approval, SPCBs can impose administrative fines for any violation

of those rules. This provision of enforcing penalties for illegal storage of hazardous waste is used in Maharashtra.

The environmental tribunals came into existence with the 186th Report of India's Law Commission (September 2003) which has exclusive jurisdiction with regard to environmental cases. According to the Report these environment courts must be established to reduce the pressure and load on the High Court and the Supreme Court. All powers of a civil court in its original jurisdiction would be exercised by these environmental tribunals. They would also have appellate judicial powers against orders passed by the concerned authorities under the Water Act, the Air Act, the EPA, and other environment related acts. At the national level, there would be a National Environmental Tribunal, with corresponding tribunals at the state level.

Key Challenge

The effectiveness of PCBs' enforcement efforts is bounded by the lack of civil administrative authority to impose fines and leads to over-reliance on the judiciary for enforcement. Filing criminal cases against violators in trial courts or reacting to PILs is a time-consuming, unpredictable and ineffective enforcement mechanism.

Institutional Arrangements and Capacity Building

The CPCB have primary enforcement authority for union territories while the same functions is performed by for SPCBs in the states. The SPCBs have further delegated some implementation responsibilities to their regional and sub-regional offices. The CPCB's role is to synchronize activities among the states and it provides technical assistance and guidance to the SPCBs. In addition, the CPCB may temporarily assume SPCB functions if a State Board fails to comply with a CPCB direction apart from overseeing the SPCBs.

There is also a co-ordination issue between SPCBs and other state-level government agencies that have some environment-related responsibilities, including urban development (municipal waste), departments of transport (with respect to mobile source pollution), of industries (siting of industrial facilities), etc. Such interagency collaboration as a system is very weak.

Key Challenges

- 1.) There is very less coordination between the CPCB and SPCBs due to the double subordination of SPCBs (state governments influence is also a factor) as well as to the lack of enforcement policies and procedures and comprehensive standard compliance.
- 2.) Funding limitations remain a strong challenge facing all environmental institutions, in the absence of strong political will to address environmental issues. The differences in the financial status and sources of funding of the PCBs lead to inequitable treatment of the regulated community. A high dependence on fees can also lead to mixed incentives and priorities for the employees.
- 3.) High level of human and technical capacity limitations are an obvious factor that impacts effective execution of all compliance and enforcement functions at the all the levels of centre, state and local bodies.

All polluting facilities are legally mandated to obtain from a respective SPCB a consent (permits) to establish (CTE) and a consent to operate (CTO). As per the Notification issued by the MOEF in September 2006, certain new industrial projects/activities or those trying major notifications also require a Prior Environmental Clearance (from the CPCB for Category A or from an SPCB for Category B) basis the environmental impact assessment (EIA) report.

3.6. Environmental Asset Accounts

An important issue to consider when evaluating any “green” national accounting approach is how its results can be used to assess the environmental sustainability of a society. As discussed in Chapter 7, we can define different levels of sustainability, which we identified as “weak” and “strong” sustainability. (Recall that these terms refer to different definitions, and do not imply that one is preferable to the other.) How well do the indicators introduced so far in this chapter reflect sustainability?

Any index that monetizes various environmental factors and combines the results with traditional monetary aggregates, such as GDP, implicitly assumes a degree of substitutability among natural capital and economic production. For example, the GPI could remain constant if an increase in pollution damage is offset by an increase in personal consumption. Thus the GPI, along with other aggregate indices like EDP and

ANS, can be considered appropriate metrics to address weak sustainability but not stronger forms of sustainability.¹⁴

If we are interested instead in achieving strong sustainability, we need to concern ourselves with the preservation of natural capital. A further distinction emphasized by some analysts is between “strong sustainability” and “very strong sustainability.” Strong sustainability seeks to maintain the overall level of natural capital but allows the substitutability of different types of natural capital, at least for noncritical resources. Very strong sustainability seeks to maintain the levels of various types of natural capital, allowing for substitutability only within each category of natural capital.

The indicators discussed so far in this chapter are not necessarily designed to provide information on stronger forms of sustainability. Still, a few of them do provide some insight into strong sustainability objectives. The environmental components of the gPI, for instance, provide information on natural capital depletion, although not the overall level of natural capital.

An alternative approach is to maintain national accounts that track the levels of different types of natural capital. The SEEA-2003 provides guidance on the maintenance of environmental asset accounts or (natural resource accounts), in both physical and monetary terms. These accounts are based on defining various natural capital categories, such as timber resources, mineral resources, agricultural land, and groundwater. The accounts may have different degrees of aggregation. For example, the account for mineral resources might include a separate account for each mineral or be disaggregated even further based on mineral quality, degree of accessibility, or location. The units would vary for different accounts based on the resource in question. So mineral accounts might be measured in tons, forest accounts in hectares of forest cover or board-feet of timber, groundwater accounts in acre-feet of water, and so on.

The two main strengths of environmental asset accounts in physical units are:

1. They provide a detailed picture of a country's natural capital levels and trends over time. A particular focus can be on ensuring that levels of critical natural capital are maintained.
2. They provide a means for assessing very strong sustainability. Since each category of natural capital is quantified in a separate account, policy makers can determine whether the levels of each are being maintained.

Environmental asset accounts can also be expressed in monetary units. In most cases, this simply involves multiplying a physical unit estimate by the market price per unit. For example, if a society has a standing timber stock of 500,000 board-feet of lumber and the market price is \$5.00 per board-foot, then the asset value of their timber is \$2.5 million. Environmental asset accounts in monetary terms offer the benefit of comparability, both among different types of natural capital and to traditional economic aggregates such as GDP. Unlike accounts in physical units, environmental asset accounts in monetary units can be used to give an overall measure of sustainability because gains and losses in different categories can be compared.

This is illustrated in figure 8.8. For simplicity, assume there are only two natural resource assets in a society: timber and agricultural land. In Year 1 the society has a stock of 500,000 board-feet of timber and 6,000 hectares of agricultural land. At the market prices indicated in figure 8.8, the total value of the environmental assets in the society is \$8.5 million in Year 1. In the next year, the society harvests some of its timber stock but brings some additional land into agricultural production, as shown in the figure. If we kept asset accounts only in physical units (i.e., in this example, board-feet of timber and hectares of land), we would not be able to assess whether this society has maintained its overall level of natural capital. But figure 8.8 indicates that the value of its natural assets has actually increased by \$500,000, indicating that the overall value of natural capital is being sustained.

Comparing different assets in monetary units has both advantages and disadvantages. Suppose that the price of timber increased in Year 2 to \$7.00 per board-foot. Even though the stock of timber was reduced by 100,000 board-feet, the value of the stock in Year 2 would be \$2.8 million ($= 400,000 \text{ board feet} \times \7.00). Even though the physical stock of timber was reduced, its market value increased relative to Year 1. So if we looked only at the monetary units, we could wrongly conclude that the society's stock of timber had increased due to factors such as increased planting or conservation. This demonstrates that we need to be wary of the effect of changing prices on the value of a society's natural assets. This is particularly problematic for mineral and oil assets because the price of these commodities can fluctuate considerably.

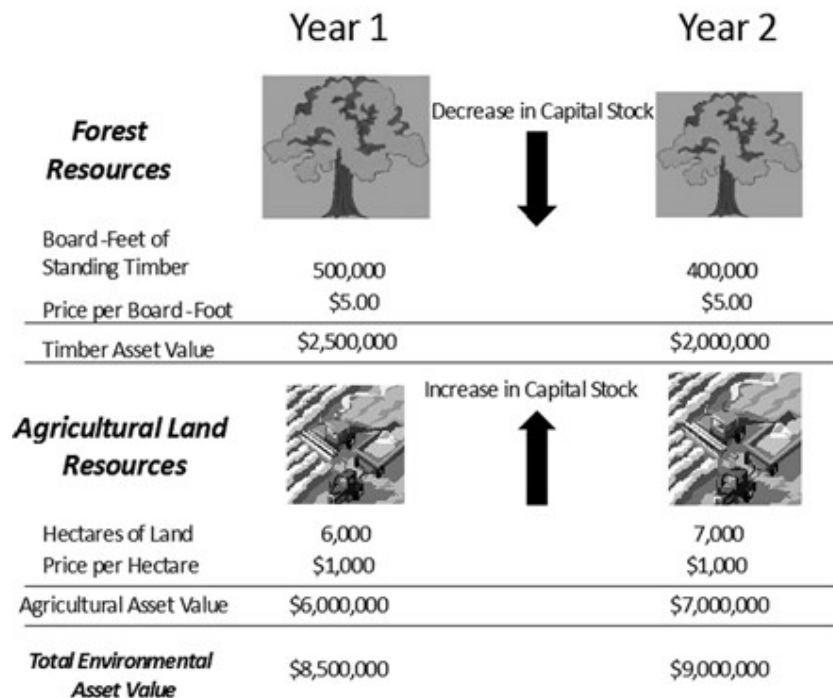


Figure 8.8 Example of Natural Resource Accounts

Another problem with the monetary value approach is that the estimates in figure do not consider the loss of ecosystem services from harvesting timber. In addition to the loss of timber, there may have been a loss of wildlife habitat, erosion control, carbon storage, and other services. Ideally, assessing strong sustainability by aggregating various asset accounts should consider nonmarket benefits as well as market values. But estimating nonmarket values, such as ecosystem services and nonuse values, can be problematic. Thus any attempt to assess strong sustainability based on monetary values is likely to be incomplete or dependent on numerous controversial assumptions. Several countries have started to maintain environmental asset accounts. The United Kingdom's Office for National Statistics provides estimates for the following three categories of natural resources:

- **Oil and gas reserves**—these accounts are maintained in both physical and monetary units.
- **Forest account**—this account includes the total area under forest cover, as well as an estimate of the market value of standing timber. The report mentions other

benefits of forests, including recreation and wildlife habitat, but it makes no attempt to quantify these benefits.

- **Land account**—this account maintains the total area of nineteen categories of habitat including woodlands, grasslands, marsh, open water, and built-up areas. Data over time track changes, with some habitats increasing over time and others decreasing.

3.7. Calculating the Value of Gross Domestic Product

As you might imagine, calculating the total value of all goods and services produced in a national economy is not a simple task. Economists use a variety of data sources to estimate aggregate production including data from tax returns, surveys of businesses and households, and government records. An estimate of GDP can be obtained in three ways: the **product approach**, the **spending approach**, and the **income approach**. The product approach simply adds up the dollar value of all final goods and services produced in the economy. The spending approach adds up the expenditures of consumers, businesses, governments, and institutions for final goods and services. The income approach adds up the earnings of everyone in the economy, including wages, profits, investment income, and rental income.

In a simplified closed economy with no depreciation or inventories and where all business earnings are paid out as income, all three approaches should produce the same value.^o In other words, if an economy produces \$7 billion worth of goods and services we can conclude that \$7 billion was spent to purchase these goods and services and \$7 billion in income was earned to make these purchases. Of course, the real economy is more complex and the different approaches may produce different values. For example, not everything produced in a year may be sold during that year. Economists have devised adjustment methods, so the different approaches should produce the same values, but even so there remain statistical discrepancies arising from the complexity of the data or missing information.

The national accounts divide the economy into four sectors: businesses, households and institutions, governments, and the foreign sector. Using the product approach, we add up the final goods and services produced by all businesses, households and institutions, and governments. As you might guess, using the product approach we

discover that the business sector produces most of the marketed final goods and service in the economy (75 percent in 2011 for the U.S. economy). Household production, as defined in the national accounts, includes rental values and paid work in households such as maid services, child care, and gardeners. However, similar household work that is not marketed, such as people cooking their own meals or cleaning their own homes, is not included in GDP. This is one common criticism of GDP. For example, essentially the same service is produced whether members of a household clean their own home or hire someone to do it, but only in the latter case is the value of the service included in GDP.

Using the spending approach, we need to consider the foreign sector in calculating GDP. We add demands by foreigners for goods produced in the United States (exports) and subtract demand by U.S. residents and institutions for foreign goods (imports). Spending by businesses on machinery, buildings, and other goods is called **gross investment**. Governments also purchase goods and services and make investments. Using the spending approach, we find that households and institutions purchase most of the final goods and services produced in the economy (about 71 percent). The spending approach can be summarized by the equation:

$$Y = C + I + G + (X - M)$$

where Y represents GDP, C is consumer expenditures, I is business investment, G is government spending on goods and services, and $(X - M)$ is net exports (exports minus imports).

Calculating GDP using the income approach, we only include income received for production that occurs within the national boundaries. The income approach includes corporate profits and rental income as well as wages and salaries. Most of the U.S. national income, about 55 percent in 2011, is paid to workers as wages and salaries.

3.8 References

- Ackerman, Frank, and Elizabeth Stanton. 2011. "The Social Cost of Carbon." *Environmental Forum* 28(6) (November/December): 38–41.
- Bolt, Katharine, Mampite Matete, and Michael Clemens. 2002. Manual for Calculating Adjusted Net Savings, Environment Department, World Bank.

- Braun, Alejandro Adler. 2009. "gross National Happiness in Bhutan: A Living Example of an Alternative Approach to Progress." Wharton International Research Experience, September 24.
- Centre for Bhutan Studies (CBS). 2011. www.grossnationalhappiness.com.
- Dietz, Simon, and Eric Neumayer. 2006. "Weak and Strong Sustainability in the SEEA: Concepts and Measurement."
- *Ecological Economics* 61(4): 617–626.
- El Serafy, Salah. 1997. "green Accounting and Economic Policy," *Ecological Economics* 21(3): 217–229.
- El Serafy, Salah. 2013. *Macroeconomics and the Environment: Essays on Green Accounting*. Cheltenham, UK: Edward Elgar.
- European Commission, food and Agriculture Organization, International Monetary fund, Organization for Economic Cooperation and Development, United Nations, and World Bank. 2012. *System of Environmental-Economic Accounting: Central Framework*. goossens, Yanne. 2007. "Alternative Progress Indicators to gross Domestic Product (gDP) as a Means Towards Sustainable Development." Policy Department, Economic and Scientific Policy, European Parliament, Report IP/A/ENVI/ST/2007–10. gundimeda, Haripriya, Pavan Sukhdev, Rajiv K. Sinha, and Sanjeev Sanyal. 2007. "Natural Resource Accounting for
- Indian States—Illustrating the Case of forest Resources." *Ecological Economics* 61(4): 635–649.
- Harris, Jonathan M., Timothy A. Wise, Kevin P. gallagher, and Neva R. goodwin, eds. 2001. *A Survey of Sustainable Development: Social and Economic Dimensions*. Washington, DC: Island Press.
- Hecht, Joy E. 2007. "National Environmental Accounting: A Practical Introduction." *International Review of Environmental and Resource Economics* 1(1): 3–66.
- McDonald, garry, Vicky forgie, Yanjiao Zhang, Robbie Andrew, and Nicola Smith. 2009. *A Genuine Progress Indicator for the Auckland Region*. Auckland Regional Council and New Zealand Centre for Ecological Economics.

- Ministry of Sustainable Development (Sweden). 2006. "Strategic Challenges: A further Elaboration of the Swedish Strategy for Sustainable Development." government Communication 2005/06:126.
- New Economics foundation. 2009. "The (Un)Happy Planet Index 2.0." www.neweconomics.org. Office for National Statistics. 2011. *UK Environmental Accounts 2011*. Statistical Bulletin, June 29.
- Organization for Economic Cooperation and Development (OECD). 2011. "How's Life? Measuring Well-Being." Paris. Posner, Stephen M., and Robert Costanza. 2011. "A Summary of ISEW and gPI Studies at Multiple Scales and New
- Estimates for Baltimore City, County, and the State of Maryland." *Ecological Economics* 70:1972–1980. www.green.maryland.gov/mdgpi/mdgpioverview.asp.
- Press, Eyal. 2011. "The Sarkozy-Stiglitz Commission's Quest to get Beyond GDP." *The Nation*, May 2.
- Repetto, Robert, et al. 1989. *Accounts Overdue: Natural Resource Depreciation in Costa Rica*. Washington, DC: WorldResources Institute.
- Skånberg, Kristian. 2001. "Constructing a Partially Environmentally Adjusted Net Domestic Product for Sweden 1993 and 1997." National Institute of Economic Research, Stockholm, Sweden.
- Smith, Robert. 2007. "Development of the SEEA 2003 and Its Implementation." *Ecological Economics* 61(4): 592–599. Statistics Sweden. 2007. "Sustainable Development Indicators Based on Environmental Accounts."
- Stiglitz, Joseph E., Amartya Sen, and Jean-Paul fitoussi. 2009. *Report by the Commission on the Measurement of Eco- nomic Performance and Social Progress*. www.stiglitz-sen-fitoussi.fr/en/index.htm.
- Talberth, John, Clifford Cobb, and Noah Slattery. 2007. *The Genuine Progress Indicator 2006: A Tool for Sustainable Development*. Redefining Progress.
- United Nations. 2011. *Human Development Report 2011*. Sustainability and Equity: A Better future for All, United Nations Development Programme, New York.

- United Nations, European Commission, International Monetary fund, OECD, and World Bank. 2003. *Integrated Environmental and Economic Accounting 2003*.
- World Bank. 2012. Adjusted Net Saving website, <http://go.worldbank.org/3AWKN2ZOY0>.
- World Bank and State Environmental Protection Agency (World Bank and SEPA), People's Republic of China. 2007. "Cost of Pollution in China," Rural Development, Natural Resources and Environment Management Unit, East Asia and Pacific Region, World Bank, Washington, DC.

- **WEB SITES**

- **www.beyond-gdp.eu/index.html**. The Web site for "Beyond GDP," an initiative to develop national indicators that incorporate environmental and social concerns. The project is sponsored by the European Union, the Club of Rome, the WWF, and the OECD.
- **<http://go.worldbank.org/3AWKN2ZOY0/>**. The World Bank's Adjusted Net Saving Web site, which includes detailed data at the country level.
- **www.green.maryland.gov/mdgpi/index.asp**. The Web site for the state of Maryland's calculation of its genuine Progress Indicator.
- **www.oecdbetterlifeindex.org**. The Web site for the OECD's Better Life Index. Note that you can adjust the weights applied to each dimension to create your own version of the BLI.
- **www.mir.scb.se/Eng_Default.htm**. The Web site for environmental accounts in Sweden.

Unit-4: Techniques of Environmental Valuation

Unit Structure

4.0 Learning objectives

4.1 Introduction

4.2 Environmental valuation as an economic and policy practice

4.3 Cost Benefit Analysis

4.4. Stated or Expressed Preference Methods:

4.4.1. Contingent Valuation Method (CVM)

4.4.2. Attributed-based discrete choice stated preference experiments:

4.5. The Revealed Preference Methods

4.5.1 Cost-Based Approach

4.5.2 Dose-Response Method

4.5.3 Travel-Cost Method

4.5.4. Hedonic pricing method

4.5.5 Preventive Expenditure Method

4.6 Summary

4.0 Learning objectives

After completion of this unit, you would be able to

- Assess environmental valuation as an economic and policy practice.
- Identify the various methods of environmental valuation
- Explain the concept of cost-benefit analysis
- analyze the various techniques of environmental valuation
- Understand the relative use of various methods of environmental valuation

4.1 Introduction

In the previous unit, you have learned the value of nature and environment and the concept of national resource accounting along with the valuation in development decision making. The role of economics in managing the natural resources, and the environment in which they are found, has been gaining increased recognition and acceptance among policy makers. One of the key factors which accepted the role of neo-classical economics in better management of the environment is the development of environmental valuation techniques. This unit will introduce you to the concept and techniques of environmental valuation along with cost benefit analysis (CBA). You will be briefly introduced to the various environmental valuation methods. This is based on

the sources of the data used to find out the valuation for environmental goods and services. By looking at actual performance of organizations, these methods of environmental valuation extract the values for environmental goods and services.

4.2 Environmental valuation as an economic and policy practice

The economic principles for economic management are used relatively more by the developed countries than the developing economies. Economic valuation studies play a key role in the environmental management wherein economic principles are used. The capacity to build such studies then becomes necessary. The developing countries require proper orientation studies of environmental valuation. In the past, many economists have viewed valuation studies with doubt and uncertainty. This is especially the case when it comes to 'stated preference techniques'. One of the reasons for this uncertainty is bad application. The credibility of the valuation studies can be improved by understanding the welfare economics foundation and application of rigorous quantitative analysis.

Environmental issues are gradually becoming more and more significant in the society not only at the political and policy making level but also being reflected in the regulation and law making. More particularly, the environmental values are used in cost-benefit analysis and are carried out to analyze and appraise their contribution to the society's welfare. Many organizations have based environmental procedures and guidelines for projects in public sector units and have accepted and adopted the use of the economic values to notify environmental decision making. These projects emphasize upon the need for environmental valuation and cost benefit. Environmental valuation is by and by becoming more significant aspect of decision making with the crucial link between environmental assets and their economy. Not only the developed countries but the developing countries too are realizing its significance.

Environmental valuation procedures and guidelines have thus become a vital part of development process. This initiation of environmental valuation procedures has been taken by the multilateral agencies such as the World Bank. Such valuation exercises that are transparent and provide information to the policymakers are considered a valuable approach to resource and environment management. Multiple issues are

taken into account while making decisions on the feasibility and desirability of projects and policies. Multiple criteria are actually considered.

4.3 Cost Benefit Analysis

So long as the environment can be valued on monetary terms, various costs and benefits are compared in a common unit of account through a methodology known as CBA or **Cost benefit analysis**. Earlier only conventional objectives like that of income, jobs and economic growth were examined but CBA applications now include a wide range of societal benefits for example, the quality of life, cultural value and equity, too. When economic value is assigned to environment and other non marketable goods and services such as the quality of life or the culture in the society, it may seem unsuitable in the beginning but it must be realized that it is a **very logical approach** to bring out better informed decisions in terms of economic outcomes. It is also asserted that when environment is valued, then environmental issues are assigned more weight which influences the decision making. An effective means to communicate the significance of environmental issues is to express the environmental change in terms of money. In this ever evolving policy situation, these projects and new policy schemes are turning out to be more and more complex.

In the absence of a well organized lobby or access to legal and technical advisors, many of the groups of the society get restricted to decision making process. In such cases, this non market valuation and CBA provides weights to those interests groups of the society. Several policy analyses are examples of this which go on to weigh up the costs and benefits of the policy choices which are being confronted.

It is very much expected that the goods which do not have a price are either overused or degraded. A glaring example of it is **the use of atmosphere** where the waste gases are disposed off. Thus the demand for prices seems judicious as it may help to reflect the preferences of the society. For this, the economists have devised a range of techniques and methods to put the economic values on non marketable environmental goods and services in order to include them completely in Cost benefit analysis. Looking at the past, it has been noticed that the environmental concerns have not been adequately addressed as they have not been accounted in CBA. As a result, when decisions were made and development planning formulated, they were not taken into account.

We have discussed the driving force for drawing out an economic value for environmental assets. We require the understanding of the basic tenets of various significant techniques which may tell the value that the individuals attach to the specific environmental assets.

The following methods are used for environmental valuation:

(A) Stated or Expressed Preference Methods:

- a. Contingent Valuation Method (CVM)
 1. trade-off game method,
 2. costless-choice method,
 3. Delphi method
- b. Attributed-based discrete choice stated preference experiments

(B) The Revealed Preference Methods:

1. Cost based approach
 - a. Opportunity Cost Method
 - b. Relocation Cost Method
 - c. Replacement Cost Method
2. Dose-Response Method
 - a. The effect on productivity and
 - b. human capital
3. travel- cost method,
4. Hedonic price method
5. Preventive Expenditure Method
6. Property-value Method
7. Wage differential method

4.4. Stated or Expressed Preference Methods:

These methods obtain measurements of value through individual reaction to hypothetical questions that, directly or indirectly, ask consumers to state their willingness to accept or willingness to pay (WTA or WTP) for an environmental change.¹ There are two major methods under expressed preference method.

¹ Zanni, Alberto M and Laurence Smith (2014): Environmental Valuation: Theory, Techniques and Application <https://www.soas.ac.uk/cedep/ipa/file60544.pdf>

a. Contingent Valuation Method (CVM)**b. Attributed-based discrete choice stated preference experiments****4.4.1. Contingent Valuation Method (CVM)**

The stated (or expressed) preference approach, usually referred to as the contingent valuation method (CVM), consists of directly asking individuals, the value they attach to environmental attributes, and to directly state their preferences towards environmental changes. In this method, individuals are asked to reveal their WTA or WTP for a imaginary change that may have taken in the environment, subject to the specific situation indicated in the survey instrument.

CVM, originally proposed by **Davis** (1963), has been generally used for assisting public decision-making in order to evaluate projects or programs involving positive environmental changes. Examples include:

- investigations carried out to estimate the benefits, individuals attributed to air pollution abatement in urban areas;
- to reduced health risks from water contaminants;
- to protection of wilderness areas and
- When official records of property transactions are not available (or they do not provide reliable) information may be collected from estate agents

Survey-based techniques are generally considered to be the examples of contingent valuation method. Once an appropriate survey instrument (questionnaire) has been prepared - and pretested, individuals' 'bids' are obtained either by face-to-face interviewing, telephone interviewing, or mail surveys. *Face-to-face interviewing is generally considered the preferable way to conduct a CVM survey.* Telephone and mail surveys are cheaper, but suffer from various potential drawbacks

This method puts questions in a direct form to the individuals so as to determine how *much they might be keen to pay* for environmental resources and if they are deprived from those resources, how much compensation they would be eager to accept.. *This method is more effective* when the respondents are familiar with the environmental good or service and have adequate information on which to base their preferences.

Trade-off game method, costless-choice method, and Delphi method are elements of contingent valuation approach.

Application of CVM: CVM has also been applied, for environmental damage assessments, though not that frequently. The interest in CVM has increased over time. The main potential advantage of CVM consists of its potential ability to provide estimates of both use and non-use values, and, using a different taxonomy, of both 'direct-use' and 'passive-use' values.

Some technical debate over CVM:

There is a debate as to whether or not non use values or rather the passive use values should be considered in decision making, whether they should be monetized or left to the 'political arena'. But much of the technical debate over CVM has focused on the survey design, and on the economic criteria which the results of a CVM application should meet. One of the best known and cited applications of CVM for damage assessments is the study concerning the 1989 Exxon Valdez oil spill. Available evidence shows that CVM estimates tend to be lower for quasi-public goods, such as outdoor recreation.

Strategic bias: Strategic bias has been one of the particular sources of concern in the CVM literature. This bias may result because the environmental changes for which respondents are required to state their bids often hold quasi public/public features. Consequently, as the effects of these changes cannot be excluded or ignored, the respondents may adopt a behaviour in the form of a 'free-riding' attitude. To avoid, minimize, or control the effects of free-riding attitude, setting up the 'hypothetical market' have been designed. It has been noted recently that CVM studies have become less prone to strategic behaviour than was once believed.

Cost of CVM applications:

As we have come to understand the basics of CVM applications, its benefits and the technical debate on it, it is worth to draw the attention to the cost of CVM applications as well as the on the impacts that resource constraints could have on carrying out a proper valuation exercise. Although the critics believe that CVM is an easy as well as a minor task to ask what the individuals would be willing to pay for a good, it must be understood that a reliable CV survey is neither simple nor economical to execute. The key objective in terms of methodological development should shift to try to determine

how to reduce the cost of conducting CV studies while still maintaining most of the quality. Development and research is crucial in these areas.

4.4.2. Attributed-based discrete choice stated preference experiments:

In this technique, the individuals are asked to convey their preferences for various imaginary situations, described by various attributes presented at different magnitude levels.

Finally, there is **benefit transfer technique**. Here the valuations estimated for one application are transferred for usage in another application. Benefit transfer methods have gained popularity because they allow the completion of such studies at a relatively lower cost.

The demand for environmental goods is measured by examining the expressed preference of the individuals for these goods as compared to their demand for other goods and services. These methods or techniques do not consider the requirement to find a complementary good or a substitute good and hence estimate how much an individual values an environmental good in an implicit form. Whereas expressed preference techniques are explicit technique forms which ask individuals clearly as to how much they value an environmental good.

4.5. The Revealed Preference Methods

We have provided an overview of valuation techniques exploiting the stated (or expressed) preference approach, usually referred to as the contingent valuation method (CVM), which consist of explicitly asking what value the individuals attach to environmental attributes, and thus to directly state their preferences towards occurring environmental changes. Now we are in a position to explain revealed preference approach. It is an approach towards some marketed good, with a connection to the (non-marketed) environmental attribute(s) of interest, in order to gain insights about the latter's economic value.

A basic difference between CVM and revealed preference techniques is that while CVM is potentially capable of holding the values derived from environmental attributes having quasi-public/public features, which are not revealed by observable market behaviour, (i.e., generally speaking, passive use values), revealed preference

techniques measure only environmental services' values which can be inferred by looking at other related marketed goods (i.e., generally speaking, direct-use values). The demand for environmental goods can be estimated by examining the purchases of related goods in the private market place.

Both the Revealed and Stated preference methods vary mainly in terms of the data source that they make use of. Some other differences between the two methods: while Revealed methods can be used for drawing out use values, stated preferences are for non-use values. The existing values do not relate either to current or future use of the resource; so it becomes quite difficult to combine these values into an environmental valuation framework which forms its basis on human preference revelation.

The choice as to which method should be used normally relies on the resources and data availability. In theoretical terms, stated preference methods use Hicksian demand curves and thus yield compensating and equivalent measures of welfare; while revealed preference methods yield *Marshallian* demand curves and as a result changes in the Consumer Surplus measure.

4.5.1 Cost-Based Approach

These methods rely on actual or potential cost which is incurred by the consumers. This is linked to desired or undesired environmental change. Various techniques, under the 'cost-based approaches' are applied to estimate the social rate of return of projects so that the impacts of the actual changes in damage assessment cases can be assessed. Broadly speaking, these techniques can be classified according to:

- the nature of environmental changes;
- the effects of such changes;
- the individuals' ability to react to them; and
- the nature of the reactive actions.

Following are the methods under the cost based approach:

a. Opportunity Cost Method:

This method values the benefits of environmental protection in form of what is being sacrificed for it. What is foregone becomes the basis of the compensation payments. This is in fact a return for the compulsory purchase of land and property by the government under existing laws. Further, on behalf of the society, the government

must compensate the owner to restrict the rights that the landlord or the owner has over the property.

Usefulness of the opportunity cost method: In such situations, where it is difficult to count the merits of an environmental change, this method finds its utility. For example, instead of comparing the benefits of various alternative schemes and choosing among them, this method enumerates the opportunity costs of those foregone developments that is associated with each scheme and then going for that option which has the lowest opportunity cost.

The opportunity cost method *does not consider non-marketed public good values of land*. This attempts to minimize external bads through development control. Thus, planning controls seek to conserve the amenity benefits by confining the development of land. However, imposing such restrictions accrues a lower financial value than its opportunity cost value.

b. Averting behavior and Relocation cost approach:

This cost-based technique is *used to estimate the monetary value of environmental harm*. It is based on the probable costs of relocating a physical facility that would be harmed by an alteration in environmental quality. This technique of cost based approach exploits individuals' willingness-to-pay for reducing the effects of negative environmental changes. This will help in inferring the quality of the environment. Individuals are able to react to changes in the environment. For example, to reduce or nullify the health effects of rising water pollution, households may go for averting expenditures like buying bottled mineral water, or using time and energy to boil water, or getting hold of water treatment equipment.

This method relies on data on potential expenditures.

c. Replacement Cost Method:

This Cost-based technique also measures those prospective expenditures which ***reinstates or restores a productive asset*** that is devastated by some project. These costs are then compared to those costs which is made in preventing the damage from occurring and then to decide which cost is more efficient. For example, acid rain affects adversely the infrastructure of the nation like highways, bridges and historic monuments. Suppose such a nation passes a bill to reduce the emissions of acid rain precursors by 50 percent. For the sake of simplicity, we assume that all such sources of these pollutants do emerge from within the nation's boundary. One noticeable

outcome of such a legislative directive is to slow down the deterioration of the nation's physical infrastructure. Measuring this benefit through the replacement cost approach is by assessing the savings that is realized from reduced expenditures on repairing, restoring and replacing the infrastructure of the nation.

The cost of replacement may be used as a substitute for the environmental damage. We then assume that the merits from the original resources are at least as important as the replacement expenses. This approach is used as a benefit measure when the damage that has been avoided as a result of improved environmental conditions can be approximated by the market value. This has naturally incurred a cost to restore a damage that had occurred.

Shadow Project: A shadow project is generally designed specially to compensate the environmental damage that another project causes to it. For example, if the original project had been a dam that flooded some forest land, then the shadow project is involved where there is reforestation of that same area of forest. It values an environment good by the cost which is incurred in restoring that environment to its original state after it has been damaged.

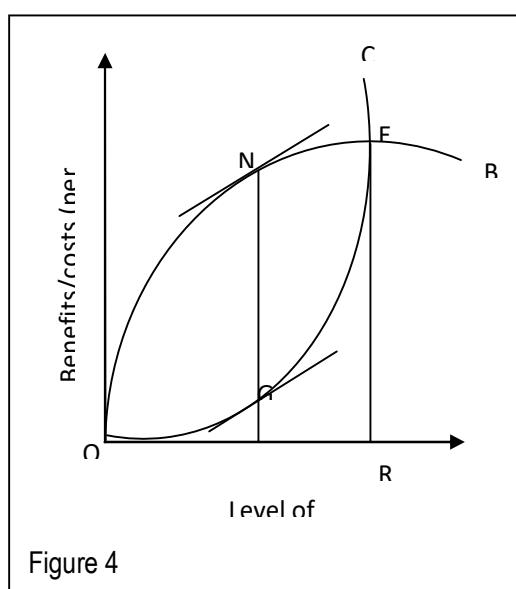


Figure 4

In Figure 4, on the vertical axis, the benefits and costs per unit are taken, while on the horizontal axis, there is the level of restoration. The restoration level implies that the lost environmental good need be replaced. The slope of curve B indicates that as restoration level is increased, there the increase in benefit decreases.

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

To avoid environmental damage, it explains people's willingness to pay to an extent where the reduction in replacement and restoration costs closely reflects the willingness to pay of the people. In some cases, environmental damage may not be completely repaired or replicated. Even if it could be, *compared to the original, the replicas would probably be of little worth*. For this reason, one should be careful while using this approach.

Merits: Despite this apparent weakness, the replacement cost approach is quite appealing because it is generally easy to find estimates of replacement costs. This approach was used to estimate the cost of recovering and replacing eroded soil from an agricultural project in Korea. In this case study by Dixon and Hufschmidt in 1986, the productive asset was the soil that was damaged in the upland areas. The costs of physically replacing lost soil and nutrients were used as a benchmark by which to measure the replacement costs.

4.5.2 Dose-Response Method

These are methods which rely on the analysis of the relationship between environmental factors and markets in physical form. The two examples of these methods are : *The effect on productivity and human capital*

Dose-response relationships are perhaps the most familiar valuation techniques. Notable examples include the valuation of health damage. Because of air pollution, a kind of morbidity prevails, and this can be further be linked to days lost from work. These days which are lost can be valued most probably through a market wage rate. The main effort of the analysis is concerned in identifying the link between dose and its response.

a. EFFECT ON PRODUCTIVITY OR THE PRODUCTION-FUNCTION METHOD

The production-function method (also known as 'change-in-productivity approach', 'effect on production approach', or '*valuing the environment as an input*') seeks to exploit the relationship between environmental attributes and the output level of an economic activity.

It is based on the assumption that when an environmental attribute enters a firm's production function, economic impacts due to environmental changes may be measured by observing the effect on production, and by valuing such effect at market

output prices. The money estimates obtained here is not the true measure value but is taken as a proxy of the environmental change's ultimate welfare impacts.

According to Barbier (1998), as many production systems in most of the developing countries have a direct dependence on natural resources and ecological functions, this approach has a wide applications to many important economic and investment decisions in these countries. The approach has been widely used, particularly to evaluate the impacts of environmental quality changes (e.g. acid rain or water pollution) upon agriculture and fisheries. Other examples of application include analysis of the impacts of water diversion and the valuation of the protection benefits provided by coastal wetlands against hurricane damage. Applications of the production function approach may be slightly problematic because of the problems of double counting and trade-offs between the different values and thus assumptions concerning the ecological relationships must be carefully constructed.

The PFA consists of a two-step procedure.

- ✓ *The aim of the first one is to identify the physical impacts of environmental changes on a production activity. For this, a well built cooperation is required between natural scientists, economists and other researchers to determine the nature of the environment-production linkages.*
- ✓ *The second step consists of valuing these changes in the output of the concerned activity..*

The PFA appears equivalent to some of the cost based methods when costs are incurred to acquire additional inputs so that the impacts of environmental changes on a firm's output can be lessened. However, various quantitative methods have been used to estimate the economic costs (or benefits) of environmental changes affecting production activities. Following Hanley and Spash (1993), these methods can be classified as follows:

- i. 'traditional' type models (or 'historical approach')
- ii. optimization models
- iii. econometric models

Of the three methods, the *traditional method* is quite simple as the informational requirements are relatively modest. *The optimization models* require extensive data sets, but provide more detailed information, and consider the indirect effects. Finally, *econometric models* do not adopt a normative approach, but, by using observable

data, and their variations over space or time (or both), try to get factual evidence. Scientific and statistical methods are rigorously applied to examine the results. This makes the work objective rather than subjective.

b. COST OF ILLNESS AND HUMAN CAPITAL APPROACH:

The cost-of-illness method has been quite frequently used to estimate the welfare effects associated to environmental changes involving changes in the level of morbidity. The method can be applied when environmental changes have repercussions on human health and when (it is assumed that) individuals are unable to react, i.e. when they may not undertake defensive actions to reduce health risks. In these cases, the costs (benefits) of an increased (decreased) level of pollution can be estimated by using information on:

(i) the relationship between environmental quality changes and changes in the level of morbidity; and

(ii) the economic costs (benefits) associated with changes in the level of morbidity.

This method is intrinsically unable to evaluate the welfare effects of environmental changes.

The so-called human-capital approach is an extension of the cost-of-illness method.

This approach entails an estimation of the value of human life and thus becomes a little problematic. It values environmental attributes through their effects on the quantity and quality of labour. The principle involved in this approach is to value the life in terms of valuing labour. Given sufficient data regarding lifetime earnings etc. it is possible that estimation of the expected future earnings value of individuals belonging to any age- group can be made.

On the assumption that wage rates are an indicator of productivity, the same measure can be used as a measure of the value of the future output of the individual to society. This type of valuation system is the commonly found.

But, besides the difficulty in predicting the expected life-time earnings, reducing the value of life to individuals' expected productivity is extremely controversial, and some agencies have recommended not using this approach.

The merit of the dose response and cost based approaches is that they offer to the analysts and the policy makers, a simple way of assigning a value to the environmental goods. This is relatively more useful in case when the information is scarce. They

render an effective help to decision making and form the basis of designing the environmental policies. The limitation of these methods is that they have restricted capacity to produce theoretically yielding welfare measures.

There are also a number of revealed preference methods such as *travel-cost method, hedonic price method, preventive expenditure and property value method*.

4.5.3 Travel-Cost Method

The travel-cost method is a widely used proxy market approach. In order to derive a demand curve for a recreational site, this method depends on information based on time and travel costs. This curve in turn, is used to estimate the consumers' surplus or we can say it helps to calculate the value of the site to all users. Thus, a combination of surveys and information from surrogate markets is used to estimate willingness to pay (WTP) for activities and related amenities in areas which have environmental significance. This approach is widely used to value environmental attributes or the recreational benefits of public parks as well as other natural areas.

A simple intuition underlies the travel cost method or TCM. The recreation site may have a free entry but the individuals who are willing to enjoy the environmental attributes have to incur the economic costs. This economic cost is in the form of the expenditure on travel beside the time taken out to reach the site of recreation. The TCM infers the demand for the site by taking into account the total cost to reach the recreation site. Thus, this method seeks to determine the demand for a recreational site as a function of many variables like price, income of the visitors, and socio-economic characteristics. The sum of entry fees to the site is usually the price which also includes cost of travel as well as the opportunity cost of time spent. The consumers' surplus which is associated with the demand curve presents an estimation of the value of the site of the recreation.

Thus the relationship between the cost of visiting a recreation site and the number of visits observed is well identified. The benefit of the visitor can be calculated by using the visitors' consumer surplus, as a welfare measure i.e. the benefit visitors enjoy above the costs involved in carrying out the recreational activity. **The TCM is taken as a special case of the production function approach**. In fact, as a firm may combine environmental goods with other purchased inputs to produce marketable commodities,

while to acquire recreation services, households may get utility by combining environmental attributes with other economic goods.

The travel-cost method is explained in Figure 1. Suppose, in a city, there is only one lake whose entry fee is OP per visit. Initially, recreational demand for the lake is shown by the demand curve BD_0 and the environmental quantity level is E_0 .

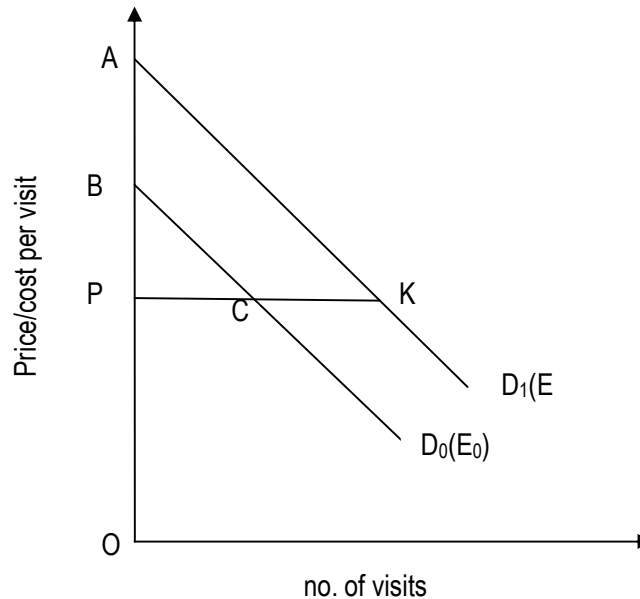


Fig 1

With an improvement in environmental quality of lake, the demand curve will shift outward as AD_1 and environmental quality level shifts to E_1 . This effect will bring an increase in the number of visits to PK. The gain in consumers' surplus is equal to the area PAK. The net gain in consumers' surplus after improvement in environmental quality of the lake is shown by ABCK. ($=PAK - PBC$)

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

Traditionally, TCM studies assumed the number of trips as a function of travel cost.

No. of trips = f (travel cost)

The travel cost is proportional to distance from the site. Moreover, a **single-purpose trip** has been frequently assumed. *All these assumptions are "often valid in the case of tourism within a country but may not be valid for international tourism"* (World Bank, 1998, p.9). This single purpose trip model has a major drawback. First, it is their

inability to account for substitution among recreation sites and the other is their inability to determine the importance of individual site characteristics. If the travel cost for the single site increases, the presence of substitutes would tempt people to visit other sites, rather than doing away with the recreation altogether. But this single site model does not incorporate the substitution in a meaningful way.

To overcome these drawbacks of the single site model, multiple site models have been developed. Problems may arise only when a valuation study is aimed to measure the value of negative environmental change rather than assessing the value of a natural resource. TCM has been widely used both in the developing and developed countries to evaluate the use-value (recreational use value) of natural assets.

Criticisms of TCM:

1. This approach is most successful only where there is a wide variation in the travel cost of various users and where the primary objective of visits is recreation. But demand estimates gets twisted when there are wide variations in tastes and preferences.
2. The travel-cost method is of limited value when the problem of congestion exists. This method is not appropriate to evaluate small changes that affect the recreational quality.
3. The basic assumption of travel-cost method is that consumers consider the increase in admission fees as a rise in travel cost. This is subject to question.
4. This technique assumes constancy of the recreational quality at the prevailing admission fee which is basically hypothetical.
5. Bateman holds the view that this method measures only the use value of recreation sites.
6. This method is not capable of producing any total economic value estimation as it cannot estimate non-use items, only use value items.

4.5.4. Hedonic pricing method

The method may be traced back to the characteristics theory of value developed by Lancaster (1966), which relies on the proposition that an individual's utility for a good is based on its attributes. The consumers postulate that every good provides a bundle of characteristics or attributes. With the help of the use of the housing and land markets, this method values the environmental quality as well as health quality,

In the case of housing, besides basic structural and amenity characteristics, these attributes only also include environmental characteristics such as clean air, landscape etc. It controls the non-governmental characteristics which has an effect on the demand for housing and allows the implicit price that individuals are willing to pay so as to consume the environmental characteristics associated with the estimated house. Thus, the hedonic method provides an appropriate way of estimating the change in amenity benefits. It has become a well-established technique for estimating the various attributes of the goods.

The demand for goods like housing can thus be considered as a derived demand. The price of a house is determined by a host of factors like structural characteristics, and the environmental characteristics of the area, etc.

This method attempts to identify how much of a difference in property is due to a particular environmental difference, and how much people are willing to pay for an improvement in the environmental quality that they face and what the social value of that improvement is.

There is a positive relation between air quality and property price as shown in Figure 2. The figure indicates that housing prices increase with improvement in the air quality.

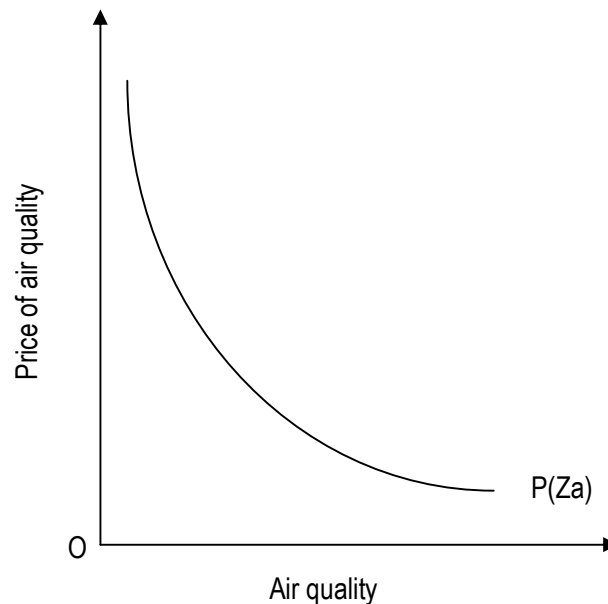


Fig 2

Assumptions:

The basic assumption of the hedonic price method is that the property price is related to the number of merits. The method is based on the hypothesis that the individuals

pay the prices for commodities having both environmental as well as non-environmental characteristics. Hedonic prices are thus the implicit prices that reflect the environmental attributes of the property.

Another assumption herein is that the individual's choice for a particular job may be affected by the environmental conditions of the surrounding where the property is located.

Basic steps:

A hedonic study may be conducted through following steps:

The first one is selecting the environmental variable(s) and then deciding the marketed good whose price is expected to provide information about the implicit environmental value(s). As far as the dependent variable is concerned, for property valuation studies, either purchase or rental data may be used, depending on data availability, data quality, and market conditions.

While the first step is to select the environmental variable, the second step consists of identifying all other explanatory variables which, together with the environmental variable (ENV) are thought to describe the property's attributes. It is potentially crucial to choose a relevant attribute.

Applications of the hedonic method:

There are many applications of the hedonic method which explore the interlinkages between environmental conditions and the prices of other assets. In particular, various applications such as trying to infer the value of environmental services e.g. fertility or access to water facilities may be found too.

Hedonic price valuation tries to measure the value of an unmarketed environmental service considering it as a measurable component of a marketed good due to its 'attribute' or 'characteristic'. The most common application of the hedonic pricing method (HPM) is exploiting the relationship between property values and environmental attributes of the neighbourhood areas. The environmental attributes comprise of air quality, noise levels, access to recreational facilities, visual amenities, etc. The hedonic Pricing method is simply not confined to the property value approach but is also applicable to labour market and wage rates. This is thus popularly known as the wage differential approach.

Examples which include the hedonic studies conducted by Miranowski and Hammes (1984) and Ervin and Mill (1985) in the United States are to explore the effects of soil

quality and erosion on cropland values. Various wage-risk studies which have been conducted in the developed world is also considered. Examples include lethal or non-lethal risks related to skin cancer (ozone layer), radiation concentration, soil pollution (toxic wastes), and nuclear accidents.

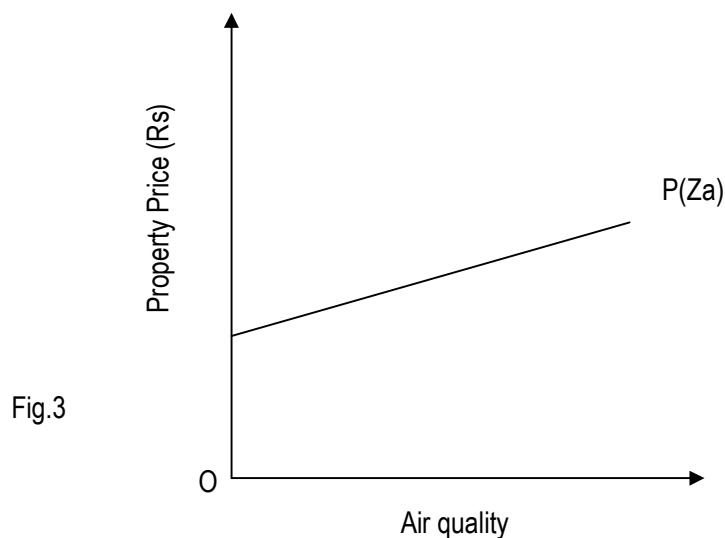


Fig.3

Figure.3

indicates that prior to the marginal change, the inherent marginal purchase price of Z_a (air quality) vary according to the ambient level (Z_a)².

Criticisms:

1. This method holds no significance when it deals with various types of public goods such as defence, air pollution, etc.
2. The hedonic price method may evaluate the environmental benefits being provided to local residents but cannot predict the benefits that will be produced in future
3. Another problem is the individual's perceptions and its property purchase decisions are based upon actual levels of pollution and environmental quality. If expectations are not the same as present pollution estimation shows, then there would be problems related to values with purchases.

² Methods Used for the Environmental Valuation,
www.yourarticlelibrary.com/economics/environmental-economics/methods-used-for-the-environmental-valuation-with-diagram/39686

4. Moreover, the expectations with respect to future environmental quality may get biased to the present purchases and may take it away from that level of present characteristic levels.
5. This method has been criticized for making the implicit assumption that households continually re-evaluate their choice of location.
6. Further, for spatially large study areas there is considerable doubt that such an assumption can hold. The results of this method will be biased if people cluster for social or transportation reasons.

The hedonic price equation is expected to be non-linear, because *“house buyers cannot treat individual housing attributes as discrete items for which they can pick and mix until their desired combination of characteristics is found.”*

4.5.5 Preventive Expenditure Method

The preventive expenditure method is a cost based valuation method which uses data on actual expenditures made to lessen all environmental problems. Often, costs may be incurred to reduce the damage caused by an undesirable impact on the environment. For example, if drinking water is polluted, extra purification may be needed. This is an example of the preventive expenditure.

In the preventive expenditure method, the value of the environment is derived from the expenditure that people make to prevent its degradation. This method involves a monetary value for an environmental externality. The costs that people are prepared to make are taken into account to avoid any harmful effects. For example, additional transportation costs are incurred both in terms of money as well as time when the movement is made from a less polluted area to a distant area from the workplace. These methods are again, conceptually closely linked.

These methods assess the value of non-marketed commodities such as cleaner air and water, through the amount individuals are willing to pay for market goods and services to reduce an environmental externality. They also wish to prevent a loss of utility from the degradation of the environment.

4.6 Summary

Environmental valuation is by and by becoming more significant aspect of decision making with the crucial link between environmental assets and their economy. When economic principles are used for environmental management, economic valuation studies are conducted. The environmental values are used in cost-benefit analysis and

are carried out to analyze and appraise their contribution to the society's welfare. Cost benefit analysis is a very logical approach to bring out better informed decisions in terms of economic outcomes. Stated or Expressed Preference Methods are related to solicit the individuals clearly as to how much they value an environmental good. The two major methods under it are - Contingent Valuation Method and attributed-based discrete choice stated preference experiments. Survey-based techniques on a general parlance are examples of contingent valuation method. Trade-off game method, costless-choice method, and Delphi method are parts of contingent valuation approach. Revealed preference approach is an approach towards some marketed good, with a connection to the non-marketed environmental attribute(s) of interest, in order to gain insights about the latter's economic value. Both the Revealed and Stated preference methods vary mainly grounds of the source of the data that they make use of. The Travel cost method, one of the types of revealed preference methods, infers the demand for the site by taking into account the total cost to reach the recreation site. The hedonic Pricing method is not confined to the property value approach but is also applicable to labour market and wage rate therefore also known as the wage differential approach. The preventive expenditure method is a cost based valuation technique that uses data on actual expenditures and not potential ones to minimize all environmental problems.

Various techniques, falling within the broad class of 'cost-based approaches' have been applied to estimate the social rate of return of projects so as to assess the impacts of actual changes in damage assessment cases. Opportunity Cost Method values the merits of environmental protection in terms of what is being foregone to acquire it and does not consider non-marketed public good values of land. A shadow project is generally designed specifically to balance the environmental damage caused by any other project. The effect on productivity and human capital are two examples of Dose-Response Method.

4.7 References

- ✓ Alberto M Zanni and Laurence Smith (2014): Environmental Valuation: Theory, Techniques and Application , Centre for Development, Environment and Policy, <https://www.soas.ac.uk/cedep/ipa/file60544.pdf>

- ✓ Madhumita Biswas (2007): Environmental Economics, Mittal Publication, New Delhi.
- ✓ Methods Used for the Environmental Valuation,
- ✓ www.yourarticlelibrary.com/economics/environmental-economics/methods-used-for-the-environmental-valuation-with-diagram/39686
- ✓ Munansinghe Mohan (1993): Environmental issues and economic decisions in developing countries, World Development, Elsevier publications, Volume 21, Issue 11, November 1993, Pages 1729-1748
- ✓ Puja Mondal: Methods Used for the Environmental Valuation
- ✓ Rabindra N. Bhattachaya (ed. 2001): Environment Economics, OUP, NewDelhi
- ✓ Richard T. Carson, Nicholas E. Flores (2000): Contingent Valuation: Controversies And Evidence
- ✓ S.N.Prasad (2011): Environmental Economics, Pointer Publishers, New Delhi
- ✓ www.researchgate.net/publication/315808627_Environmental_Valuation_Theory_and_Applications

4.8 Suggested Readings

Ahmed Hussien (2012): Principles of Environmental Economics and Sustainability: An Integrated Economic and Ecological Approach , Routledge

Cesare Dosi (2000): Environmental Values, Valuation Methods, and Natural Disaster Damage Assessment

Robert Adams and Christopher Essex (2009): Valuation and Cost-Benefit Analysis of the Environmental Resources, Course Solution Manual " Calculus: A complete course", - Chapter 1 - 18 University, Adama Science and Technology University

4.9 Model Questions

Explain the difference between Expressed Preference Methods and Revealed preference methods

What is the basic difference between contingent valuation method and revealed preference techniques?

Which method yields Hicksian and Marshallian demand curves?

What are the drawbacks of travel cost method? How can they be overcome?

What are the basic steps to undergo a hedonic study?

Give some applications of hedonic Pricing method and production function approach.

What are the problems faced under this approach?

State the merits of dose response and cost based approach.

What is a shadow project? Why should one be careful in using this approach?

Unit-5: Methodological Problems and Issues:

Unit Structure

5.0 Learning objectives

5.1: Introduction

5.2. Distribution of cost and benefit

5.3. Applications of Cost Benefit Analysis

5.3.1. Valuation

5.3.2. Discounting

5.3.3. Institutional Capture

5.3.4. Sustainability Criteria

5.3.5. Complexity of the Ecosystem

5.3.6. Ethical Concern

5.0 Learning objectives

After studying this unit you are able to understand about:

- Distribution of cost and benefit;
- Applications of Cost benefit analysis;
- valuation
- Discounting
- Sustainability
- Complexity of the Ecosystem

5.1: Introduction

Economists have long been intrigued by the problem of how to decide whether one outcome is better than the other from the society's point of view. The branch of economics called 'Welfare Economics' was developed out of the search for an answer to the aforesaid problem. Welfare economics allows us to compare outcomes with the help of a criterion taken from the 18th century philosophy called 'Utilitarianism'. According to utilitarianism, outcomes are compared on the basis of the utility derived from them. Those outcomes that give the highest level of utility to the society as a whole are thus chosen. But, measuring each individual's utility and adding up the utility of all individuals in the society posed serious practical problems because each person's utility function may have a different functional form. Given this, the Italian

economist Pareto suggested another method of determining whether a project or government policy improved society's welfare or not. This suggestion was the idea of 'Pareto Improvement'. A Pareto Improvement is where at least one person is made better off by reallocation of resources and no one is made worse off. However, in practice, it is hard to find a resource allocation that does not impose costs on anyone. If Pareto Improvement criterion is taken literally, then that would mean that any project or government policy which makes just one person worse off should not be adopted. But practically speaking, there will always be some 'losers' who are going to become worse off as a result of a new project/policy being introduced. The solution to this problem was proposed independently, but at around the same time, by Nicholas Kaldor and John Hicks in the late 1930s. They modified the Pareto Improvement criterion to arrive at what is today known as the 'Potential Pareto Improvement' (PPI). When the gainers (those who benefit from a resource allocation) compensate the losers (those who are worse off as a result) and still remain better off, it is called 'Potential Pareto Improvement'. Since losses and costs are taken to be synonymous, as are gains and benefits, Potential Pareto Improvement criterion simply implies that any project/policy that gives aggregate benefits greater than aggregate costs should be taken up. This is nothing but carrying out 'Cost-Benefit Analysis'(CBA) of a project. To put it more formally, Cost-Benefit Analysis is a technique used for comparing projects and their feasibility. It involves comparing the total costs against the total benefits from different projects to see whether the benefits outweigh the costs and by how much. Thus, Potential Pareto Improvement provides the theoretical underpinning for using Cost-Benefit Analysis as a decision making rule. By measuring the gains as the money value of benefits, and costs as the money value of losses, the PPI criterion can be transformed into a single number, namely, the money value of the total net benefits of a project/policy. Thus, in Cost-Benefit Analysis, benefits and costs are expressed in monetary terms and are adjusted for the time value of money (costs and benefits are 'discounted'), so that all flows of benefits and flows of project costs over time (which tend to occur at different points in time) are expressed on a common basis in terms of their 'Net Present Value' (NPV). If the NPV turns out to be positive, it means the sum total of discounted benefits far exceeds the discounted costs, thereby implying that it is feasible to take up the project. To put it in other words, NPV being positive implies that the resultant resource reallocation is economically efficient and would improve the

society's welfare as a whole. If however, the NPV turns out to be negative, it means that the costs imposed by the project are greater than the resultant benefits and hence, such a project is not feasible and should not be taken up.

NOTE : Cost-Benefit Analysis differs from the Discounted Cash Flow (DCF) Analysis that is usually applied to the firms' investment decisions. While many similarities exist, the key difference is the scope of whose welfare is being considered. In DCF analysis, the scope is narrower, since only impacts of relevance are those on shareholder wealth and the way these are valued in terms of the financial implications for the firm (its profits). In CBA, the scope is much broader and the relevant impacts are those on anyone living in the society for which the cost-benefit is being carried out. These impacts are valued in terms of their social cost or social benefit, which includes costs and benefits not expressed through markets.

5.2. Distribution of cost and benefit

Stages of a Cost-Benefit Analysis

1. Project/Policy Definition

The very first step of a Cost-Benefit Analysis involves identifying exactly what is being analysed; whose welfare is being affected as a result of implementing a new project/policy and over what time period. For example, suppose the government has proposed a new sewage treatment plant for a seaside town. In this case, carrying out Cost-Benefit Analysis of the proposed project would involve identifying all those who will be affected by this project. The affected party includes the people who live in the town since they are funding the project through the taxes they pay and will also benefit from cleaner water available post the sewage treatment, plus the visitors to the beaches in town since they will also get to enjoy high quality water.

2. Identifying physical impact of the Project

Any project/policy has implications for resource allocation. Therefore, the next stage of a Cost-Benefit Analysis is to identify these outcomes in physical magnitudes. For example, if the government proposes a new tax on landfill sites as part of a waste management project, then, its immediate physical impact would be less waste being land filled and more recycled.

Once physical impacts have been identified and quantified, it is then necessary to find out which of them are relevant to the Cost-Benefit Analysis. Essentially, anything, which has an impact on the quantity or quality of resources, or on their price, maybe said to relevant if it can be traced back to a link with utility. Since we specify relevant impacts in terms of utility impacts, it is not necessary to restrict attention only to those impacts that have a market value since the non-market value changes, such as an improvement in air quality, also affect people's utility. In carrying out Cost-Benefit Analysis of a proposed environment project, it is to be particularly kept in mind that environmental effects can also make their presence felt through production links with marketed goods; for example, the effect of air pollution on farm crops.

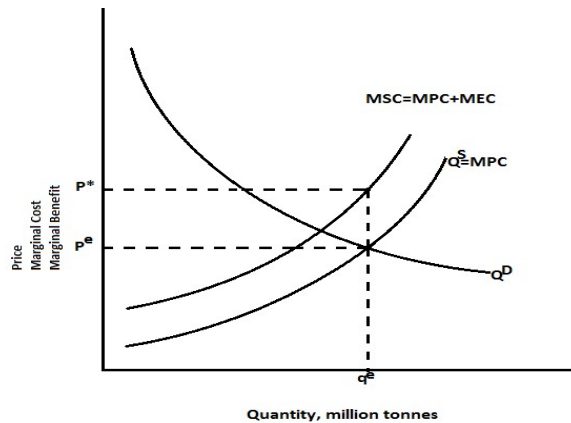
3. Valuing Impacts

Under Cost-Benefit Analysis, all the effects of a proposed project/policy are expressed in monetary values so that they can be aggregated. The general principle of monetary valuation in Cost-Benefit Analysis is to value the impacts in terms of their Marginal Social Cost (MSC) and Marginal Social Benefit (MSB). 'Social' here means that the effects of the project are seen with respect to economy as a whole. For example, consider equilibrium in the world market for coal. The demand curve shows the Marginal Willingness To Pay (WTP) of buyers of coal at a range of quantities which represents a schedule of Marginal Social Benefits (MSB). The demand curve is downward sloping because the marginal benefit from each additional unit of coal goes on declining. The supply curve shows the Marginal Private Cost (MPC) to the mine owners of producing coal. If there were no externalities in coal production, then the Marginal Social Cost (MSC) would be equal to only the Marginal Private Cost. The equilibrium market price in this case would then be determined by the intersection of MSB and MPC Curves. However, if coal mining results in external costs, then the Marginal Social Cost of Coal would be equal to the Marginal Private Cost (MPC) plus the Marginal External Cost (MEC) i.e.,

$$\text{MSC} = \text{MPC} + \text{MEC}$$

In the presence of an externality, the equilibrium price is determined by the intersection of the MSC and MSB curves. In the diagram, the marginal social cost of coal, which should be used to value coal impacts in a CBA, is shown as P*. The price P*, representing the Marginal Social Cost of coal as an input to a project, is referred to as

a Shadow Price. Shadow Prices are estimates of Marginal Social Costs/Benefits when market prices are distorted in some way, either through externalities or due to government intervention in the market. We will take up shadow prices in greater detail a little later.



MSC = Marginal social cost

MPC = Marginal private cost

MEC = Marginal external cost

Q^S = Supply curve

Q^D = Demand curve

p^* = Shadow price

4. Discounting of Cost and Benefit Flows

Once all the relevant cost and benefit flows have been identified and expressed in monetary terms it is necessary to convert them all into Present Value (PV) terms. In economics, Present Value, also known as the Present Discounted Value (PDV), describes how much a future sum of money is worth today. The Present Value is always less than or equal to the future value because money has interest-earning potential, a characteristic referred to as the time value of money. For example, suppose an individual is asked to choose between Rs.100 today and Rs. 100 in one year's time. It is likely that the more immediate sum might be preferred due to impatience. This means that a given sum of money and most kinds of benefits, are more highly valued, the sooner they are received. Similarly, a sum of money to be paid out or any kind of cost seems less troublesome the further away in time we have to bear it.

Under Cost-Benefit Analysis, all costs and benefit flows are discounted using a discount rate which is assumed to be the market rate of interest, i . The present value of a cost or benefit (X) received in time ' t ' is given as:

$$PV(X_t) = X_t [(1+i)^{-t}]$$

The expression in square brackets is known as the discount factor. Discount factors always lie between 0 and 1. The further away in time a cost or benefit occurs (the higher the value of t), the lower the discount factor. The higher the discount rate i for a given t , the lower the discount factor, since a higher discount rate means a greater preference for things now rather than later.

Discounting in Cost-Benefit Analysis is done in one of the two ways:

- a) Either by finding the net value of benefits minus costs for each time period, and discounting each of these annual net benefit flows throughout the lifetime of the project;
- b) Or by calculating discounted values for each element of a project, then summing the discounted elements.

5. Applying the Net Present Value Test

The main purpose of the Cost-Benefit Analysis is to help select projects which are efficient in terms of their use of resources. This is done using the Net Present Value Test. The Net Present Value Test entails evaluating whether the sum of discounted gains exceeds the sum of discounted losses. The Net Present Value of a project is thus:

$$NPV = \sum B_t(1+i)^{-t} - \sum C_t(1+i)^{-t}$$

where the summations run from $t=0$ (the first year of the project) to $t=T$ (last year of the project). The criterion for project acceptance is: The project will be accepted of and only if the $NPV > 0$. Based on the Potential Pareto Improvement (PPI), any project passing the NPV test is deemed to be an improvement in social welfare. If the NPV is equal to zero, then the discount rate is referred to as the Internal Rate of Return (IRR) and is interpreted as the rate of return on the resources (investment funds) used in the project. This can be compared with the opportunity cost of these investment funds,

which can be taken to be the market rate of interest. However, the IRR is not an accurate measure of resource allocation for two principle reasons:

- A. Many projects cash generate multiple IRRs from the same data set so it becomes difficult to decide which one to use as the decision making criterion.
- B. The IRR is unreliable when comparing performance across many projects in a portfolio. This is because the IRR only compares the return on one project relative to the opportunity cost of funds.

Because of these problems, we can use the Benefit-Cost ratio instead of the IRR to evaluate a given project/policy. The Benefit-Cost Ratio is simply the ratio of discounted benefits to discounted costs. In case of the Benefit-Cost ratio, the decision rules is: proceed if and only if the Benefit-Cost ratio exceeds unity.

6. Sensitivity Analysis

The NPV Test described above tells us about the relative efficiency of a given project, given the data input to the calculations. If these data change, then clearly the results of the NPV Test will also change. An essential final stage therefore of any Cost-Benefit Analysis is to conduct Sensitivity Analysis. This means recalculating NPV when the values of certain key parameters are changed. These parameters include:

- a) Discount Rate
- b) Physical quantities and qualities of inputs.
- c) Shadow Prices of these inputs.
- d) Physical quantities and qualities of outputs.
- e) Shadow Prices of these outputs.
- f) Project lifespan.

By carrying out the Sensitivity Analysis, we wish to discover to which parameters the NPV outcome is most sensitive. Once the most sensitive parameters have been identified, then (i) forecasting effort can be directed at these parameters to try to improve our best guess and; (ii) where possible, more effort can be made once the project is underway to manage these parameters carefully. The NPV decision will often depend crucially on the choice of discount rate, especially for projects with long-term effects.

5.3. Applications of Cost Benefit Analysis

CBA can be applied for appraisal of various public projects and for assessing various public policies concerning environment, education, infrastructure investment etc. In this section we will study the various problems faced while carrying out a CBA of projects related to environment.

Environment and Cost Benefit Analysis

CBA can be used to assess any environment project and policy. But its application to environment is filled with a lot of problems:

5.3.1. Valuation

For carrying out a CBA, we need to calculate (or do the valuation) of benefits and costs. But how do we value the environmental costs in monetary terms? For example: suppose a project of “constructing a dam” is taken up for CBA analysis. The costs which the society have to bear will not only be the monetary expenditure but also will be the loss of wildlife and landscape. How do we measure this loss in monetary terms? And even if we do it, using some method, would it be reliable? And is it ethical or morally correct to weigh the environment in terms of money?

So in short: estimating the value of non-market goods is the foremost problem faced while conducting CBA.

5.3.2. Discounting

To calculate the Present Value, we need a discount rate, to discount the future costs and benefits. Generally, we take the prevailing market rate of interest, as a discount rate for the marketable goods. Should we also do the same while measuring environmental benefits and costs? Will it not infringe upon the rights of future generation – the right to enjoy the scenic beauty of landscape or to witness the diverse wildlife?

The PPI criteria [which is the foundation of CBA and talks about the compensation to be paid to the losers (here the future generation) by the gainers (here the present generation)], may not hold as it is difficult to sign binding inter generation agreements. Thus maximizing Net Present Value criteria imposes potentially heavy cost on future generations.

5.3.3. Institutional Capture

Many institutions and agencies can use the CBA to produce results that suit their interests. The technical nature of CBA, makes it vulnerable and it can be misused in the name of social welfare. Any inspection by the non-experts will be futile.

5.3.4. Sustainability Criteria

Sustainable development includes both the efficient and fairness (equitable) aspect of the resource allocation. But CBA only talks about improving the efficiency of resources. Thus we cannot check the sustainability of any resource allocation by subjecting it to the CBA test. Also CBA allows for the trade-off between natural and man-made capital thus violating the strong sustainability criterion. (It says that reduction in any natural capital cannot be compensated by any increase in either human or man-made capital)

5.3.5. Complexity of the Ecosystem

One of the task under CBA is to predict the effects of any economic change on the environment. But there is a weak scientific linkage between the two. The complexity of the eco-system makes it difficult to exactly predict all the different changes or even if they are predicted, there will still be uncertainty about the probability of their occurrence. As a result, CBA must fall back on sensitivity analysis, which estimates net benefits under different known states of the world.

5.3.6. Ethical Concern

Closely related to the “valuation” problem, is the problem of ethics in using CBA for environment. There exist two schools of thought: First is the “utilitarian” view point which believes that environmental goods can be traded off for the man-made goods. They think that environment is like any other good, which is made for human consumption and thus human being have the right to use it in any way. They compare the different states in term of “utility” and are not concerned how they have achieved the state. What ultimately matters is that the “ends” should be fulfilled, “means” is not the concern. Second is the “Rights based” viewpoint which believes that no trade off can exist between man made goods and environment. They believe that environment is not like any other marketable good. It itself has a “right to exist” i.e. have an “intrinsic

value” and should not be treated only as an object for deriving utility. For them “ends do not justify the means” and no amount of compensation, could compensate them for the loss of environment.

This ethical and moral belief leads to the violation of the PPI criteria, the very foundation of the CBA.

Unit-6: Environmental Valuation in Practice

Unit Structure

6.0 Learning objectives

6.1. Introduction

6.2 Deforestation

6.2.1 Meaning of Deforestation

6.2.2. Causes of Deforestation

6.2.3 Effects of Deforestation

6.3 Pollution

6.3.1 Types of Pollution

6.3.1.1 Land Pollution

6.3.1.2 Water Pollution

6.3.1.3 Air Pollution

6.3.1.4 Noise Pollution

6.3.1.5 Light Pollution

6.4 Biodiversity

6.4.1 Measuring Biodiversity

6.4.2 Biodiversity Loss

6.5 Agro Forestry

6.5.1 Categories of Agro-Forestry

6.5.2 Agro Forestry Techniques

6.6 Let Us Sum Up

6.7 Check Your Progress: The Key

6.0 Learning objectives

On the completion of the Unit, you should be able to:

- Understand the meaning, causes and effects of deforestation.
- Understand the meaning and types of pollution.
- Explain the concept of biodiversity and describe the drivers of biodiversity loss.
- Describe the issue of global climate change and its impact on environment.
- Describe the Ecosystem goods and services.
- Explain the concept of Farm-forestry and Agro-forestry.

6.1. Introduction

The environment is an imperative factor for human development in all forms. However, human development has led to the destruction of environment. Man has destroyed forests for the construction of buildings, industries, roads, etc. and has termed it as development. Further the rise in population and access to technology has led to pollution, destruction of biodiversity. We have not compensated the Earth for what it gave us in the form of forests, water and air. Infact, we have harmed it in all ways we

can. Sometimes, we see and observe a lot of things but fail to comprehend them in the right manner. This unit is highlighting the issues related to deforestation, pollution, biodiversity, ecosystems, farm forestry and agro-forestry. The unit will teach you the ways man has destroyed the environment and in the last two sections it covers the issue of how forestry can be conserved.

6.2 Deforestation

Deforestation represents one of the largest issues in global land use. Conversion of forests to land used for other purposes has a long history. Earth's croplands, which cover about 49 million square km (18.9 million square miles), are mostly deforested land. Most present-day croplands receive enough rain and are warm enough to have once supported forests of one kind or another. The Global Forest Resources Assessment (FRA) reported a 3.16% decline in the global forest cover from 1990 to 2015, and the total forest cover stands at about 30.6% in the present time compared to 31.6% in 1990. The rate at which the forest cover is declining poses a direct threat in the near future if not checked. With an estimated annual loss of 18.7 million acres, it is evident that future demands on forest resources would certainly lead to immense competition among nations. Recently, in 2016, a study from the Maryland University reported that 73.4 million acres of the global tree cover were lost. Such a destruction of this essential and self-sustaining resource puts the implementation of the principle of sustainable development as mentioned in the Brundtland Report and Sustainable Development Goals of the 1992 of Rio Earth Summit in the state of question. And, it is an urgency to conserve the forests of which a vital part is already lost.

6.2.1 Meaning of Deforestation

Deforestation means the clearing or thinning of forests by humans. Estimates of deforestation traditionally are based on the area of forest cleared for human use, including removal of the trees for wood products and for croplands and grazing lands. In the practice of clear-cutting, all the trees are removed from the land, which completely destroys the forest. In some cases, however, even partial logging and accidental fires thin out the trees enough to change the forest structure dramatically. The UN Food and Agricultural Organization (FAO) has defined deforestation as the conversion of forest to another land use or the long-term reduction of tree canopy cover below the 10% threshold. The United Nations Food and Agriculture Organization (FAO) estimates that the annual rate of deforestation is about 1.3 million square km

per decade, though the rate has slowed in some places in the early 21st century as a result of enhanced forest management practices and the establishment of nature preserves. The greatest deforestation is occurring in the tropics, where a wide variety of forests exists. They range from rainforests that are hot and wet year-round to forests that are merely humid and moist, to those in which trees in varying proportions lose their leaves in the dry season, and to dry open woodlands. Because boundaries between these categories are inevitably arbitrary, estimates differ regarding how much deforestation has occurred in the tropics.

6.2.2. Causes of Deforestation

1. Agriculture: The conversion of forests into agricultural land is a big reason for deforestation. Due to overgrowing demand for food products, many trees are chopped down for crops and for cattle grazing. Over 40% of the forests are cleaned to obtain land and meet the needs of agriculture and wood.

2. Mining: Mining of Oil and Coal require a large amount of forest land. Construction of roads leads to deforestation as they provide the way to remote land. The waste that comes out from mining pollutes the environment and affects the nearby species.

3. Urbanization: As the population grows, the needs of people increases which further leads to deforestation. Forests shrink to a great extent to meet the requirements like for construction of roads, development of houses, mineral exploitation and expansion of industries. Increasing population directly affects forest as with the expansion of cities there is a need for more land for housing and settlements.

4. Timber Production: One of the primary cause of deforestation is the production of timber. There is a lot of demand for timber and so deforestation increases. It a source of raw material which is used for the production of paper and also for construction.

5. Forest Fires: We lose a large number of trees each year due to fires in the forest in various portions worldwide. This happens due to extreme summers and winters. The fire caused, by man or nature, results in huge loss of forest cover.

6.2.3 Effects of Deforestation

1. **Greenhouse Gas Emissions:** Gases such as methane and carbon dioxide trap heat in Earth's atmosphere, leading change in climate. Trees absorb the carbon dioxide and release oxygen and water into the atmosphere and this contributes to global warming. Cutting carbon dioxide adds to the environment and then this lack of

the tree creates an absorption deficit. Deforestation leads to the emission of greenhouse gas.

2. **Soil Erosion:** Cutting down on trees leads to clearance of forests and so soil erosion occurs. Exposure of the soil to the sun's heat dries up the moisture inside the soil. Nutrients evaporate and it affects the bacteria that help to break down organic matter. Due to this, rain washes the soil surfaces and erosion takes place. Large amounts of soil wash into local streams and rivers and cause damage to hydroelectric structures and irrigation infrastructure.

3. **Biodiversity Losses:** Deforestation alters land and so that many of the plants and animals do not survive. With more deforestation, the entire species can extinct. This is the 'biodiversity loss'. Many wonderful species of plants and animals have been lost, and many others remain endangered. As each species of an ecosystem rely upon other species, loss of one species can have far-reaching consequences for other species. We lose about 50 to 100 species of animals each day due to the destruction of their habitats. Millions of plants and animal species are on the verge of extinction due to deforestation.

4. **Floods:** Deforestation leads to land erosion because the trees maintain the surface of the mountains. The water level of the rivers increases suddenly, causing floods. When it rains, trees absorb and store a large amount of water with the help of their roots. Chopping down of trees disrupts the flow of water and leads to floods in some areas.

Check Your Progress 1

Urbanization is one of the major cause of deforestation. Explain.

Notes: (a) Space is given for your answer.

(b) Compare your answer with the one given at the end of this Unit.

6.3 Pollution

Pollution is the process of making land, water, air or other parts of the environment dirty and not safe or suitable to use. This is usually done through the introduction of a contaminant into a natural environment, however, the contaminant need to be tangible.

Things as simple as light, sound and temperature are considered pollutants when introduced artificially into an environment. According to Pure Earth, a non-profit environmental organization, toxic pollution affects more than 200 million people worldwide. In some of the world's worst polluted places, babies are born with birth defects, children have lost 30 to 40 IQ points, and life expectancy has become as low as 45 years because of cancers and other diseases.

6.3.1 Types of Pollution

There are majorly five types of pollution:

- Land Pollution
- Water Pollution
- Air Pollution
- Noise Pollution
- Light Pollution

6.3.1.1 Land Pollution

Household garbage and industrial waste are the major determinants of Land pollution. According to the U.S. Environmental Protection Agency, in 2014, Americans produced about 258 million tons of solid waste. A little over half of the waste — 136 million tons— was gathered in landfills out of which only about 34% could be recycled or composted. Organic material was the largest component of the garbage generated, the EPA said. Paper and paperboard accounted for more than 26%; food was 15% and yard trimmings were 13%. Plastics comprised about 13% of the solid waste, while rubber, leather and textiles made up 9.5% and metals 9%. Wood contributed to 6.2% of the garbage; glass was 4.4% and other miscellaneous materials made up about 3%. Commercial or industrial waste is a significant portion of solid waste. Industries generate hazardous waste from mining, petroleum refining, pesticide manufacturing and other chemical production. Households generate hazardous waste as well, including paints and solvents, motor oil, fluorescent lights, aerosol cans and ammunition.

6.3.1.2 Water Pollution

Water pollution is caused due to the introduction of chemicals or dangerous foreign substances to water, including chemicals, sewage, pesticides and fertilizers from agricultural runoff, or metals like lead or mercury. According to the Environmental Protection Agency (EPA), 44% of assessed stream miles, 64% of lakes and 30% of

bay and estuarine areas are not clean enough for fishing and swimming. A study of United Nations states that 783 million people do not have access to clean water and around 2.5 billion do not have access to adequate sanitation. Adequate sanitation helps to keep sewage and other contaminants from entering the water supply. EPA has also stated that low levels of dissolved oxygen in the water are also considered a pollutant. This is caused by the decomposition of organic materials, such as sewage introduced into the water.

According to National Oceanic and Atmospheric Administration (NOAA), 80% of pollution in marine environment comes from the land through sources like runoff. Water pollution can also severely affect marine life. Harm can also be done through 'Warming Water'. The artificial warming of water is called thermal pollution. It can happen when a factory or power plant that is using water to cool its operations ends up discharging hot water. This makes the water hold less oxygen, which can kill fish and wildlife. Nutrient pollution, also called eutrophication, is another type of water pollution. It is when nutrients, such as nitrogen, are added into bodies of water. The nutrient works like fertilizer and makes algae grow at excessive rates, according to NOAA. The algae blocks light from other plants. The plants die and their decomposition leads to less oxygen in the water. Less oxygen in the water kills aquatic animals.

6.3.1.3 Air Pollution

The air we breathe is made up of 99% nitrogen, oxygen, water vapor and inert gases. Air pollution occurs when things other than these are added to the air. The most common type of air pollution is when people release particles into the air by burning fuels. This pollution looks like soot, containing millions of tiny particles, floating in the air.

Another type of air pollution is caused due to dangerous gases, such as sulfur dioxide, carbon monoxide, nitrogen oxides and chemical vapors. These can take part in further chemical reactions once they are in the atmosphere, creating acid rain and smog. Finally, air pollution can take the form of greenhouse gases, such as carbon dioxide or sulfur dioxide, which are warming the planet through the greenhouse effect. According to EPA, the greenhouse effect is when gases absorb the infrared radiation that is released from the Earth, preventing the heat from escaping which is a natural process to keep our atmosphere warm.

Air pollution kills more than 2 million people each year. The effects of air pollution on human health can vary widely depending on the pollutant. If the pollutant is highly toxic, the effects on health can be widespread and severe. For example, the release of methyl isocyanate gas at Union Carbide plant in Bhopal in 1984 killed over 2,000 people, and over 200,000 suffered respiratory problems. An irritant (e.g. particulates less than 10 micrometers) may cause respiratory illnesses, cardiovascular disease and increases in asthma.

6.3.1.4 Noise Pollution

Even though we cannot see or smell noise pollution, it still affects the environment. Noise pollution happens when the sound coming from planes, industry or other sources reaches harmful levels. Research has shown that there are direct links between noise and health, including stress-related illnesses, high blood pressure, speech interference, hearing loss. For example, a study by the WHO Noise Environmental Burden on Disease working group found that noise pollution may contribute to hundreds of thousands of deaths per year by increasing the rates of coronary heart disease. Under the Clean Air Act, the EPA can regulate machine and plane noise. Underwater noise pollution coming from ships has been shown to upset whales' navigation systems and kill other species that depend on the natural underwater world. Noise also makes wild species communicate louder, which can shorten their lifespan.

6.3.1.5 Light Pollution

We cannot imagine life without the modern convenience of electric lights. For the natural world, though, lights have changed the way that days and nights work. Some consequences of light pollution are:

- Some birds sing at unnatural hours in the presence of artificial light.
- Scientists have determined that long artificial days can affect migration schedules, as they allow for longer feeding times.
- Streetlights can confuse newly hatched sea turtles that rely on starlight reflecting off the waves to guide them from the beach to the ocean. They often head in the wrong direction.
- Light pollution, called sky glow, also makes it difficult for astronomers, both professional and amateur, to properly see the stars.

- Plant's flowering and developmental patterns can be entirely disrupted by artificial light.
- According to a study by the American Geophysical Union, light pollution could also be making smog worse by destroying nitrate radicals that helps the dispersion of smog.

Turning on so many lights may not be necessary. Research published by International Journal of Science and Research estimates that over-illumination wastes about 2 million barrels of oil per day and lighting is responsible for one-fourth of all energy consumption worldwide.

Check Your Progress 2

What are the causes of Water Pollution?

Notes: (a) Space is given for your answer.

(b) Compare your answer with the one given at the end of this Unit.

6.4 Biodiversity

The surface and the seas of the Earth occupies a complex, dynamic and varied layer of living organism and this feature of the Earth is experiencing dramatic change at the hands of the human beings. This layer of living organisms carries out collective metabolic activities of its innumerable plants, animals, and microbes physically and chemically. Through these activities it unites the atmosphere, geosphere, and hydrosphere into one environmental system within which millions of species, including humans, have thrived. Biodiversity is the foundation of ecosystem services to which human well-being is intimately linked. Biodiversity is defined as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.”

6.4.1 Measuring Biodiversity

Precise quantification of biodiversity is difficult, in spite of many tools and data sources. Species Richness and Ecological Indicators are two major methods which are being used to measure biodiversity.

Species Richness: Species richness (the number of species in a given area) represents a single but important metric to measure the diversity of life—but it must be integrated with other metrics to fully capture biodiversity. Because the multidimensionality of biodiversity poses formidable challenges to its measurement, a variety of surrogate or proxy measures are often used. While this serves as a valuable measure there are several limitations associated with an emphasis on species. First, what constitutes a species is not often well defined. Second, although native species richness and ecosystem functioning correlate well, there is considerable variability surrounding this relationship. Third, species may be taxonomically similar (in the same genus) but ecologically quite distinct. Fourth, species vary extraordinarily in abundance; for most biological communities, only a few are dominant, while many are rare.

Ecological Indicators: Ecological indicators are scientific constructs that use quantitative data to measure aspects of biodiversity, ecosystem condition, services, or drivers of change, but no single ecological indicator captures all the dimensions of biodiversity. Ecological indicators form a critical component of monitoring, assessment, and decision-making and are designed to communicate information quickly and easily to policy-makers. The National Research Council in the United States have identified three categories of ecological indicators to assess the dimensions of biodiversity: i) Ecosystem extent and status (such as land cover and land use) indicates the coverage of ecosystems and their ecological attributes; ii) Ecological capital which is further divided into biotic raw material (such as total species richness) and abiotic raw materials (such as soil nutrients), indicates the amount of resources available for providing services and iii) Ecological functioning (such as lake trophic status) measures the performance of ecosystems. However, caution must be taken not to apply ecological indicators to uses they were not intended for, especially when assessing biodiversity.

6.4.2 Biodiversity Loss

Biodiversity contributes directly (through provisioning, regulating, and cultural ecosystem services) and indirectly (through supporting ecosystem services) to many constituents of human well-being, including security, basic material for a good life, health, good social relations, and freedom of choice and action. Many people have benefited over the last century from the conversion of natural ecosystems to human-

dominated ecosystems and the exploitation of biodiversity. At the same time, however, these losses in biodiversity and changes in ecosystem services have caused some people to experience declining well-being, with poverty in some social groups being exacerbated.

DIRECT DRIVERS OF BIODIVERSITY LOSS

There are both direct and indirect drivers of biodiversity losses. The most important direct drivers of biodiversity loss and change in ecosystem services are habitat change, over-exploitation, biotic exchange and nutrient loading.

1. Habitat transformation: This is particularly due to conversion to agriculture. Cultivated systems (areas where at least 30% of the landscape is in croplands, shifting cultivation, confined livestock production, or freshwater aquaculture) now cover one quarter of Earth's terrestrial surface. A further 10 to 20 percent of grassland and forestland is projected to be converted by 2050, primarily to agriculture. While the expansion of agriculture and its increased productivity has enhanced production of one key ecosystem service, but this success has come at high and growing costs in terms of trade-offs with other ecosystem services, both through the direct impact of land cover change and as a result of release of nutrients into rivers and water withdrawals for irrigation (globally, roughly 15–35% of such irrigation withdrawals are estimated to be unsustainable). Habitat loss also occurs in coastal and marine systems, though these transformations are less well documented. Trawling of the seabed, for instance, can significantly reduce the diversity of benthic habitats, while destructive fishing and coastal development can lead to losses of coral reefs.

2. Overexploitation (especially overfishing): Overfishing has been the dominant direct driver of change globally for marine systems. Demand for fish as food for people and as feed for aquaculture production is increasing, resulting in increased risk of major, long-lasting collapses of regional marine fisheries. About three quarters (75%) of the world's commercial marine fisheries are either fully exploited (50%) or overexploited (25%).

3. Biotic exchange: Increased trade and travel has increased the spread of invasive alien species and disease organisms. Increased risk of biotic exchange is an inevitable effect of globalization. While increasingly there are measures to control some of the pathways of invasive species—for example, through quarantine measures

and new rules on the disposal of ballast water in shipping—several pathways are not adequately regulated, particularly with regard to introductions into freshwater systems.

4. Nutrient loading: Since 1950, nutrient loading—anthropogenic increases in nitrogen, phosphorus, sulfur, and other nutrient-associated pollutants—has emerged as one of the most important drivers of ecosystem change in terrestrial, freshwater, and coastal ecosystems, and this driver is projected to increase substantially in the future.

INDIRECT DRIVERS OF BIODIVERSITY LOSS

Globally there are five indirect drivers of changes in biodiversity and ecosystem services: demographic, economic, socio-political, cultural and religious, and scientific and technological.

Growing populations and growing per capita consumption in particular has increased consumption of ecosystem services (as well as the growing use of fossil fuels), which leads to increased pressure on ecosystems and biodiversity. Global economic activity increased nearly sevenfold between 1950 and 2000. Per capita GDP has been projected to grow by a factor of 1.9 to 4.4 by 2050. Global population has doubled in the last 40 years, reaching 6 billion in 2000, and is projected to reach 8.1–9.6 billion by 2050. The processes of globalization have encouraged some driving forces of changes in ecosystem services and promoted other forces. Over the last 50 years there has been a significant change in socio-political drivers, which includes a declining trend in centralized authoritarian governments and a rise in elected democracies, which developed new forms of management, particularly in the form of adaptive management, of environmental resources.

Culture conditions, individuals' perceptions of the world — by influencing what they consider important—has implications for conservation and consumer. The development and diffusion of scientific knowledge and technologies on the one hand allow for increased efficiency in resource use while on the other hand provide the means to increase exploitation of resources.

Check Your Progress 3

How does habitat transformation lead to biodiversity loss?

Notes: (a) Space is given for your answer.

(b) Compare your answer with the one given at the end of this Unit.

6.5 GLOBAL CLIMATE CHANGE

Humans are accustomed to climatic conditions that vary on daily, seasonal and inter-annual time-scales. There is widespread consensus among the scientific community that the Earth is warming and this warming is majorly caused by human emissions of greenhouse gases (GHGs). The Earth's average temperature has been increasing since Industrial Revolution. Between 1880 and 2015, average global surface temperature rose by 0.9oC. In 2016, the Earth experienced its third consecutive hottest year since recordkeeping began. The GHGs causing the warming are particularly carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). GHG emissions were 60% higher in 2014 than they were in 1990.

The primary sources of year-on-year GHG emissions are the "burning of fossil fuels (coal, oil and gas), with important contributions from the clearing of forests, agricultural practices and other activities". Fossil fuel consumption for electricity and heat production generates about 25% of total GHG emissions; industry 21%; transportation 14%; other energy 14%; buildings 6%; agriculture, forestry and other land uses contribute the remaining 24% of total GHG emissions. Higher level of atmospheric GHGs raise temperatures by increasing radiative forcing, or the amount of energy arriving on Earth's surface. Nearly 200 nations have formally agreed that human activity is responsible for global climate change. 97% of climate scientists believe that human activity is causing climate change. The United Nations Environmental Program and the World Meteorological Organisation created the Intergovernmental Panel on Climate Change (IPCC) in 1988 "to prepare, based on available scientific information, assessments on all aspects of climate change and its impact, with a view of formulating realistic response strategies". The IPCC's states that, if no additional efforts are taken to mitigate the effects of climate change, CO₂eq concentrations are likely to increase to approximately 450 ppm by 2030 and between 750ppm and 1300 ppm by 2100. if this occurs, by 2100 the planet may experience global mean surface temperature increases of 3.7oC to 7.8oC. However, these are just estimates that the actual could be greater or perhaps smaller.

6.5.1 IMPACTS OF CLIMATE CHANGE

Rising Sea Levels:

The rising GHG concentrations is causing the temperatures to rise leading to ice fields to melt. The oceans themselves are also warming up. This is causing the sea levels to rise. Since 1870 rates of global sea level rise have accelerated and are now about 3.5mm per year. By 2100, sea levels are projected to rise by up to 2 metres, depending on GHG emissions and the effects of warming air and ocean water on ice. Two-third of the world's largest cities are located in low-lying coastal areas, and increasing sea levels could submerge the land on which an estimated 470 million to 760 million people are living. By 2050, between 665,000 and 1.7 million people in the Pacific are expected to be forced to migrate due to rising sea levels, including the entire populations of islands of Fiji, the Marshall Islands and Tuvalu. It is also estimated that in larger countries, such as Bangladesh and Netherlands, a very large proportion of population will be forced to relocate.

Changing Weather Patterns and Extreme Weather:

Though it is difficult to link any single event directly to climate change, rising temperatures means that the atmosphere can hold more water vapour, allowing both for greater rates of rainfall and runoff when the air is saturated and for drier conditions otherwise. Since 2013, extreme droughts has affected Western US. Somalia, Kenya and other East African countries have experienced below-average rainfalls since the late 1990s, leading to a 30 percent reduction in crop yields and famines in 2010, 2011 and 2016. There has also been an increase in the prevalence of hurricanes and other destructive weather events.

Pressure on Water and Food:

Food production is highly correlated with water availability. The warming up of Earth due to global climate change is resulting in shrinking glaciers, reduced snow pack and increasingly erratic rainfalls. Water shortages in Pakistan and India, for example, threaten the viability of agriculture in the region. By the 2090s, the proportion of the global land surface in extreme drought could increase from 1% to 3% today to 30% if significant reductions in GHG emissions are not brought about. Global food production is also affected by warmer temperatures, increased CO₂ levels and extreme weather events.

Political and Security Risks:

Climate change has been linked to increased political instability worldwide. When food prices rose sharply in 2007-08, dozens of so-called “food riots” caused casualties in Argentina, Cameroon and Haiti. The U.S. military has suggested that climate change is “a salient national security concern”, which could redraw maps and spheres of engagement while compounding conflicts and resource constraints in some of the world’s already vulnerable countries, leading to instability and even war.

Human Health Risks:

Increasing heat waves in India (2015), Europe (2006) and around the world have led to the death and injury to thousands. Water and vector-borne diseases are also projected to increase as insects and other carriers move into higher latitudes. A warmer atmosphere also increases the concentrations of smog, while continuing burning of fossil fuels particularly of coal may lead to millions of premature deaths.

Impact on Wildlife and Ecosystems:

Global climate change also significantly affects many natural habitats and puts many species at higher risk of extinction. As the current extinction rates are 100 times the normal rate, some scientists predict that the Earth is headed for a mass extinction. By 2100, 30% to 50% of the world’s land and marine animal species may get extinct. Climate change has also affected the oceans significantly. During the last 100 years near-surface ocean temperatures have risen by about 0.74°C. This has made sea significantly more acidic, likely affecting marine animals’ reproduction and survival.

Check Your Progress 4

What is the impact of climate change on the health of the humans?

Notes: (a) Space is given for your answer.

(b) Compare your answer with the one given at the end of this Unit.

6.6 ECOSYSTEMS GOODS AND SERVICES

The term ecosystem refers to the combined physical and biological components of an environment. These organisms form complex sets of relationships and function as a unit as they interact with their physical environment.

Some ecosystems are familiar, and others more exotic:

- A meadow is an ecosystem in which insects pollinate flowers and grasses. Cattle feed on these plants, and their manure, broken down by organisms in the soil, helps in turn to nourish the earth the plants grow in. Each element of the cycle depends on others for survival.
- Coral reefs form ecosystems in which fish and coral formations, rock and seawater interact together. Some 500 million people worldwide use coral reefs for tourism, fishing, pearl culture and other activities.

6.6.1 ECOSYSTEMS GOODS AND SERVICES

The Earth's ecosystems provide humanity with a wide range of benefits known as 'ecosystem goods and services'. Goods produced by ecosystems include food (meat, fish, vegetables etc.), water, fuels, and timber, while services include water supply and air purification, natural recycling of waste, soil formation, pollination, and the regulatory mechanisms that nature when left to itself use them to control climatic conditions and populations of animals, insects and other organisms. Because many of these goods and services have always been freely available, with no markets and no prices, their true long-term value is not included in society's economic estimates.

Experts have identified four different kinds of services, all vital to human health and well-being:

- Provisioning services supply the goods themselves, such as food, water, timber and fibre.
- Regulating services govern climate and rainfall, water (e.g. flooding), waste, and the spread of disease.
- Cultural services cover the beauty, inspiration and recreation that contribute to our spiritual welfare.
- Supporting services include soil formation, photosynthesis and nutrient cycling, which underpin growth and production.

6.6.2 UN Millennium Ecosystem Assessment

The Millennium Ecosystem Assessment (MA) was called for by the UN Secretary General in 2000, to assess the consequences of ecosystem change for human well-being. The MA was a multi-agency initiative and involved the work of over 1,360 experts worldwide. The five volumes assessment published in 2005 provides decision-makers and the public with relevant scientific information on the conditions of ecosystems, consequences of its change and options for response.

FACTS ON ECOSYSTEMS

- Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fiber and fuel. This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth.
- The changes that have been made to ecosystems have contributed to substantial net gains in human well-being and economic development, but these gains have been achieved at growing costs in the form of the degradation of many ecosystem services, increased risks of nonlinear changes, and the exacerbation of poverty for some groups of people. These problems, unless addressed, will substantially diminish the benefits that future generations obtain from ecosystems.
- The degradation of ecosystem services could grow significantly worse during the first half of this century and is a barrier to achieving the Millennium Development Goals.
- The challenge of reversing the degradation of ecosystem while meeting increasing demands for services can be partially met under some scenarios considered by the MA, but will involve significant changes in policies, institutions and practices that are not currently under way. Many options exist to conserve or enhance specific ecosystem services in ways that reduce negative trade-offs or that provide positive synergies with other ecosystem services.

The diagram below shows the functioning of ecosystems goods and services

Check Your Progress 5

State the ecosystem services.

Notes: (a) Space is given for your answer.

(b) Compare your answer with the one given at the end of this Unit.

6.7 FARM FORESTRY

Management of trees for timber yields by farmers is termed as Farm forestry. Farm forestry takes many forms. Some farm forestry projects resemble small-scale forest plantations. Others are diverse agroforests, involving timber trees mixed with animals, crops, or other trees with non-timber products. Projects can range in size from very small (one acre) to very large (hundreds of acres). Farm forestry has the potential to produce quality timber products, increase farm incomes, support community development, and provide employment and environmental benefits.

6.7.1 Timber Trees on Farms

Some farm foresters may choose to devote all or part project to a solid stand of timber trees. These plantings usually consist of trees planted close together, uniformly spaced, and managed as small-scale timber plantations. Sometimes called woodlots or tree farms, these plantings can also be a productive use of poor, difficult, or hard-to-access farmland, such as steep slopes, river banks, or waterlogged areas.

There are many ways to integrate timber trees with other farm practices such as with pasture, windbreaks, and crops. These may improve returns and enhance environmental benefits. Integrating trees into farm systems may also have potential drawbacks. Careful planning is necessary to select appropriate species, and to prevent problems from competition and shading. Good planning helps to ensure that the interactions between the trees and other farm elements are beneficial, and result in a net gain for the farmer.

Some examples of ways to integrate timber trees with other farm elements include:

- Silvopastoral systems (trees and livestock)
- Windbreaks (also known as shelterbelts)
- Sequential cropping systems (short-term crops planted with and eventually replaced by long-term timber trees)
- Wide row intercropping (Wide spacing between rows of timber trees, with crops cultivated between the rows)

- Dispersed trees (timber trees with shade-tolerant crops in a permanent arrangement)

In agroforestry systems, the return from timber will usually be lower than if the timber trees were cultivated in solid stands. However, integrating timber trees with farm systems can enable farmers to diversify their yields, reap earlier returns, and make more efficient use of land. The total return per acre over time from combined timber and nontimber products may exceed the financial yields of single-species forestry.

6.7.2 Some Benefits and Drawbacks of Farm Forestry

Farm forestry differs from large-scale commercial forestry in a number of important ways. Some of these differences can work in the farm forester's favor; others may be a disadvantage. In most cases, it is unrealistic to assume that the small-scale grower can hope to compete in the same markets, and with the same product line, as large-scale industrial plantations. The farmer must instead understand the advantages and disadvantages of their situation in order to optimize the potential for an economically viable forestry planting on their property.

The smaller scale of farm forestry projects and the higher level of personal involvement puts farm foresters in a position to benefit from many economic or environmental products of the forest that are not available to the industrial grower. For example, small scale operations may enable the farm forester to exploit market niches of specialty timbers for which there is a small but high-value market. Site-specific planning and species selection can allow the farm forester to make optimal use of the resources, microclimates, and conditions available on the site. Farmers may also make better economic and/or personal use of the secondary benefits of trees on their property, such as recreation, wildlife habitat/hunting, livestock shelter, aesthetic values, windbreak, watershed enhancement, etc. Integrating trees with other crops can result in diversified returns and increased net benefits.

Farm forestry also has some drawbacks compared with large-scale industrial forestry. The long-term investment required for forestry may be difficult for farmers to make. Misunderstanding or ignorance of farm forestry in government, planning agencies, funding sources, and the community at large may also be a barrier. Constraints to harvesting and marketing relatively small quantities of wood products may also be an issue. Harvesting, processing, and marketing are other areas where little is known of the critical factors influencing the economics of forestry for small land holders.

6.7.3 Financial Returns of Farm Forestry

Timber trees represent a long-term investment of land, labor, and resources for farmers. For this reason, it is important that the farmer/landowner carefully consider the economic prospects. Good planning, including careful financial analysis, is essential.

However, farm forestry involves financial questions that economists, researchers, government officials, and scientists cannot presently answer with any degree of certainty. Predicting growth rates, timber volumes, prices, and markets in twenty or more years is difficult. The diverse conditions and practices of farm forestry can add to the uncertainty. For example, in mixed agroforests, interactions between timber species and other elements may be unknown and untested. On degraded lands where environmental conditions have become inhospitable to many species, the growth and yields even from well-known plantation forestry species are uncertain.

An understanding of some basic financial analysis tools can help a farm forester estimate the potential of investing in a forestry project. Financial analysis provides a means to compare different forestry scenarios. This can be used to weigh the costs and returns of investing in farm forestry against the farmer's other options for economic use of the property. Analysis tools also aid in project design, in selecting project size, budget, implementation factors and management strategies.

Financial analysis includes estimating the costs and returns of a farm forestry project. Typical costs include planning, site preparation, fertilizers, seedlings, planting and maintenance costs, thinning, pruning, and harvesting. Estimating returns can be a very uncertain process, but there are ways to conservatively determine the potential for returns, including "best-case" and "worst-case" scenarios. These scenarios can be varied to examine the possibilities of changing market conditions, risks of natural disasters, or other factors.

Check Your Progress 6

What is Farm forestry?

Notes: (a) Space is given for your answer.

(b) Compare your answer with the one given at the end of this Unit.

6.5 Agro Forestry

Agro-forestry may be defined as the intimate integration of trees and crop and/or animals in the farming system or, more widely, as the integrated management and use of forest and agricultural resources. It combines woody perennials with annual crops and/or livestock, either simultaneously or sequentially on the same unit of lands. Its purpose is usually to satisfy local consumption needs and generate additional income, while sustaining agricultural productivity and maintaining ecological stability. Agro-forestry is a land use strategy that would:

- (a) increase the output of food and other products on a given unit of land;
- (b) ensure that increases in output were stable and sustainable; and
- (c) raise farmers' cash incomes. It is noteworthy that these are exactly the conditions necessary for greater food security in developing countries.

6.5.1 Categories of Agro-Forestry

The following categories of agro-forestry may be considered here.

- i) **Shelter.** Systems in which trees provide shelter for crops, pastures or livestock. The main purpose is agriculture; trees fulfil a service role.
- ii) **Forest grazing.** The grazing of livestock in forests or woodlands not originally planted with grazing in mind. The main purpose is forestry, with agriculture playing a supplementary role.
- iii) **Silvopastoralism.** The deliberate integration of trees and livestock.
- iv) **Shifting cultivation** - or periodic agriculture within a natural forest environment.
- v) **Agrosilviculture.** Combinations of trees and crops.
- vi) **Agrosilvopastoralism.** The integration of trees, crops and livestock - often in a temporal sequence as well as in a spatial pattern.

6.5.2 Agro Forestry Techniques

Many of today's agro-forestry techniques will be adaptations of traditional practices. However, non-traditional problems are raised by the decline of shifting cultivation, growing pressure on land, and rapid deforestation. Some of the most promising agro-forestry techniques are outlined below.

1. **Scattered Farm Trees:** The first agro-forestry intervention is simply to increase the number of trees or shrubs scattered among crops or pastures and along

farm boundaries. The trees enhance the productivity of crops and pasturage by replenishing soils and helping to reduce erosion. Scattering trees across the farm will not by itself meet all domestic needs for tree products or ensure sustainable agriculture. The major benefits may be - new species may be introduced and risks are minimized. In a number of countries, this approach is now the principal way of agro-forestry

2. **Improved fallows** : Another technique that can be introduced in the farming systems is the improvement of fallows. This is required by the fact that fallow periods in many areas have been substantially shortened.

3. **Alley cropping**: A much more complex agro-forestry technique is alley cropping, as developed by the International Institute for Tropical Agriculture (IITA). This involves the growing of crops between closely-spaced lines of trees or shrubs, usually legumes. To prevent competition with crops for light and water, the trees are regularly cut back and are kept pruned during the growing season. Larger cuttings are available for firewood. Leaves and twigs are spread as mulch among the crops. This mulch replenishes the soil with humus and nutrients, as well as providing a barrier against erosion.

4. **Mulching**: Mulch may also be used outside of alley cropping systems to protect or rehabilitate land. For example, the application of branch mulch helps restore nutrients to the soil, reduces erosion by breaking the impact of falling raindrops, and encourages water infiltration by slowing run-off and making the soil more porous.

5. **Buffer strips**: Strips of vegetation planted along the contour lines of slopes can serve as "buffers" against water erosion. In more complicated systems, buffer strips may include grasses, fodder legumes, trees and shrubs. In such cases, the strip can yield mulch, forage, fruit and fuelwood, as well as controlling erosion.

6. **Terracing**: On gentle slopes, water erosion may be prevented through buffer strips and mulching. Where slopes are more severe, however, construction of terraces may also be necessary. This job will be made simpler if buffer strips are included in the form of dense vegetation planted along the risers and edges of each terrace. If this is done, a much smaller earth structure will be required to control run-off than would the case with conventional, "naked" terraces.

7. **Windbreaks:** Planting lines of trees to break the wind sweeping across open land can prevent erosion and slow the evaporation of moisture from the soil. Species can be chosen that will also yield fodder, poles or firewood.
8. **Live fencing:** Many of the trees and crops in an agro-forestry system are vulnerable and can be eaten or trampled by livestock. To solve this problem, farmers can plant live fences.
9. **Woodlots:** Farm woodlots have often been promoted to provide firewood, either for domestic consumption or for sale.

Check Your Progress 7

Explain Buffer strips.

Notes: (a) Space is given for your answer.

(b) Compare your answer with the one given at the end of this Unit.

6.6 Let Us Sum Up

The economic development is caused by development of technology and the application of technology, urbanization and industrialisation has led to harmful effects on our environment. There is a dire need to understand that conservation of environment along with economic development is important. Reforestation along with deforestation is needed. Similarly we have to understand we humans are creating pollution which is harmful for all the species in the long run. The loss of biodiversity and climate change will ultimately lead to harmful effect for the present and future generations. This Unit has highlighted some of such issues and also suggested methods of Farm-forestry and Agro-forestry as the means of conserving the environment. Little efforts at all spheres can create a better environment for us and for our children.

6.7 Check Your Progress: The Key

1. **As the population grows, the needs of people increases which further leads to deforestation.** Forests shrink to a great extent to meet the requirements like for construction of roads, development of houses, mineral exploitation and expansion of

industries. Increasing population directly affects forest as with the expansion of cities there is a need for more land for housing and settlements.

2. Causes of water pollution can be:

- Due to introduction of chemicals or dangerous foreign substances to water, including chemicals, sewage, pesticides and fertilizers from agricultural runoff, or metals like lead or mercury.
- The low levels of dissolved oxygen in the water are also considered a pollutant.
- The artificial warming of water is called thermal pollution.
- It is when nutrients, such as nitrogen, are added into bodies of water.

3. While the expansion of agriculture and its increased productivity has enhanced production of one key ecosystem service, but this success has come at high and growing costs in terms of trade-offs with other ecosystem services, both through the direct impact of land cover change and as a result of release of nutrients into rivers and water withdrawals for irrigation (globally, roughly 15–35% of such irrigation withdrawals are estimated to be unsustainable).

4. Increasing heat waves in India (2015), Europe (2006) and around the world have led to the death and injury to thousands. Water and vector-borne diseases are also projected to increase as insects and other carriers move into higher latitudes. A warmer atmosphere also increases the concentrations of smog, while continuing burning of fossil fuels particularly of coal may lead to millions of premature deaths.

5. Ecosystem services are the benefits that people obtain from ecosystems.

Ecosystem services are indispensable to the wellbeing of all people, everywhere in the world. They include provisioning, regulating, and cultural services that directly affect people, and supporting services needed to maintain the other services. From the availability of adequate food and water, to disease regulation of vectors, pests, and pathogens, human health and well-being depends on these services and conditions from the natural environment. Biodiversity underlies all ecosystem services.

6. Management of trees for timber yields by farmers is termed as Farm forestry.

Farm forestry takes many forms. Some farm forestry projects resemble small-scale forest plantations. Others are diverse agroforests, involving timber trees mixed with animals, crops, or other trees with non-timber products. Projects can range in size from very small (one acre) to very large (hundreds of acres). Farm forestry has the potential

to produce quality timber products, increase farm incomes, support community development, and provide employment and environmental benefits.

7. **Buffer strips:** Strips of vegetation planted along the contour lines of slopes can serve as "buffers" against water erosion. In more complicated systems, buffer strips may include grasses, fodder legumes, trees and shrubs. In such cases, the strip can yield mulch, forage, fruit and fuelwood, as well as controlling erosion.

References

- Czikkely, M. (2018). Actual Issues of Environmental Economics. Hungary: Institute of Regional Economics and Rural Development.
- Government of India, (1987). Evaluation Report on Social Forestry. New Delhi: Government of India.
- World Resources Institute, (2005). Ecosystems and Human Well-Being. Washington DC: Millennium Ecosystem Assessment.
- JA Patz, W. M. (2000). The Potential Health Impacts of Climate variability and Change for the United States: Executive Summary of the Report of the Health Sector of the US National Assessment. Environmental Health Perspective.
- Rebecca M. Henderson, S. A. (2018). Climate Change in 2018: Implication for Business. Harvard Business School, 1-39.
- S., Puttaswamaiah (2016). Farm Forestry in Dryland Management. International Journal of Creative Research Thoughts, 11-30.
- Websites:
 - www.who.int/globalchange/ecosystems/en/
 - www.livescience.com/27692-deforestation.html
 - www.worldagroforestry.org6.1: Deforestation

Unit-7: The Tragedy with Development

Unit Structure

7.0 Learning objectives

7.1 Introduction

7.2 Inequality

7.2.1 Types of Inequality

7.2.1.1 Economic Inequality

7.2.1.2. Social Inequality

7.2.1.3 Global Inequality

7.2.1.4 Political Inequality

7.2.2 Inequality in India

7.2.2.1 Characteristics of inequality in India

7.3 Displacement

7.3.1 Causes of Displacement of Population

7.3.2 Environmental Degradation and Displacement

7.3.3 Causes of Population Displacement In India

7.4 Industrial Insecurity and Cruelty With Earth

7.4.1 Impact of Industrialization on Environment

7.4.2 Causes of Ill-Effects of Industrialization

7.5 Let Us Sum Up

7.0 Learning objectives

This will bring the following understandings for the readers:

1. Description of the meaning, types and consequences of inequality.
2. Understanding the concept of displacement of population and its causes in India.
3. Explaining the concept of industrial insecurity and the ways of creating cruelty with earth due to industrialization.

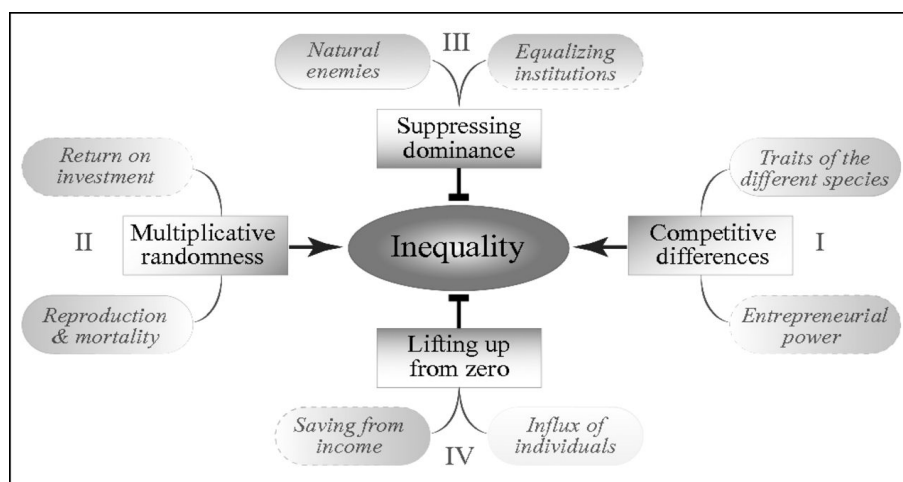
7.1 Introduction

Development has been a major concern of all the policy makers across the world. Today era is the era of war of the market of goods and services. However, this development has led to many socio-economic and environmental problems. Where at one place development needs more industries, more roads, more technology and more houses, which enhances the economic activity; but on the other hand these activities lead to inequalities of income and wealth, urbanization causes conflicts, leading further to migration of people and industrial pollution overall destroys the environment. There is a need to understand the effects of development from these aspects. Once I heard

an economist saying that establishing of a Cement industry leads to employment generation and increase in national income. It also causes environmental hazards which will lead to diseases which will further increase the demand of doctors in the place, more increase in the national income. But what about the health problems and the environmental issues created by such establishment? This Unit highlights some of such issues.

7.2 Inequality

Development across the world was meant to flow goods and services from the haves to have nots. However, the development across countries, through years has shown that the prime objective of development has not been achieved. Infact, it has led to a major problem which has been termed as “Inequality”. The Cambridge dictionary describes inequality as “the unfair situation in society when some people have more opportunities, etc. than other people”. The United Nations describes it in a more simple way as “the state of not being equal, especially in status, rights and opportunities”. While the term itself is quite vast and has various interpretations, for the purpose of simplicity, the two large umbrellas under which we can classify inequality would be economic inequality and social inequality. Both these categories are deeply intertwined and inequality in one often affects the inequality in another.



7.2.1 Types of Inequality

Inequality is a very vast term and it can take different forms also. Though major studies have been related with the economic aspect of inequality, there have been social, regional and political consequences of inequality also. This section has tried to cover all aspects of inequality. Thus the major types of inequality are as follows:

- Economic Inequality
- Social Inequality
- Global Inequality
- Political Inequality

Now let us understand these types of inequality.

7.2.1.1 *Economic Inequality*

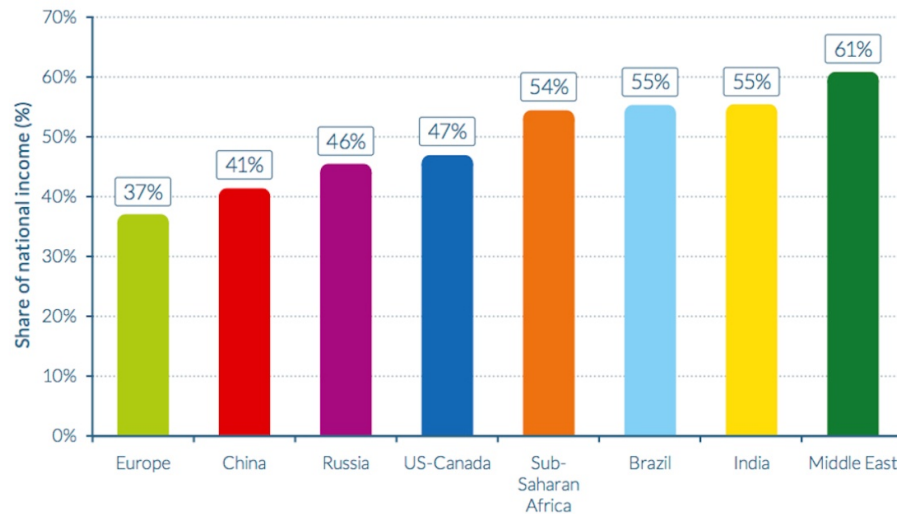
Perhaps the most quantified and calculated form of inequality is the economic variant. Under this variant the inequalities are measured in the form of wages, income and the wealth. Thus, the most predominant forms of inequality measured are those of income inequality and wealth inequality. Income inequality is the inequality in and disparity in the incomes commanded by the top percentile of the population in comparison to the bottom percentiles, while wealth inequality measures look to do the same but by calculating disparities in wealth instead of income. Income inequality and Wealth inequality are described below.

Income Inequality

According to Equality Trust, "Income is not just the money received through pay, but all the money received from employment (wages, salaries, bonuses etc.), investments, such as interest on savings accounts and dividends from shares of stock, savings, state benefits, pensions (state, personal, company) and rent." Unlike wealth statistics, income figures do not include the value of homes, stock, or other possessions. Income inequality refers to the extent to which income is distributed in an uneven manner among a population. Income disparities are so pronounced that America's top 10 percent now average more than nine times as much income as the bottom 90 percent. A study has shown that the higher the U.S. income group the larger the share of income derived from investment profits. By contrast, Americans who are not among the ultra-rich get the vast majority of their income from wages and salaries. This disparity

has contributed significantly to increasing inequality because of the preferential tax treatment of long-term capital gains. Currently, the top marginal tax rate for the richest Americans is 37 percent, while the top rate for long-term capital gains is just 20 percent.

Since 1980, income inequality has increased rapidly in North America, China, India, and Russia. Inequality has grown moderately in Europe.



Source: World Inequality Report 2019

Wealth Inequality

According to Equality Trust, “Wealth refers to the total amount of assets of an individual or household. This may include financial assets, such as bonds and stocks, property and private pension rights. Wealth inequality, therefore, refers to the unequal distribution of assets in a group of people”. In some countries, wealth inequality is more pronounced than income inequality.

The most visible indicator of wealth inequality is considered the Forbes magazine list which includes America’s 400 richest. In 2018, the three men at the top of that list — Amazon founder Jeff Bezos, Microsoft founder Bill Gates, and investor Warren Buffett — held combined fortunes worth more than the total wealth of the poorest half of Americans. In 1982, the “poorest” American listed on the first annual Forbes magazine list of America’s richest 400 had a net worth of \$210 million in today’s dollars. The average member of that first list had a net worth of \$600 million. In 2019, rich Americans needed net worth of \$2.1 billion to enter the Forbes 400, and the average

member held a net \$7.4 billion, over 12 times the 1982 average after adjusting for inflation.

7.2.1.2. Social Inequality

Social inequality occurs when resources in a given society are distributed unevenly, typically through norms of allocation, that engender specific patterns along lines of socially defined categories of persons. It is the differentiation preference of access to social goods in society brought about by power, religion, kinship, prestige, race, ethnicity, gender, age, sexual orientation, and class. In India, one of the most distinctive forms of social inequity come within the spheres of gender and caste, where, people coming from the marginalized sections of these social categories, are directly impacted in terms of their opportunities, access to essential utilities, and their potential as a whole. One of major form of Social inequality is regional inequality and gender inequality. They are discussed below.

Gender Inequality

Social and economic differences among males and females have made gender inequality a distinct sphere of study. The global trend towards extreme wealth and income concentration has dramatically strengthened the economic and political power of those individuals — overwhelmingly male — at the top. Different studies have concluded that women do considerably more unpaid work, from housekeeping to caring for children and the elderly. Among the 21 countries reporting data for at least one year during the 2013-2015 period, the West Bank and Gaza had the greatest imbalance, with men devoting just 16 percent as much time to unpaid domestic and caregiving work as women.

Another measure of gender inequality is from the wealth possession. Most inequality analysis focuses on income (the wages earned from a job or from capital gains) rather than wealth (the sum of one's assets minus debts). Income inequality, while stark, pales in comparison to wealth inequality. The divides become even more dramatic when viewed through a gender lens.

Regional Inequality

Regional Inequality refers to the uneven distribution of income or other variables across different locations. Regional inequalities can occur at different scales i.e. within

a continent or a country. The major causes of regional inequality are uneven access to services, disparity at quality of life, unequaleconomic opportunity and geographical remoteness. Regional inequality leads to overcrowding, imbalance of population (young + elderly in rural areas), production of food threatened (not enough peasants to feed the cities), social deprivation, poor quality schools, higher unemployment, inadequate infrastructures and migration.

According to economic models, low-income regions have the capacity to grow faster than high income regions. Poor places can grow more quickly because they copy the technologies and economic policies of the wealthy regions. This phenomenon is referred to as “convergence” or the “catch-up effect” by economists. This theory holds true in most cases. Within countries like the United States, Japan and China, less developed states are growing faster than wealthy ones. In India, however, convergence across states is not happening. The relative lack of growth in the poor states like Uttar Pradesh, Bihar and Odisha over the past 30 years is a major contributor to India’s increasing inequality. Given that India contains nearly 18% of the world’s population, this divergence also has important consequences for global poverty and inequality.

7.2.1.3 Global Inequality

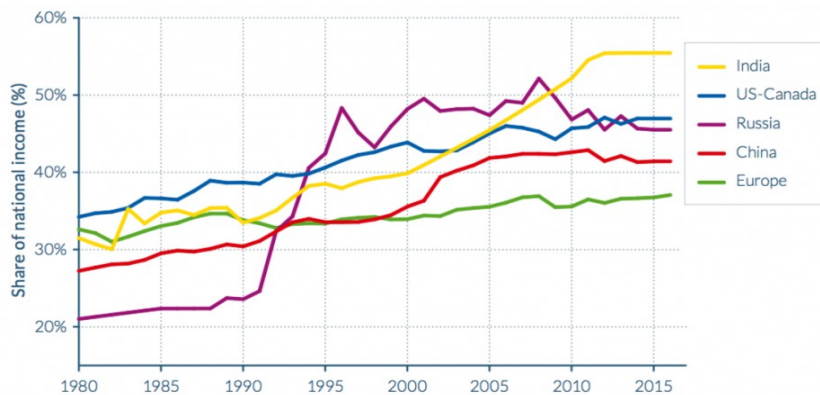
Inequality has been on the rise across the globe for several decades. Some countries have reduced the numbers of people living in extreme poverty. But economic gaps have continued to grow as the very richest amass unprecedented levels of wealth. Among industrial nations, the United States is by far the most top-heavy, with much greater shares of national wealth and income going to the richest 1 percent than any other country. The following are some of the statistics showing the facts about inequality globally:

According to the Credit Suisse Global Wealth Report, the world’s richest 1 percent, those with more than \$1 million, own 44 percent of the world’s wealth. Their data also shows that adults with less than \$10,000 in wealth make up 56.6 percent of the world’s population but hold less than 2 percent of global wealth. Individuals owning over \$100,000 in assets make up less than 11 percent of the global population but own 82.8 percent of global wealth. Credit Suisse defines “wealth” as the value of a household’s financial assets plus real assets (principally housing), minus their debts.

- The United States dominates the global population of high net worth individuals, with over 5.3 million individuals owning at least \$1 million in financial assets. According to Global Wealth Report, 62 percent of the world's millionaires continue to reside in Europe or North America, out of which almost 40 percent of these millionaires hail from United States.
- China has had the most rapid growth in the share of world millionaires, nearly doubling from 5 percent of the global total in 2017 to 9.5 percent in 2019.

Figure E2a

Top 10% income shares across the world, 1980–2016: Rising inequality almost everywhere, but at different speeds



Source: WID.world (2017). See wir2018.wid.world for data series and notes.

In 2016, 47% of national income was received by the top 10% in US-Canada, compared to 34% in 1980.

The graph above shows that during 1980-2016 period the share of top 10 percent across the world has grown in almost all countries. India has shown the highest growth in the inequality rate.

7.2.1.4 Political Inequality

Political inequality is a distinct form of inequality which has yet to attract sustained, systematic scholarly attention in comparison with its sibling inequalities. Social scientists, philosophers and other scholars have offered many definitions of political inequality. Built on the classics, modern definitions of political inequality depend on whether one is concerned about equality of opportunities or equality of outcomes. According to Joshua K. Dubrow, political inequality has the following features:

- Political inequality is structured differences in the distribution of political resources. According to this definition, one group has greater or lesser access to, or acquisition of, political resources than another group
- Political equality is when everybody's preferences are equally weighted in political decisions. The definition of "everybody" matters, of course: Everybody

could mean all citizens, or it could mean all who are potentially impacted by the decision.

- Political inequality is the existence of authority divisions. Here, we speak of political inequality when groups have unequal political input into the decisions that affect them. The more layers of authority between the citizen and the decision, the greater the political inequality.
- We can usefully combine these approaches with a definition that both simple and flexible: Political inequality is unequal influence over decisions made by political bodies and the unequal outcomes of those decisions.

7.2.2 Inequality in India

The introduction of economic reforms in the early 1990s led India to achieve unprecedented per capita growth rates. Poverty reduction also accelerated. However, there is great concern, that this growth has been accompanied by rising inequality. At the national level, inequality is broadly found to have risen in India between 1983–2012, particularly in the early 2000s. This has happened at differing degrees depending on the dimension being considered and the measurement method employed. The evidence also suggests that while poverty has fallen, most of those who have escaped poverty continue to face a high risk of falling back into it. Moreover, those who remain poor are increasingly chronically poor, and may be particularly difficult to reach via the introduction or expansion of safety nets.

Some statistical facts about inequality in India are as follows:

- Income inequality in India has reached historically high levels. In 2014, the share of national income accruing to India's top 1% of earners was 22%, while the share of the top 10% was around 56%.
- The income share of India's top 1% rose from approximately 6% in 1982–1983 to above 10% a decade after, then to 15% by 2000, and further still to around 23% by 2014. The latest data thus shows that during the first decade after the millennium, the share of national income attributable to the top 1% grew to be larger than that pertaining to the bottom 50%. By 2014, the national income share of the bottom 50% - a group of approximately 390 million adults - was just two-thirds of the share of the top 1%, who totalled 7.8 million. An even stronger increase in the share of national income was experienced by the top

0.1% and top 0.01% ,whose shares grew fivefold and tenfold, respectively, from 2% and 0.5% to almost 10% and 5%, between 1983 and 2014.

- The bottom 50% earned significantly less than the average income per adult, receiving less than one-third of the nationwide mean income before tax, while the average income of the middle 40% was around four-fifths the national average. Those in the top 10% earned five times the national average, and when one examines further up the income distribution, the same exponential trend as seen in the growth statistics is evident. The top 1% of earners, for example, received around ₹ 3.2 million per year on average, while the top 0.1% receive approximately ₹ 12.4 million, 22 and 86 times the average income for Indian adults, respectively. For the top 0.001%, this ratio is 1871.

7.2.2.1 Characteristics of inequality in India

- Local-level inequality within rural villages and urban blocks accounts for the bulk of overall inequality in India. Understanding what occurs at the local level is thus important for understanding overall inequality. Local-level inequality and its direction of change vary considerably across India's states.
- National averages also mask disparities across social groups. Scheduled Tribes and Scheduled Castes have persistently worse outcomes across health, education, and monetary indicators.
- Another dimension where India stands out is gender-based inequality. While gender gaps in education and nutrition have been closing over time the disadvantaged position of women is very visible in the labour market. But the true extent and impact of gender inequality remains difficult to establish because most economic indicators are household-based and they therefore mask the intra-household inequality between genders.

Check Your Progress 1

Explain Global Inequality.

Notes: (a) Space is given for your answer.

(b) Compare your answer with the one given at the end of this Unit.

7.3 Displacement

Displacement in population denotes being forced or obliged to flee or leave one's home or place of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights or natural or human-made disasters. It may occur within or across national borders. Displacement should not be understood solely in terms of the movement of people from one place to another but in terms of what happens to those people during and after flight.

As of 2020, 1 person is uprooted every 2 seconds (often with nothing but the clothes on their backs). Currently, the global total of forcibly-displaced people is over 68.5 million. There are a number of different factors that lead hundreds of millions of people around the world to leave their homes. All of these factors, however, lead to one common goal: To have a better, safer, life.

7.3.1 Causes of Displacement of Population

There are majorly six factors which displace population across the world. These are as follows:

1. Drought

Drought causes disaster for communities whose lives and livelihoods rely on regular and successful harvests. In a number of African countries including Somalia, Kenya and Ethiopia droughts have been increasingly severe, leaving millions of citizens without the ability to grow food. Drought also leaves families without access to clean water, often leading to them turning to dirty water as their only alternative for bathing, drinking, and growing crops. This is major cause of forced migration of people to other places where there is availability of food and clean water.

2. Hunger

Hunger's connection to drought and other causes on this list is significant. What people in farming regions don't consume from their own harvests is sold to make a living. War and conflict can also mean a lack of access to markets and fields, or that crops and food supplies are destroyed or stolen. Without any other alternatives, families affected by food shortages are often separated by forced migration, with one parent (usually the father) seeking work in a city to cover costs. Other families leave as a unit to begin their life in a new country.

3. Flooding

After Hurricane Matthew made landfall in Haiti in 2016, the storm's lethal winds and rain left 200,000 homes in its wake of destruction. An estimated 1.5 millions citizens – or more than 10% of the country – were left in need of humanitarian aid and damages were approximately of \$1.9 billion. According to a report, events prompted by climate change such as drought and flooding could account for up to 1.4 billion forced migrations by the year 2060. By 2100, they estimate that number would surpass 2 billion.

4. Earthquakes

It has been found that almost 60,000 Haitians currently live and work in the United States. Many were driven from their homes due to the devastating effects of two major hurricanes and one earthquake in recent years. In 2010, a 7.0-magnitude earthquake hit the capital city of Port-au-Prince, leaving 1.5 million Haitians homeless. The earthquake created a ripple effect that even paralyzed areas well outside the disaster zone. In 2015, a devastating series of earthquakes hit Afghanistan, Pakistan, and India (7.5-magnitude) and Nepal (7.8-magnitude and 7.3-magnitude, respectively). These drove hundreds of thousands of residents from their homes.

5. War & conflict

The most common factor for forced migration around the world is conflict. Most recently, the world's focus has been on the Rohingya crisis in Myanmar, with nearly 75% of the country's Muslim population displacing themselves to neighbouring Bangladesh in the wake of violence and ethnic cleansing. Forced migration has been a norm in the Middle East for most of the 21st Century, according to a study. Syria's civil war has caused over 11 million instances of forced migration. To-date nearly 6.2 million Syrians are internally displaced, and over 5.6 million Syrians are counted as refugees. The Democratic Republic of Congo has the highest number of displaced

people on the continent of Africa, with nearly 6 million people forced from their homes by various conflicts. Similar evidences have been a reason for population displacement across different parts of the world.

6. Economic circumstances

One of the biggest factors for migration are the economic challenges that may affect individuals in their countries of origin. The UN's 2018 World Migration Report notes that this is a major driver in West Africa, where temporary and permanent migrant workers commonly relocate from countries like Niger and Mali to Ghana and the Côte d'Ivoire for more opportunities to work and support their families. Contemporary economic decay due to corruption by local rulers, lack of political accountability, widespread nepotism, militarism, economic mismanagement, political instability, the debt crisis and the politics of international economic system, multinational corporations, private banks, globalization, the World Bank, and the International Monetary Fund (IMF) have compelled some states not only to rely on foreign loans and foreign aid for their annual budgets, but also to hand over the (mis)management of their economies to the World Bank and the IMF. These economic crises—which leave the industrialized countries, with approximately 20 per cent of the global population, in a violent sea of poverty—condemn over one billion people in the underdeveloped world to absolute poverty. Absolute poverty means poor health, high incidence of HIV/AIDS, high infant mortality, lack of adequate and proper nutrition, lack of relevant education, mass unemployment, persistent insecurity and hopelessness, increased crimes, and life-threatening labour. The crises also intensify struggles over scarce resources and lead to widespread violence, political repression, torture, and displacement of population. Ironically, victims of national and international economic and political policies, past and present, who seek asylum, are dismissed as bogus refugees or economic refugees.

7.3.2 Environmental Degradation and Displacement

According to many writers, the number of people who have been displaced by environmental degradation has been immense. Different scholars have written in the following way:

- Jacobson (1988) notes that, “environmental refugees have become the single largest class of displaced persons in the world.”

- Homer-Dixon (1991) further notes that environmental degradation is likely to produce “waves of environmental refugees that spill across borders with destabilizing effects” on domestic order and international relations.
- Speaking of displaced persons unaccounted for in official refugee figures, the Executive Director of UNEP at the time, Mustafa Tolba (1985), stated that “these people are the millions fleeing the droughts of northern Africa, the victims of Bhopal and the thousands made homeless by the Mexico earthquake. They are environmental refugees.”
- Estimates of the number of environmental refugees start at 10 million (compared to 17 million official refugees); more than half of these are believed to be in Sub-Saharan Africa (Jacobson, 1988; Trolldalen, et. al., 1992; Westing, 1992).
- Because governments generally take little official account of this unconventional category, Myers (1992) estimates that the numbers may be as high as 25 million. It is also claimed that the numbers are increasing rapidly.
- The Intergovernmental Panel on Climate Change (IPCC, 1990) noted that the greatest effect of climate change may be on human migration as millions of people will be displaced due to shoreline erosion, coastal flooding and agricultural disruption. Following from this, Myers (1992) projected environmental refugees in a greenhouse-affected world (in yr. 2050) at 150 million persons.
- Westing (1992) further documented displaced persons throughout the world in 1990 (using UN data), including officially recognized refugees (16.7 million), unrecognized, cross-border “refugees” (3.5 million), and unrecognized, internal “refugees” (21.3 million). He sums these into a category of “total national refugees” with 41.5 million persons. In 1986, the total was only 26.4 million, and he speculates that the growth is due to the addition of “environmental refugees.” The consideration for people who may have been displaced by environmental degradation has reached far beyond a humanitarian concern for a disenfranchised population; in some quarters, it is being considered a “threat to security.”
- Betterton (1992, as cited in Honebrink, 1993) noted that the U.S. military may be needed “to guard the border with Mexico, as it is expected that problems

may result from environmental refugees fleeing the Third World.” Indeed, the anti-immigration literature in the United States and Europe often claims that immigration is a cause of environmental degradation, thereby bringing the links full circle.

- Lamm and Imhoff, (1985) stated that it is not antihuman or antisocial to say that too many people can be a problem.... People pollute, and too many people living in an area can degrade that area irrevocably. Immigration at high levels exacerbates our resource and environmental problems. It will leave a poorer, more crowded, more divided country for our children.

7.3.3 Causes of Population Displacement In India

The nature, frequency and extent of the causes of internal displacement in India are varying. There is a huge variation in estimates of the numbers of internally displacement population in India. The latest World Refugee Survey put the total number of internally displaced persons in India as 507000; the Indian Social Institute in Delhi and the Global IDP Project place it at 21.3 million. The majority of cases in which people are forced to flee their homes are the consequence of government pursuit of political goals and development objectives. Development-induced displacement has overwhelmingly dominated IDP scenario in India. Alongside development-induced displacement new casual factors are also emerging. In India there are four categories of displacement.

Political Causes:

In India there has been displacement of population due to the following political causes:

1. Since, independence, North-east India has witnessed two major armed conflicts; the Naga movement and the Assam movement. The violence and retaliatory responses from the government and other forces opposed to the secessionists continue to generate a steady flow of displaced people.
2. In Kashmir's conflict between state forces and militants, the killing of Kashmiri Pandits by fundamentalist secessionist groups, the widespread anarchy due to political instability and the continuous violation of fundamental human rights have led to a large scale displacement.

3. Identity-based autonomy movements like that of Punjab and Assam have also led to violence and displacement.
4. Internal displacement has also arisen from caste disputes, religious fundamentalism and aggressive denial of residency and employment rights to non-indigenous groups.

Development – Induced displacement

In order to achieve rapid economic growth, India has invested in industrial projects, dams, roads, mines, power plants and new cities which have been made possible only through massive acquisition of land and subsequent displacement of people. According to the figures provided by the Indian Social Institute, the 21.3 million development induced IDPs include those displaced by dams (16.4 million), mines (2.55 million), industrial development (1.25 million) and wild life sanctuaries and national parks (0.6 million). Development projects are usually located in remote villages, hills and forests which means that those displaced tend to be the indigenous people who have been the traditional agents of conservation.

Natural-disaster induced displacement

There has been massive and recurrent displacement due to floods, cyclones and landslides. A report by the Centre for Science and Environment states that India is the most flood-affected country in the world after Bangladesh and that over 30 million people are displaced annually. Flood-affected areas shot up from an average of 6.4 million hectares in the 1950 to 9 million in the 1980s. The massive natural disasters of Gujarat, Uttarakhand are other examples of natural disasters which have led to displacement of population.

Socio-Economic factors

Besides the above stated factors one major factor which has been displacing the population in India both internally and internationally are the economic factors like employment opportunities, better standard of living, urbanizationalong with social factors like availability of education and health facilities, etc. India is a country with wide regional disparities and thus its population has been moving from lesser developed regions to developed regions. The biggest example of this case is

Uttarakhand itself where the people have moved to the plain areas from the hill areas in search of jobs, better education and health facilities and better living standards.

Check Your Progress 2

Explain Development-induced displacement.

Notes: (a) Space is given for your answer.

(b) Compare your answer with the one given at the end of this Unit.

7.4 Industrial Insecurity and Cruelty With Earth

Industrialization is considered as the engine of economic development. Production and consumption are the two parts of the economic activities. In the era of consumerism, production of goods and services are imperative. Globalization has also led to increase in the industrial activities across the world. In this era of competition and perfectionism there are insecurities in the industrial sector. Industrial insecurity may be defined as a state where the growth of industries as a whole or of a specific industry in particular is not certain or is under certain threats. Industrial insecurities can be classified as four types:

- Firstly, a country has not a certain industry which is necessary for future development of national economy and this can be called industrial insecurity due to shortage.
- Secondly, a country has a certain industry, but it is of small scale and incomplete in certain kind. These industries are especially of wealth technology and international competitiveness and they are called industrial insecurity due to fragility.
- Thirdly, a country is of fragile industries and strives for improving industrial competitiveness through introducing advanced foreign similar industries or technology but industrial insecurity due to uncontrollable industries will occur if existing goals are not achieved through introduction of foreign capital and

foreign capital controls the lifeline of industrial development and threatens the survival of industries.

- Lastly, a country has a certain industry which keeps pace with that of other countries and seems to be secure now, but there is issue of long-term security due to laggard development caused by future competition and subsequent impact. So it is necessary to consider industrial security in advance and this can be called industrial insecurity due to lagging.

Every country aspires for industrial security by corresponding autonomous right and control power for the industry's initiation, adjustment and development. These controls and rights leads to high level of industrialization. Industrialization to achieve economic development has resulted in global environmental degradation. The impacts of industrial activity on the natural environment are a major concern in developed countries. Industrial processes play a major role in the degradation of the global environment. In industrialised countries, environmental regulation and new technologies are reducing the environmental impact per unit produced, but industrial activities and growing demand are still putting pressures on the environment and the natural resource base. In developing countries a double environmental effect is occurring: old environmental problems, such as deforestation and soil degradation, remain largely unsolved. At the same time, new problems linked to industrialisation are emerging, such as rising greenhouse gas emissions, air and water pollution, growing volumes of waste, desertification and chemicals pollution.

The more developed a country's industrial capacity, the greater the potential for economic growth and development. If carried out in a sustainable manner, taking into account the often fragile nature of the surrounding environment, societal patterns and economic conditions, this can achieve lasting improvements in living standards, incomes, working conditions, education and healthcare. If, on the other hand, industrial development is coupled with environmental degradation and resource depletion, societal exploitation and economic recklessness, the associated benefits, if any, will not last. Accordingly, there is a need to ensure access to basic services as well as to modern, safe and affordable energy in developing countries. Access to energy will also contribute to the Millennium Development Goals (MDGs) on achieving universal primary education and on promoting gender equality. Increasing energy efficiency and

diversifying energy supply, among other things, by exploiting the opportunities of renewable energy, are important aspects in ensuring sustainable industrial development. The EU is implementing various initiatives to improve access to sustainable energy services and promote renewables, such as the EU energy initiative (EUR 220 million is available through the associated EU energy facility from 2006) and the Johannesburg.



7.4.1 Impact of Industrialization on Environment

Industrialization has led to the following ill-effects on environment:

- **Water Pollution:** The effects of industrial pollution are far-reaching and liable to affect the ecosystem for many years to come. Most industries require large amounts of water for their work. When involved in a series of processes, the water comes into contact with heavy metals, harmful chemicals, radioactive waste, and even organic sludge. These are either dumped into open oceans or rivers. As a result, many of our water sources have a high amount of industrial waste in them which seriously impacts the health of our ecosystem. The same water is then used by farmers for irrigation purpose which affects the quality of food that is produced.

- **Soil Pollution:** Soil pollution is creating problems in agriculture and destroying local vegetation. It also causes chronic health issues to the people that come in contact with such soil on a daily basis.
- **Air Pollution:** Air pollution has led to a steep increase in various illnesses and it continues to affect us on a daily basis. With so many small, mid and large scale industries coming up, air pollution has taken the toll on the health of the people and the environment.
- **Wildlife Extinction:** By and large, the issue of industrial pollution shows us that it causes natural rhythms and patterns to fail, meaning that the wildlife is getting affected in a severe manner. Habitats are being lost, species are becoming extinct and it is harder for the environment to recover from each natural disaster. Major industrial accidents like oil spills, fires, the leak of radioactive material and damage to property are harder to clean-up as they have a higher impact in a shorter span of time.
- **Global Warming:** With the rise in industrial pollution, global warming has been increasing at a steady pace. Smoke and greenhouse gases are being released by industries into the air which causes an increase in global warming. Melting of glaciers, extinction of polar bears, floods, tsunamis, hurricanes are few of the effects of global warming.

7.4.2 Causes of Ill-Effects of Industrialization

The above stated ill-effects are caused due to the following reasons, which need analyses by the policy makers to control the cruelty on earth:

- **Lack of Policies to Control Pollution:** Lack of effective policies and poor enforcement drive allowed many industries to bypass laws made by the pollution control board which resulted in mass scale pollution that affected the lives of many people.
- **Unplanned Industrial Growth:** In most industrial townships, unplanned growth took place wherein those companies flouted rules and norms and polluted the environment with both air and water pollution.
- **Use of Outdated Technologies:** Most industries still rely on old technologies to produce products that generate a large amount of waste. To

avoid high cost and expenditure, many companies still make use of traditional technologies to produce high-end products.

- **Presence of a Large Number of Small Scale Industries:** Many small scale industries and factories that don't have enough capital and rely on government grants to run their day-to-day businesses often escape environment regulations and release a large number of toxic gases in the atmosphere.
- **Inefficient Waste Disposal:** Water pollution and soil pollution are often caused directly due to inefficiency in the disposal of waste. Long term exposure to polluted air and water causes chronic health problems, making the issue of industrial pollution into a severe one. It also lowers the air quality in surrounding areas which causes many respiratory disorders.
- **Leaching of Resources From Our Natural World:** Industries do require a large amount of raw material to make them into finished products. This requires the extraction of minerals from beneath the earth. The extracted minerals can cause soil pollution when spilled on the earth. Leaks from vessels can cause oil spills that may prove harmful for marine life.

Check Your Progress 3

What are the ill-effects of industrialization on environment?

Notes: (a) Space is given for your answer.

(b) Compare your answer with the one given at the end of this Unit.

7.5 Let Us Sum Up

Development policies across the countries have led to destruction of environment leading to other socio-economic features like inequality, migration, regional conflicts etc. These features have raised issues of research and study. This Unit has covered features of inequality, displacement and cruelty with earth, which are burning issues of discussion in different Summits. The complex nature of environment – population

linkages makes it difficult to develop policy recommendations that are as concrete as many would like. However, it is apparent that environmental degradation and resource depletion may play a contributing role in affecting population movement, often filtered through contexts of poverty and inequity. In turn, it is clear that some population movements—particularly large scale, mass movements—have a negative impact on the natural environment of receiving regions. In order to develop a more concise policy agenda, it is imperative that further attention be given to the links among environment, population and poverty; to which groups are most vulnerable to environmental change; and to identifying vulnerable regions and future “hot spots” of insecurity and potential migration/refugee pressure.

Check Your Progress: The Key

1. Inequality has been on the rise across the globe for several decades. Some countries have reduced the numbers of people living in extreme poverty. But economic gaps have continued to grow as the very richest amass unprecedented levels of wealth. Among industrial nations, the United States is by far the most top-heavy, with much greater shares of national wealth and income going to the richest 1 percent than any other country.
2. Development projects have been identified as the main cause of displacement. These types of development projects leading in causing displacement, include water supply projects (dams, reservoirs and irrigation), energy, Agricultural expansion; parks and forest reserves, population distribution schemes, and Urban infrastructure and transportation projects. In the urban context, the type of projects involving forced displacement and resettlement include environmental improvement projects (urban beautification, infrastructure and services projects like roads, education and health facilities, water supply and sewerage systems), slum upgrading programs and those related to urban economic growth (industrial estates, transport corridors, economic ancillaries and infrastructure) and non-urban programs which extend beyond the project location and pose a threat to urban inhabitants such projects are like reservoirs projects. Displacement caused by these projects is termed as development – induced displacement.

3. Industrialization contributes major part for the economic development and prosperity of a country. On one hand it provides employment opportunities and wealth generation while on other hand it leads to following environmental deterioration:
- It leads to the depletion of natural resources.
 - It leads to air pollution, water pollution and soil pollution.
 - Global warming, climatic changes are the major consequences of industrialization.
 - It causes acid rain.
 - It leads to the degradation of land quality.
 - It leads to the generation of hazardous waste whose safe disposal become a big problem.
 - These industries are responsible for the following adverse diseases and ill effect like silicosis and pneumoconiosis, tuberculosis, skin diseases and deafness.

References

- Deepika Bhandari, R. K. (2015). Effect of Industrialization on Environment (Indian Scenario). *Global Journal for Research Analysis*, 281-281.
- Ghosh, J. (n.d.). Inequality in India: Drivers and Consequences. *World Social Science Report - Current Trends in Inequalities*, 89-92.
- Lama, M. P. (n.d.). Internal Displacement in India: Causes, Protection and Dilemmas. *Forced Migration Review*, 24-26.
- Lonergan, S. (1998). The Role of Environmental Degradation in Population Displacement. *Environmental Change and Security Project Report*, 5-15.
- Lucas Chancel, T. P. (2017, July). Indian Income Inequality, 1922-2015: From British Raj to Billionaire Raj. *WID.WorldWorkingPaper Series No 2017/11*. World Inequality Database.
- Sarah Opitz Stapleton, R. N. (2017). *Climate Change, Migration and Displacement*. New York: UNDP.

Unit-8: Sustainability

Unit Structure

8.0 Learning objectives

8.1: Introduction

8.2: Concept of sustainability

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8.2.3. Sustainable yields

8.2.4. Resilience

8.2.5. Consumption Priority View

8.2.6. Socio-Political Viewpoint

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8.4: Limitations of sustainability

Summary

8.0 Learning objectives

After studying this unit you are able to understand about:

- Sustainability and the concept of sustainability
- Principles of sustainability
- Limitations of sustainability

8.1: Introduction

Development and sustainability issues have remained at the core of concern for a majority of class of environmental economists. These issues were first highlighted in a book *The Limits to Growth* (Meadows et al, 1972), which held environmental constraints as a significant factor in slowing down of world economic system in the middle of the twenty-first century. The book received a mixed response from the economists but was able to stimulate economists' interest in environmental resources.

The limits discussed in this book were in terms of:

- The amount of land available for agriculture;
- The amount of agricultural output producible per unit of land in use;
- The amounts of non-renewable resources available for extraction;
- The ability of the environment to assimilate wastes arising in production and consumption, which falls as the level of pollution increases.

All these proposed limits would result in sudden and uncontrollable decline in both population and industrial output amid unrestricted industrialization and resource extraction. Concerted efforts would then be needed to restore ecological and economic stability that is sustainable far into the future. Thus it becomes important to explore existing and effective substitutes of environmental services to overcome various limits to growth. Daly (1987) discussed two aspects of limits to growth. First the bio-physical limits governed by laws of thermodynamics and other dynamics of ecosystems. The second aspect talks about the will or desirability of growth, rather than its feasibility. Daly states the following propositions about limits to growth:

- The future generations pay the price of current generations' pursuits of growth in terms of depleted stock of resources.
- Growth is in turn affected by the extinction or reduction in the number non-human species whose habitat is taken over for higher growth rates.
- The growth or will to grow is usually driven by vested interests and a scientific-technocratic worldview.

Trade expansion does offer economic benefits and various empirical studies testify that these economic benefits trickle down to elevate living standards of poor people as a group in the society. However, the environment consequences of trade expansion need to be assessed before a case for free trade is proposed on the basis of economic benefits it offers. Poor countries are usually rich in endowment of natural resources like forests or fisheries. Expansion of trade may only mean extraction of these resources at the expense of livelihood of many poor people. For eg. timber concessions to private logging firms in order to promote exports cause deforestation which in turn leads to increased siltation and risk of floods. The victims are the scattered group of poor farmers and coastal fishermen who are usually not compensated by private logging firms, making the firms' private cost of logging less than the true cost of logging. This reasserts that the environmental impacts of free trade must not be ignored. Climate change is another concern that intertwines the environment and economics. Intergovernmental Panel on Climate Change (IPCC), an organization representing mainstream scientific opinion, apprehends climate change to be the result of exploitative human activity. Emission of carbon dioxide (CO₂) into the atmosphere is one of the most important factors that influence climate change. CO₂ absorbs infra-red heat at a constant rate and at a higher rate than nitrogen and oxygen—the main

constituent parts of the atmosphere. Hence an increased amount of CO₂ in the air leads to warming up of air. According to scientists at IPCC, indiscriminate burning of fossil fuels to catalyze economic growth is responsible for large increases in CO₂. In the United States, for example, 38% of the CO₂ produced in 2012 came from generating electricity and 32% came from vehicle emissions (the rest came from industrial processes, buildings and other smaller CO₂ production). People also contribute to release of CO₂ when they cut down forests for farmland and pasture (The Economist, 2 Nov 2014).

Sustainable Development has many dimensions to it apart from just ecology and environment. In this module we discuss various concepts of sustainability emanating from its interdisciplinary nature.

8.2: Concept of sustainability

Sustainability translates into the ethical concern for future generations and the need to incorporate this concern into current planning and decision making of economic activities. The concern for future generation affects the use of environmental resources in current production and also the current decision making process. There are various parameters through which sustainability issues can be comprehended and one of them is through our understanding of different consumption patterns. Utility functions where consumption is the only argument, and where utility increases with consumption is a standard proposition to address inter temporal distribution issues. The idea of sustainability as non-declining consumption is the concept of sustainability that is most widely used in economic analysis. However, constant consumption for indefinite time period into the future, at any rate other than zero, satisfying various constraints of social welfare maximization problem might not be sufficient to explain and address sustainability issues in totality.

The six core concepts of sustainability:

The following core concepts of sustainability define a sustainable state as where:

- 1) The utility or consumption is non-declining through time.

- 2) The resources are managed so as to maintain production opportunities for the future.
- 3) The natural capital stock is non-declining through time.
- 4) The resources are managed so as to maintain a sustainable yield of resource services.
- 5) The minimum conditions for ecosystem resilience is satisfied through time.
- 6) The consumption approach to environmental sustainability, where consumption needs to be optimized over time and space.
- 7) Consensus building and institutional development are considered imperatives for sustainable development.

8.2.1. Economists' viewpoint

Two first two concepts are the economic concepts of sustainability. A sustainable state is one in which utility/consumption is non-declining through time and in which resources are managed so as to maintain production opportunities for the future. Definitions proposed by various economists in support of these concepts are given in table 4.1

	Definitions of Sustainability
Pezzy 1992, pg 323	Sustainability is defined as non-declining utility of a representative member of society for millennia into the future.
Page 1977, pg 202; 1982, pg 205	Preserving opportunities for future generations as a common sense minimal notion of intergenerational justice.
Brundtland Report, WECD (1987, P43)	Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Solow 1986	We have no obligation to our successors to bequeath a share of this or that resource. Our obligation refers to generalised productive capacity or, even wider, to certain standards of consumption/living possibilities over time.
Jha and Murthy (2000)	When we say that a contemporaneous profile of consumption is not sustainable, then it probably means that a switch in consumption either spatially and/or over time would improve global welfare, again perceived as a magnitude referring to the indefinite future.

Constant consumption and equal opportunities are closely linked in economics. For many economists, the opportunities that matter are consumption opportunities. In this sense sustainable development is not only about leaving behind stocks of resources

for our future generations, but rather the capability to do things we do with those resources. In other words sustainability involves providing same consumption opportunities if not any more to our future generations so that they have the capabilities to do the same things that we do using the current stock of resources. If we cannot bequeath to our successors something that is a substitute for non-renewable resources, then to honour our ethical commitment, we do have an obligation 'to bequeath a share of the resources that we currently use.

The third concept of sustainable state (non declining natural capital) brings us to the differentiation between weak and strong sustainability. Both the perspectives of sustainability (weak and strong) define sustainability in form of constant utility or consumption through time. However they differ in the ways in which the state of constant consumption (or utility) is realized. As developed in the literature, the weak versus strong sustainability debate makes extensive use of the notion of 'natural capital'. To explain this concept we first define total stock of capital as sum of human made capital and natural capital. Human made capital consists of physical (plant, equipment, buildings and other infrastructure), human capital (stocks of learned skills) and intellectual capital (disembodied skills and knowledge like state of technology). Whereas, the natural capital may refer to all naturally provided stock like water, soil, forest, fisheries etc.

This way of classifying production inputs helps in denoting the economy's production function in summary representative form as:

$$Q = F(L, KN, KH)$$

where L represents labour, KN natural capital and KH human-made capital. Within this framework, the difference between weak and strong sustainability lies in the extent of the substitution possibilities between KN and KH. Proponents of strong sustainability argue that sustainability requires the level of KN to be non-declining. This conforms to the third core concept of sustainability. Proponents of weak sustainability argue that it requires the sum of KN and KH must be non-declining. Sustainability as non-declining KN assumes that possibilities for substituting KH for KN are limited.

8.2.2. Ecologists' viewpoint

The fourth and fifth core concepts of sustainability reflect the viewpoint of ecologists. The fourth core concept is based on the sustainable yields in the economy and the fifth

is based on meeting minimum requirements to uphold resilience of ecosystem. Both the concepts are explained below along with the observations on the general approach to policymaking process that is frequently advocated by ecologists.

8.2.3. Sustainable yields

Existing stocks of renewable resources like flora and fauna have the potential to grow by the means of natural reproduction. Their stock size in any given period depends upon the balance between the rate of their natural growth and the rate of harvest. If in any period the resource harvest exceeds its natural growth, stock size reduces. However, if the harvest is less than natural growth, stock size grows. Stock size of a few renewable resources may fall continuously or even exhaust if the rate at which they are harvested, exceeds the rate at which they replenish themselves. If the rate of harvest is the same as the rate of natural growth, stock size remains constant and the resource can be used indefinitely into the future at a constant rate. If for a period of time the stock being harvested remains equal to the amount of net natural growth of the resource and these magnitudes remain constant over a sequence of consecutive periods, it is called the steady-state harvesting. The constant magnitude being harvested is called the sustainable yield as, in the absence of exogenous shocks, it can be maintained or sustained, indefinitely. The concept of sustainable yield runs into difficulty in the case of extraction of non-renewable natural resources. For non-renewable resources, natural growth is zero, so that the only sustainable rate of harvest for a non-renewable resource is zero. However, this situation may be partly countered if some proceeds from the economic progress made with the use of non-renewable resources can be used to generate the capacity to provide substitutes for the resource.

8.2.4. Resilience

Concept of resilience is of fundamental importance in ecology. Holling (1973, 1986) describes resilience as the propensity of an ecosystem to retain its functional and organizational structure following a disturbance, without undergoing catastrophic or discontinuous change. Resilient ecosystem does not necessarily imply that all of its component populations remain stable. If the ecosystem continues to function in the

same way, even after a component population disappearing as a result of disturbance, the ecosystem is said to exhibit resilience.

In more technical interpretation, resilience relates to the size of the parameters of the relationships determining ecosystem structure and function in terms, say, of energy flows through the system. A resilient ecosystem is characterized by parameters that are not affected by shocks to the system. However, some economic activities appear to reduce resilience, but the extent of this cannot be known ex-ante. In other words, we can judge the resilience of ecosystem after a disturbance has taken place but we may not be able to infer ex-ante that ecosystem will remain resilient far in future against any shock that comes by. Uncertainty pervades the behaviour of ecological systems, and hence one cannot know in advance that whether some system is resilient or not.

This is the reason why ecologists give more importance to uncertain nature of ecosystem while conceptualising the sustainability problem and considering policy responses to it. Ecologists advocated the precautionary principle according to which, valid opinions against any action that may have adverse environmental impacts must be presented, before the action is permitted. Thus for approval on the action, it should be necessary to show convincingly that such adverse impacts will not occur. Maintaining the safe minimum standard is another closely related idea wherein actions that may entail irreversible adverse environmental impacts should not be undertaken unless it can be shown that not undertaking the action, would give rise to unacceptably large social costs.

8.2.5. Consumption Priority View

“Human activity (anthropogenic) is essentially the cause of environmental degradation. In as much as human activity as is necessary for a minimal standard of living, it is justified. Accordingly, much of degradation that is caused in the process of such human activity is warranted. This lays down the basis for the notion of sustainability. If current economic activity causes degradation of the environment beyond such justifiable limits it compromises the health, standard of living and the very existence of future generations (Murthy (2011), p. 289).

This notion of sustainability does not endorse 'non-declining consumption through time,' which is based on the notion of a continuous increase in the level of consumption. The alternative though in this approach is that sustainability is a problem of optimization and not the sustenance of a certain level of consumption. This can be achieved by redistribution of consumption across time and space. It does not rule out increase in consumption in repressed economies. It does not rule out suppression of consumption in such economies where it is excessive. In this sense, 'non-declining consumption' is not desirable in any absolute sense. This new notion of sustainability is not based on natural resource economics. Nor is it based on neo-classical economics. It is also not based exclusively on social discount rate. It does not treat technology and production as the basis of sustainability. The level and distribution of consumption is the purported basis of the new notion of sustainability.

8.2.6. Socio-Political Viewpoint

The sixth core concept of sustainability puts in place consensus building and institutional development as vital components in discussion of sustainability. Although economists and ecologists do recognize that sustainability issues entail both socio-political and cultural dimensions, this sort of view of sustainability is found mainly in the writings of political scientists and sociologists. This view lays primary focus on developing processes to ensure sustainable development, rather than looking at outcomes or constraints. Some important definitions of sustainability justifying this view point were proposed by de Graaf et al (1996).

.... development of a socio-environmental system with a high potential for continuity because it is kept within economic, social, cultural, ecological and physical constraint it is kept within economic, social, cultural, ecological and physical constraints.

And ...

development on which the people involved have reached consensus.

For many years, it was thought that the eradication of poverty required well-designed development programmes that were largely independent of considerations relating to the natural environment. But perspectives have changed post 1970's. During the 1970s, a concern for sustainability took form of the international political agenda as

was widely discussed in a series of international conferences. The common feature of these debates was the interrelationship between poverty, socio-economic & cultural development and the state of the natural environment. It has now become difficult to separate environmental objectives from other social and political objectives as their interdependence cannot be ignored. Rather such interdependence is seen as both pervasive and complex. Perhaps the 1987 report of the World Commission on Environment and Development, popularly known as Brundtland report set the agenda for much of the subsequent discussion of sustainability with the institutional dimension. In political terms the Brundtland report was an influential piece of work which highlighted that sustainability problems are set in the framework of economy-environment interdependence. Thus, according to the Brundtland report:

Environment and development are not separate challenges: they are inexorably linked. Development cannot subsist on a deteriorating environmental base; the environment cannot be protected when growth leaves out of account the costs of environmental protection (p37). The Brundtland report simply urges that national governments merge environmental and other considerations in their decision making as conventional approaches to the sustainability issues may not be sufficient. Though the Brundtland report stressed upon economic systems with environmental dimensions, the proponents of institution and consensus building consider cultural development, political will and feasibility as additional core components of sustainability. In proposing a new strategy, de Graaf et al. urge that one must not view the attainment of sustainability as simply a technical problem. Necessary and sufficient conditions for sustainability cannot represent the problem comprehensively in the presence of fundamental limits to our ability to know the consequences of human behaviour.

Consensus building should be attempted through negotiations. The notion of negotiation that de Graaf et al had in mind was very broad, referring to an institutional process of social choice that involves people as widely as possible, and involves a process of trade-offs in which all benefit from the avoidance of environmental disturbances. According to de Graaf et al, research should be focused on the structure and management of these negotiations, and on the supply of relevant information about avertable problems steerable development.

8.3: Principles of sustainability

Economic production, trade and consumption are driving changes to the natural environment. The natural environment encompasses the physical, chemical, and biological surroundings that support life on earth. The economy is dependent on the environment for (i) the extraction of resources to be used as inputs to production, (ii) the disposal of waste, (iii) the provision of environmental services.

However, the earth's resources are finite and there is a theoretical upper limit to the quantity of resources that can be extracted and a limit to the capacity of the natural environment for the assimilation of waste. For the economy to be sustainable, the production of economic goods must not diminish the capacity of the environment to provide resources and environmental services or contribute to social difficulties such as poverty, unemployment or inequality (Hirsch, 1976)

The United Nations World Commission on Environment and Development published *Our Common Future* in 1987. This report identified 'sustainable development' as a crucial and integral component to future economic growth:

"Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs." -(WCED, 1987) *Our Common Future*, p.16

The modern definition of sustainable development recognises three principle aspects to sustainability: economic, environmental, and social. The objective of sustainable development can be thought of as maximising the synergies between these elements through an adaptive process of trade-offs, such as that shown in Figure 1 (Barbier, 1987).

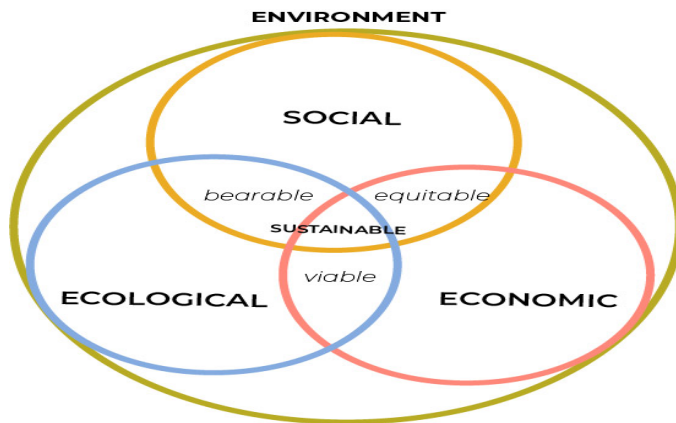


Figure 1. Conceptual model of sustainability, comprising the social, economic and ecological principles and their overlapping dimensions within the environment.

Accessible description for Figure 1: A large circle represents the system boundary of the environment. Within this circle, a Venn diagram contains three overlapping circles. The three circles are titled 'social', 'economic' and 'ecological'. Where the social and environmental circles overlap, the area is titled 'equity', where the economic and ecological circles overlap this is titled 'viable', where the ecological and social areas overlap this area is titled 'bearable'. Where all three circles overlap, this is titled 'sustainable'.

In 2015, leaders of all 193 countries of the United Nations adopted Agenda 2030, "Transforming our world: the 2030 Agenda for Sustainable Development". Agenda 2030 introduced the 17 United Nations Sustainable Development Goals as a call to action to end poverty, protect the planet and improve the lives and prospects of everyone, everywhere (United Nations, 2015).



Figure 2. The United Nations (2015) Sustainable Development Goals

Accessible description for Figure 2: Icons representing the following united nations sustainable development goals: Alt text for Figure 2: Icons representing the following united nations sustainable development goals: 1 No Poverty, 2. Zero Hunger, 3. Good Health and Well-being, 4. Quality Education, 5. Gender Equality, 6. Clean Water and Sanitation, 7. Affordable and Clean Energy, 8. Decent Work and Economic Growth, 9. Industry, Innovation and Infrastructure, 10. Reduced Inequality, 11. Sustainable Cities and Communities, 12. Responsible Consumption and Production, 13. Climate Action, 14. Life Below Water, 15. Life on Land, 16. Peace and Justice Strong Institutions, 17. Partnerships to achieve the Goals.

8.4: Limitations of sustainability

Organisations often face barriers when implementing sustainability into their strategy and projects. Doppelt (2003) has identified seven types of these limitations that organisations often fail to overcome and he calls them blunders. He suggests solutions to them and points out that by becoming aware of these blunders reduces the risk of them taking place (Doppelt, Overcoming the Seven Sustainability Blunders, 2003). The blunders are following:

- A. Patriarchal thinking
- B. The silo approach to environmental and socio economic issues
- C. No clear vision of sustainability
- D. Confusion over cause and effect
- E. Lack of information
- F. Insufficient mechanisms for learning
- G. Failure to institutionalize sustainability

A. Patriarchal thinking

Organisations often adopt a patriarchal thinking where employees only do what management orders. Therefore the employees abandon personal responsibility and create a false sense of security in the organisation. The most important step to avoid this blunder is to disturb the organisational control mechanism in order to point it towards a new way of managing. Employees have to be open to new ways of thinking and taking actions and therefore the false sense of security needs to be undermined (Doppelt, Overcoming the Seven Sustainability Blunders, 2003). Project groups in project organisations have a certain degree of autonomy and that is usually higher than individuals have in non-project based organisations (Forsyth & Danisiewicz, 1985). High autonomy of project teams minimizes the likelihood of patriarchal thinking to take place (Doppelt, 2003) and it requires a steering group made up of department managers and project managers to integrate the project group into the organisation (Hovmark & Nordqvist, 1996).

B. The silo approach to environmental and socio-economic issues

Executives often see sustainability as a special program that is not intergraded into the organisation's or project's processes (Doppelt, Overcoming the Seven Sustainability Blunders, 2003). Although Badiru (2010) explains how project sustainability indicates that sustainability exists in all aspects of the project. Doppelt (2003) calls the imperfection of project sustainability the silo approach to environmental and socio-economic issues. He suggests that project teams in the organisation should be mixed up in order to bring fresh perspective and new ideas to the table, this requires involvement of people from every function of the organisation and key stakeholders.

C. No clear vision of sustainability

No clear vision of sustainability is Doppelt's (2003) third blunder and often it reflects in organisations having a negative vision that focuses on what not to do. That does not go hand in hand with sustainability and depresses human motivation. The alternation of organisational goals towards sustainability is Doppelt's (2003) advice and he recommends backcasting in order to do so. Backcasting is a tool used in strategic planning for sustainability. The main ideology behind it is to generate a desirable future and from there look to the present and find ways to move to the desired future by using strategy, pathways and planning (Vergragt & Quist, 2011). The ideas produced with backcasting are often perceived as a political standpoint and therefore they lose their value (Dreborg, 1996). It is also vital in the vision creation process that many employees are involved in the process, that way it is more likely that they will understand and incorporate it better (Verhulst & Boks, 2012; Lewis et.al., 2006).

D. Confusion over cause and effect

The fourth blunder is confusion over cause and effect where the main focus is usually on the symptoms of sustainability challenges instead of designing out root causes. Organisations spend a lot of money on mitigations of emissions and discharges when they should be focusing on the causes of these results (Doppelt, Overcoming the Seven Sustainability Blunders, 2003). Hart & Milstein (1999) point out that addressing pollution to minimize resources use and to improve community and stakeholder relations are just superficial actions that do not conduct to a sustainable organisation. In order for organisations to focus on the cause not the effect Doppelt (2003) suggest that new operational and governance strategies be implemented.

E. Lack of information

Organisations often fail to communicate effectively the purpose and strategy of their sustainability efforts and Doppelt (2003) describes it as lack of information. This is often seen in project based organisations where the project divisions make it difficult to have unified strategy and for knowledge to be diffused across projects (Newell et.al., 2003). Trainings, sign posting and scattered events are unsatisfactory to describe the commitment the organisations have made to sustainability (Doppelt, Overcoming the Seven Sustainability Blunders, 2003). In the change management literature the emphasis is on giving important stakeholders as much information as possible early in

the project process. It is also important to constantly repeat the change messages in a clear and consistent way (Verhulst and Boks, 2012; Lewis et.al., 2006). Human behaviour, social values and attitudes towards the world and environment are facilitated by communication and humans construct their reality on the basis of perceptions and experiences (Godemann & Michelsen, 2011). Therefore transparency and honesty in communications is the key to avoid the fifth blunder (Doppelt, Overcoming the Seven Sustainability Blunders, 2003). By constantly communicating the messages across to employees with structured dialogue the members feel more involved in the process (Lewis et.al., 2006). Eventually sustainability will become the languages of the organisation (Doppelt, Overcoming the Seven Sustainability Blunders, 2003). Languages are a vital part of communications and it constructs reality and social actions as well as allowing humans to find orientation and coordinate action. The meaning of our world is expressed with the relationship between words and the boundaries of our languages points to the boundaries of our world. It is therefore important to learn to express sustainability with words (Siebert, 2011). Sustainability communication is the human process of dealing with future development of society towards sustainability. It provides a framework for understanding a wide variety of social systems and actors such as the interactions amongst individuals, between individuals and institutions, between and within institutions, in the media and politics as well as on different levels; regional, national and international. When changes in individual attitudes and behaviour are connected to sustainability communication the modifications in lifestyle take on a special meaning, however only emphasising the importance of the concept is not enough to trigger change in a population. Communication about sustainability is about communicating knowledge (Godemann & Michelsen, 2011).

F. Insufficient mechanisms for learning

Organisational learning and the motivation for employees to test new ideas are important to overcome barriers to change. Doppelt (2003) calls failure in these areas insufficient mechanisms for learning. Organisation must alter their feedback and learning mechanisms so that employees and stakeholders are motivated to develop their skills, knowledge and understanding. According to Lewis et.al. (2006) the management literature recommends adapting a two-way communication route with the

employees and highlights the importance of being a good listener in order to provide productive feedback. Communications along with educational procedures make individuals able to actively participate in shaping a sustainable society by endorsing individual engagement, encourage political education and strengthening civil society (Godemann & Michelsen, 2011). Training and education is one of main ways to overcome barriers to implementation of sustainability (Esquer-Peralta, Velazquez, & Munguia, 2008). Sustainability communication is managed with methods and tool to influence the process. One method is empowerment of strategies, which is about helping people recognise non-sustainable actions and apply knowledge about sustainability in order to rectify them. The ultimate goal is to involve people in shaping the conditions of their own life. Education processes for sustainability have the mission of sharpen individual awareness in both private and personal life. In order for them to be able to take action against non-sustainable doings, evolve their problem-solving skills and make suitable changes in their behaviour. (Godemann & Michelsen, 2011). The critics on educating for sustainability point out that the education lacks grounding in educational theory and that it is rather politically driven (Bormann, 2011).

G. Failure to institutionalize sustainability

The last blunder Doppelt (2003) talks about is the failure to institutionalize sustainability. Few organisations have successfully implemented sustainability-based thinking into everyday processes, policies and culture. One of main difficulties with the implementation of sustainability is the problem of how humans think, human values and perceptions might not be in line with sustainability values (Millar, Hind, & Magala, 2012; Marshall, Coleman, & Reason, 2011; Brown, 2005). Doppelt (2003) recommends that parameters be adjusted by aligning systems and structures with sustainability. This is a continuous process and the organisation needs to incorporate new ways of thinking and acting in how it does business (Doppelt, Overcoming the Seven Sustainability Blunders, 2003). Focusing on involvement and empowerment is important to get the employees engaged and enthusiastic in the implementation process. Which in turn will make them participate actively and enables new sustainable culture to prosper inside the company (Verhulst & Boks, 2012). To implement sustainability change it has to be rooted in personal value systems because the initial sources of sustainability barriers can be traced to personal cognitive frameworks (Millar, Hind, & Magala, 2012). In order for companies to live up to their values as

being a sustainable organisation they have to train their future leaders. Not only do they have to deal with complex economic, social and environmental problems but also practice leadership that makes a difference for the business and the world. Those companies that are ahead in this process have an internal steering committee of executives in order to bring different departments together. On top of that they have board of directors that have overview over their sustainability performance. Publishing of reports to show their progress in the area is also a factor in the process (Mirvis, Googins, & Kinnicutt, 2010).

Summary

The sustainability from economic perspective is constant, or non-declining, consumption (or utility) where as ecologists are more concerned about properties of biosphere such as resilience and maintaining healthy equilibrium between man-made and natural processes. Ecologists' perspective is similar to the idea strong sustainability, whereas economists' are drawn towards the concept of weak sustainability. However, one must also note that these concepts fall somewhat short in explicitly specifying the duration of time over which sustainability is to operate. If the idea of sustainability is to influence the policy makers, it must lay focus the time horizons in which the state of sustainability can be reproduced in perpetuity.

Doppelt's seven sustainability blunders describe the barriers organisations and project teams face when implementing sustainability. Keeping those blunders in mind reduces the risk of them taking place. To be able to recognize the benefits of implementing sustainability into projects and organisations it is vital to translate the sustainability strategy into measurable goals (Edwards, 2009; Epstein and Roy, 2001). But it can be hard for organisations to link project performance to higher-level goals and therefore the project's contribution to sustainable development is not always clear (Boswell, Wallace, & Boswell, 2005). Gilbert Silvius states that the impact of sustainability is not yet recognized in project management because of the way projects are managed, measured and reported does not fit with the sustainability concept. Therefore there is a growing need to practically implement the concept in the management of projects (Maltzman & Shirley, 2012, cited Gilbert Silvius).

References

- Barbier, E. B. (1987). The Concept of Sustainable Economic Development. *Environmental Conservation*, 14(2), 101–110. <https://doi.org/10.1017/S0376892900011449>.
- Hirsch, F. (1976). *Social Limits to Growth*. Harvard University Press. <https://doi.org/10.4159/HARVARD.9780674497900>
- United Nations. (2015). Transforming our World: The 2030 Agenda for Sustainable Development. <https://sdgs.un.org/publications/transforming-our-world-2030-agenda-sustainable-development-17981>
- WCED. (1987). Report of the World Commission on Environment and Development: Our Common Future. UN,. <https://digitallibrary.un.org/record/139811>
- Barbier, E. B. (1987). The Concept of Sustainable Economic Development. *Environmental Conservation*, 14(2), 101–110. <https://doi.org/10.1017/S0376892900011449>
- Hirsch, F. (1976). *Social Limits to Growth*. Harvard University Press. <https://doi.org/10.4159/HARVARD.9780674497900>
- United Nations. (2015). *Transforming our World: The 2030 Agenda for Sustainable Development*. <https://sdgs.un.org/publications/transforming-our-world-2030-agenda-sustainable-development-17981>.

Unit-9 Sustainable Development -I

Unit Structure

9.0 Learning objectives

- 9.1 Introduction
- 9.2 Sustainable Development Strategies (World)
- 9.4 Sustainable Development: Roots in Indian Philosophy
- 9.5 Millennium Development Goals (MDGs) in India
- 9.7 The GAIA Hypothesis
- 9.8 Summary
- 9.9 Glossary
- 9.10 Answers of Study Questions
- 9.11 References

9.0 Learning objectives

This unit will help you to learn about the following-

- Traditional concepts and the environment.
- Role of science streams for the environment.
- Root causes of environmental issues.
- Difference between environment and sustainability.
- Policies for sustainable future.
- Strategies followed by India for a sustainable future.

9.1 Introduction

As civilisation grew with time, the environment unintentionally and increasingly came to be treated as a field of unlimited space with ample resources for those with the power and mental skills to manipulate these natural resources. Without the knowledge of the natural resources' distribution, the exploitation of resources was intensified in a manner which further unbalanced the ecosystem system and the time to recover natural resources itself was enough.

The course of human history has been one of increasing capacities to modify and manipulate the environment. To manipulate its resources and to move into new farming lands at the expense of weaker sections when resources became

insufficient to satisfy appetites, personal and social competence emerged as main objectives of education in for this progress.

The explosive growth of human populations and the impacts of modern technology have been such that limits to growth and the penalties of wasteful-management have become familiar issues at a global level. Science availed the photographs of our planet captured from space and gave the public in the 1960s and 1970s a powerful visual image of finite resources. From here, the environmental education emerged as an essential part of the response to these dangerous perceptions.

9.2 Sustainable Development Strategies (World)

There are numerous pieces of evidence across the world that our ancestors or primitive peoples have exceeded the carrying capacity of the lands like- slash and burn agriculture pattern sounds less harmful for the ecology but proved penetrated highly the atmosphere if analysed in terms of shifting cultivation pattern of certain regions.

Sustainable development strategies are a continuing process that combines aspects of formal planning and incremental learning with emphasise on institutional policymaking. Sustainable decision-making involves political decisions at the national, regional and local levels, which aim at a balanced development of socio-environmental systems in their particular jurisdiction. A tough question in sustainable decision-making is that of defining and measuring sustainable development.

After the publication of the Brundtland report (1987), the concept of sustainability has gained rapid attention among researchers, policy-makers and scientists. The Brundtland report described that ‘Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs’.

Among the results of the Earth Summit (held in Rio de Janeiro, Brazil in 1992), Agenda- 21 is a comprehensive list of progressive actions needed to achieve sustainable development at the global level.

150 states committed themselves to start the actions which will render future development sustainably but without the scientific tools to guide policy-making towards sustainable directions.

Decisions leading to sustainable development expected to be based on scientific data and adequate information which were later addressed as the indicators of sustainability. Many researchers recognize that sustainable development is a function of two major components-

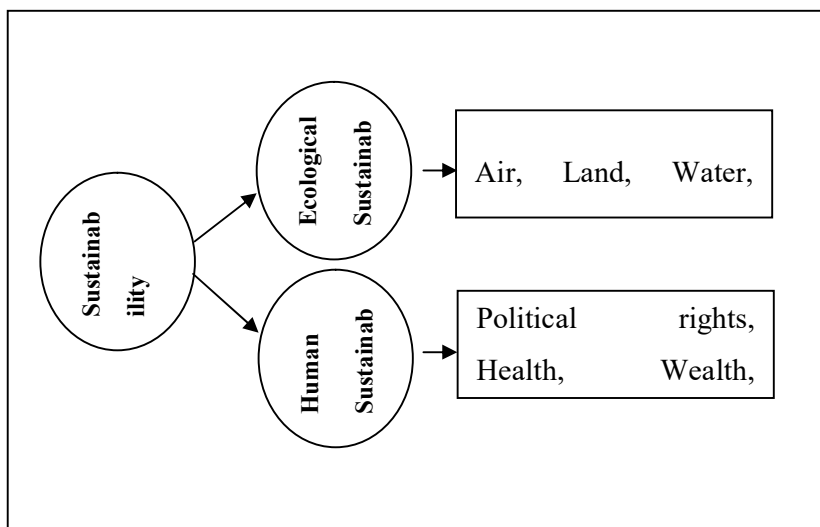
- Ecological and
- Human.

Above components derives that sustainable decision-making should have two simultaneous goals-

- protection and improvement of the environment as a dynamic practice
- human development index to secure high standards of living

Now it is clear that sustainable development ought to have environmental, economic, political, social, and cultural dimensions simultaneously. Ecological sustainability with water, land, air and biodiversity, and human sustainability with political-rights, health, wealth and education, is referred to as the primary components of sustainability.

The following graph illustrates this relationship-



Graph: 9.1:

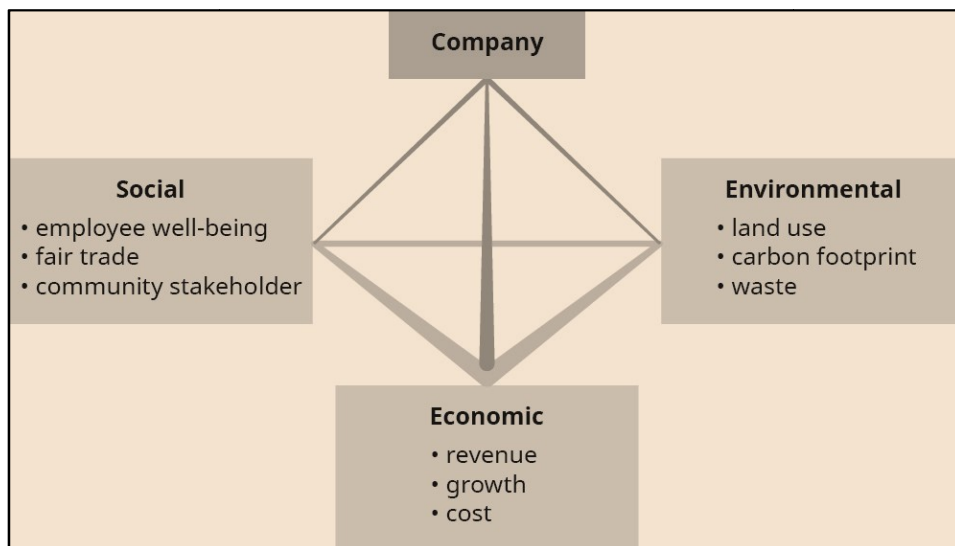
Components of Sustainability/ Source: Self elaboration

There are many evidences that the development process is currently unsustainable. Ozone depletion, global warming, climate change, species extinction, the collapse of water bodies, soil erosion and air pollution are among the obvious signs of ecological distress. Climate change has now become a hot topic of conversation all over the world.

Indigenous peoples were and are inevitably closer to the land and its ecology for their survival. They are more likely to learn from their ecological misbehaves than modern people as there are many modes of transportations are now available across the world.

Environmental issues such as climate change and global warming have come to the foremost attention of the public as well as of business. Throughout the world, everyone is noticing these climatic changes and accepting that global warming is causing such change.

The argument that the corporate excesses have gone beyond the limits are starting to become disclosed and due to effects on large numbers of people, and awareness raised on the social behaviours of corporations. This is one reason why the issue of Corporate Social Responsibility (CSR) has become a much more prominent feature of the corporate landscape.



Graph: 9.2: Corporate Social Responsibility/ Source: BC Open Textbooks

There are many contemporary works of literature available that deal with sustainability focuses on human population and the effects of the growth rate on the environment and global sustainability.

The decreased attention of the scientific debate on the possible consequences of population growth on the Earth's ecological equilibrium has led to progressive indifference. There is an attitude of extreme caution by political authorities and institutions in dealing with the issue of demography and its consequences for global dynamics. Hence, more and more attention is paid by governments and institutions to the partnerships and international agreements to reduce greenhouse gas emissions and to combat climate change to achieve the goals toward sustainability and development.

Many demographic studies suggest that the growth forecasts for 2100 and beyond will be well within the capacity of our production system.

The World Conservation Strategy was based on the following three requirements-

- The maintenance of life-support systems,
- The preservation of genetic diversity (extending to species and habitat diversity) and
- The sustainable use of natural resources.

In a contribution to The Observer Magazine (1975), Higgins encompassed seven enemies of the mankind- among six were the- population explosion, food shortages, other resource scarcities, environmental degradation, misuse of nuclear capacities and uncontrolled technology. The seventh and more hazardous enemy was the nature of humankind itself. There were various instances in the world that proved this right.

If we try to treat the environment holistically, then we must go along with education. The holistic approach will not be complete until education has its place in the whole system of environmental protection. It is necessary to remind people constantly that our environment is the totality of what we live in, visible or invisible.

Study Questions: 1

Answer the following questions as True/ False –

1. Our ancestors never damaged ecology.
2. Slash and burn is a cultivation method.
3. The 'Brundtland report' was published in the year 1987.
4. Sustainable development considers the need for the present generation only.
5. Agenda-21 paves the way for economic development.
6. The health sector is a part of ecological sustainability.
7. Corporate Social Responsibility (CSR) is a set of strategy for sustainability.
8. According to Higgins, the most dangerous enemies of mankind is human itself.

9.4 Sustainable Development: Roots in Indian Philosophy

Respect to everyone is the core part of the Indian philosophy, be it for nature or for knowledge. This respect, is in fact, the incense of the modern-day sustainability and eco-conservation debate. The Indian culture incorporates respects, rituals and celebrations each day around cycles and forces of nature.

Now, the world strongly believes that unless people's moral and spiritual qualities are nurtured and developed in a harmonious way, the best of sustainability efforts will not become fruitful.

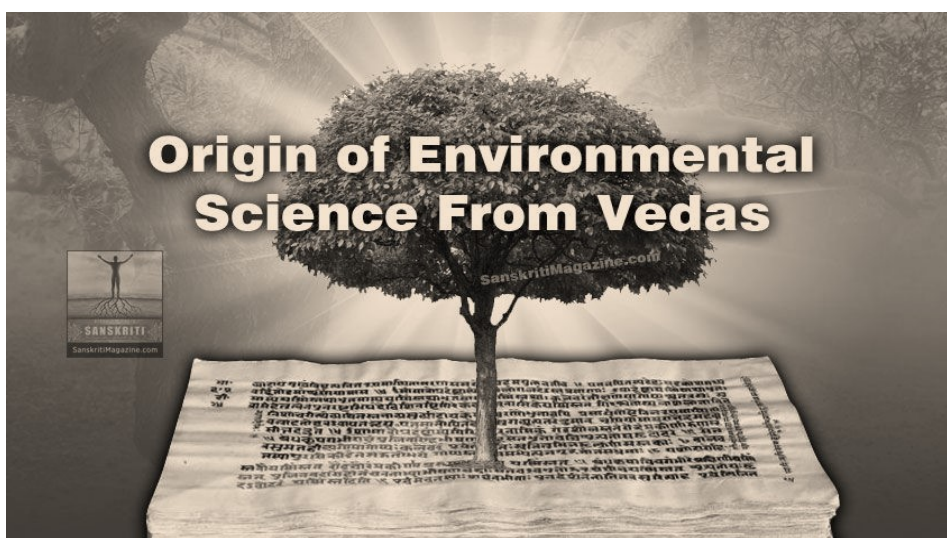
Most of the people in India, live in the way to achieve sustainable and harmonious living in all spheres of life through living with morality and spirituality at the individual level. The journey for world transformation starts indeed at the individual level and targets the world community in wide.

Sages in ancient India have even composed prayers and songs in praise of almighty human-life force and said that it is the essence of all creatures and creations. Undoubtedly, all of us acknowledge and recognise the uniqueness of ourselves and the cohabitants of our world. Despite this fact, we seem to be strangely neglectful of the natural resources that nurture us.

The Vedic philosophy of India has always emphasized for a harmonious and corresponding human connection with nature. Vedas have originated from ‘Aranyakas’ (forest-books) which were written by sages who lived in the forest and survived on natural produces. Even the ancient works of literature like- Mahabharata, Ramayana, Vedas, Upanishads, Bhagavad-Gita, Puranas and Smriti, contain some of the earliest and important ethical messages on ecological balance and the need for people’s ethical approach for nature.

In a short period of our human history as a species people have transformed their habitats and surroundings in many irreversible ways.

Modern-day unformed sustainability agendas revolve around environmental, social and economic prosperity which is well reflected in Indian type of livings and can be traced well across our beliefs, rituals and practices.



Graph: 9.3: Origin of environment from Vedas/ Source: Pinterest

The concept of nature has become the foundation of a relatively new discipline of philosophy called environmental philosophy. The scope of environmental philosophy is to gather knowledge of the relationship between living beings and their environment from different perspectives. This discipline also tries to find out the answer about the belief and knowledge that communities hold about nature and their moral interest towards nature.

Study Questions: 2

Fill in the blanks to complete the following sentences –

1. Respect is the core part of the philosophy.
2. Sustainability efforts will result only when qualities are nurtured.
3. Vedas have originated from
4. ‘Aranyakas’ was written by
5. Modern-day sustainability agendas are well reflected in the Indian type of livings, beliefs, rituals and
6. Environmental philosophy focuses on the concept of

9.5 Millennium Development Goals (MDGs) in India

The words nature and environment are used interchangeably by scholars in common parlance. The term environment is associated with the functional definition according to which our surrounding provides us with conditions for growth and development and is also a source of danger and destruction. In ecological sciences environment is described by scholars ‘consistency of both biotic and abiotic components available on our planet’.

As a discipline environmental ethics is relatively new but human concern for the environment and nature in the form of worships and practices has always existed from the past.

The idea that nature has its intrinsic value apart from the utilitarian values it has for human beings is a significant idea that forms the basis for what is called “bio-centric” vision of nature. These philosophers believe that human beings thought that they are separate from nature and use nature for our own survival is nothing but camouflage. So one must care for the environment because ultimately the human welfare depends on the environment in all aspects.

Millennium Development Goals (MDGs): An extreme measure to eradicate poverty and other evils from all over the world, the Millennium Development Goals (MDGs) were adopted by world leaders to combat eight social and economic concerns within their political boundaries. These goals were decided with a global vision and individual responsibility.

MDGs evaluation mandated a positive response among all stakeholder countries and their internal contributors too. Most of the indicators grabbed positive values, as a result, newer and comprehensive goals were adopted to meet holistic socio-economic reforms.

United Nations Development Programme (UNDP) supports a range of capacity building initiatives that address implementation challenges. UNDP works directly with central ministries and several states by strengthening capacities of representatives and officials at each level of governance. UNDP also participates in strategic programmes and schemes which are geared towards the achievement of MDGs and other National Development Goals.

India is a signatory to the Millennium Declaration adopted in September 2000. The targets of the MDGs eight development goals converge with India's own commitment towards the development goals to reduce poverty and other areas of deprivation.

India has witnessed significant progress towards the MDGs, as some targets achieved before the 2015 deadline.

For example- India has achieved the target for reducing poverty by half, but falling short of achieving the target for reducing hunger. Again, the country has achieved gender parity in primary school enrolment but was lagged behind on targets for primary school enrolment and completion. Overall, India has made progress in providing clean drinking water however; access to sanitation facilities remains inadequate.



Graph: 9.4: Eight MDGs/ Source: MoSPI

MDGs brought critical development challenges to the forefront and also embraced countries with a strong target-oriented agenda. India steps towards the right direction in some areas but the progress yet looking for some major reforms.

Goal 1: Eradicate Extreme Hunger and Poverty

In order to meet the MDGs, the Poverty Head Count Ratio (PHCR) level has to be 23.9%. In 2011-12, the PHCR was 21.9 per cent. indicating that India has achieved the poverty reduction target but the progress is uneven. The credit for this achievement is on both- economic growth (including the agriculture sector) as well as increased social spending on interventions such as MGNREGA and the National Rural Health Mission (NRHM).

India represents one-quarter of the world's undernourished population. It comprises over a third of the world's underweight children and nearly a third of the world's food-insecure people. Till 2015, malnourishment in all ages declined to 40 per cent but it is still below the target of reduction up to 26 per cent.

Section 1.01 Goal 2: Achieve Universal Primary Education

Universalizing primary education in India was a herculean task, but due to moderate efforts, India is on-track to achieve this Millennium Development Goal. Enrolment and completion rates of girls in primary school have increased drastically and are catching up with those of boys. This effort also lowered the gender biases. At the national level, the male and female youth literacy rate is likely to be at 94.81 per cent and 92.47 per cent.

In 2009, India introduced the Right of Children to Free and Compulsory Education Act (RTE) to improve the quality of education, especially at primary level.

Section 1.02 Goal 3: Promote Gender Equality and Empower Women

As of August 2015, the Indian parliament has only 65 women representatives out of 542 members in Lok Sabha, while there are 31 female representatives in the 242 member Rajya Sabha. These data present that the proportion of seats

in the National Parliament held by women is only 12.24 per cent against the target of 50 per cent.

Section 1.03 Goal 4: Reduce Child Mortality

This MDG aims to reduce mortality among children under five years. India's Under Five Mortality Rate (U5MR) declined from 125 per 1,000 live births in 1990 to 49 per 1,000 live births in 2013. Considering the MDG target is of 42 per 1000, these data suggest that India is on the right track, largely due to the sharp decline in recent years.

The large scale of the under-nutritional condition in mothers and children poses a critical development challenge for India. To overcome this situation many programmes such as- National Policy on Children (2013), National Policy on Early Childhood Care and Education (ECCE) and Integrated Child Development Services (ICDS) are designed for focusing on real-time monitoring of child development.

Section 1.04 Goal 5: Improve Maternal Health

India is required to reduce Maternal Mortality Rate (MMR) to 139 per 100,000 live births by 2015 to meet the MDG. There has been some improvement in the Maternal Mortality Rate (MMR) between 1990 to 2006 (declined to 167 per 100,000 live births in 2009). However, despite these signs of progress, India's progress on this goal has been found slower.

Delivery in institutional facilities has risen from 26 per cent (1992-93) to 72 per cent (2008-09). Consequently, deliveries by trained personnel have also increased at the same pace. Main reason contributing to this factor has been the introduction of a conditional-cash-transfer scheme 'Janani Suraksha Yojana' which improved the deliveries in hospitals and nursing homes up to 72 per cent in 2009.

Section 1.05 Goal 6: Combat HIV/AIDS, Malaria and Other Diseases

India is on track to achieving this goal, since HIV, malaria and tuberculosis prevalence has been declining continuously.

India has made significant strides in reducing the prevalence of HIV/AIDS and transmissions of HIV/AIDS in India has brought down from 0.45 per cent

(2002) to 0.36 per cent (2009). Malaria has consistently come down from 2.12 per thousand (2001) to 0.72 per thousand (2013).

India alone accounts for one-fifth of the global share of tuberculosis (TB), tuberculosis prevalence per lakh population has reduced from 465 (1990) to 211 (2013).

Section 1.06 Goal 7: Ensure Environmental Sustainability

India has made some progress and is on track towards achieving this MDG. The forest cover or green assets has increased to 21.23 per cent, an increase of 5871 square km and protected areas cover to about 4.83 per cent of the country's total land area, this has reduced the energy intensity of GDP growth through higher energy efficiency.

Section 1.07 Goal 8: Develop a Global Partnership for Development

The Indian telecom network is the second-largest network (according to 2014 data) in the world after China. The total number of Internet users has increased from 198.39 million (2013) to 259.14 million (2014), which reflects an annual growth of 60%.

Due to the globalization's effect, India has emerged as one of the key development partners for fostering economic and intellectual assistance to various developed and developing countries through the world. India's development assistance in terms of funds is significantly complementing to the conventional assistances inflows from developed countries.

Study Questions: 3

Answer the following questions as True/ False –

1. Nature has its intrinsic value apart from the utilitarian.
2. MDGs has eight development goals.
3. India has achieved the MDGs target for reducing hunger.
4. Right of Children to Free and Compulsory Education Act (RTE) was introduced in 2012.
5. 'Janani Suraksha Yojana' is a Direct Benefit Transfer (DBT) scheme.
6. The forest cover of a country is also referred to as green assets.

9.6 Efforts for Sustainability in India

Cooperation and coordination both are inherent to India's ancient civilisation, aligning this philosophy Prime Minister of India pressed for the International Solar Alliance at the UN Climate Change Conference in Paris in 2015. This alliance has played an important role in shaping the Sustainable Development Goals (SDGs), further mirrored in the country's national development goals also.

India is fully dedicated to achieving the SDGs even before they were fully crystallized. The National Institution for Transforming India (NITI) has carried out a detailed mapping of the 17 Goals and 169 targets and other supporting major government initiatives.

This report about the focuses on the progress made towards achieving SDGs- 1, 2, 3, 5, 9, 14 and 17. These Goals have been considered as focus areas for evaluation. As NITI Aayog parts the oversight responsibility. It has led the process of Voluntary National Reviews (VNR) preparation. A multi-disciplinary VNR Task Force was constituted to coordinate the reviews for the fulfilment of the exercise.

While targeting economic, infrastructure and industrialisation developments, the nation's war against poverty elimination, social inclusion and empowerment of the marginalised sections have never compromised.

Goal 1: End Poverty in All its Forms Everywhere

There are many enthusiastic evidences that the rapid economic growth of India which was achieved following the economic reforms initiated in 1991, has led to a reduction in poverty. Numbers of people below the poverty line has fallen across all economic, social and religious groups nationally and in all states.

The Mahatma Gandhi National Rural Employment Guarantee Act alone has generated over 2 billion employment days during 2016-17, largely for the deprived sections of society. In an effort to achieve the goal of 'housing for all' by 2022, direct-transfer financial assistance is being extended to poor homeless people.

Pradhan Mantri Jan-Dhan Yojana (PMJDY), launched in 2014 for ensuring access to the entire gamut of financial services like- banking, credit, insurance, pension and other conditional transfers.

Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Significant progress has been made in improving food and nutrition security through various plans. As a result, stunting among children under 5 years age has declined from 48% to 38.4% in the decade of 2005-15. The absolute numbers of stunted and underweight children, still remain high. To address this concern, more than 800 million people are covered by providing the food grains at affordable prices through the Public Distribution System (PDS). The Mid-Day-Meal (MDM) Programme is providing nutritious cooked meals to 100 million children in primary schools across the entire country.

India is one of the largest producers of milk, pulses and other grains in the world. The National Mission on Sustainable Agriculture (NMSA) is functioning under the National Action Plan on Climate Change (NAPCC). This plan is working towards mitigating the impact of climate change on agricultural productivity. Due to Soil Health Card scheme, land under organic farming has increased by over 17- fold over the last 10 years.

Crop insurance support schemes also helped in minimizing the losses incurred to farmers and provide single-window comprehensive risk coverage for various crops and horticulture produces.

Goal 3: Ensure healthy lives and promote wellbeing for all at all ages

India made significant gains in various health indicators by improvement in vaccination coverage for children between 12-23 months of age. The country's strategy in health is focused on providing essential medical services to the entire population with a special emphasis on the poor and marginalised.

The National Health Policy (2017) is targeted for- universal primary health care, to achieve further reductions in infant and U-5 mortality, to reduce premature deaths due to non-communicable diseases as well as to increase governmental expenditure on health. Nowadays, a composite index is being

used to monitor and evaluate the improvements in health services delivery in the country. ANMOL (Auxiliary Nurse Midwives Online) is an application launched by the Ministry of Health & Family Welfare for enabling Auxiliary Nurse Midwives (ANMs) to electronically enter and update data for beneficiaries.

National Vector Borne Disease Control Programme focuses on prevention and control of six diseases including- Malaria, Japanese Encephalitis, Dengue, Chikungunya, Kala-Azar and Lymphatic Filariasis.

Goal 5: Achieve gender equality and empower all women and girls

While much more progress still remains, a number of indicators showing the status of women in India have moved to the right direction over these years. For instance- around 68.4 per cent of women were literate in 2015-16 compared to 55.1% in 2005-06. Around 53 per cent of women were using bank services in 2015-16 compared to 15.1 per cent in 2005-06.

The 'Beti Bachao Beti Pado' (BBBP) initiative focuses on a comprehensive package of interventions for the girl child including education, health-care and protection.

'One Stop Crisis Centres' are being established across the country for providing integrated and instant support to women affected by violence, whether in private or public spaces. Further, the Women Helpline initiative has also strengthened these Centres.

Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

All types of connectivity including road connectivity and electricity are being brought to all villages across India. The Bharat Broadband Network Limited (BBNL) initiative is aiming to provide high-speed broadband connectivity to all villages in the country. Over the last decade, there has been a consistent growth in installed electricity generation capacity and also the proportion of non-fossil-fuel sectors has grown by 51.3 per cent.

8,000 km of pavements and cycle tracks are proposed for 106 cities over the course of the next 5 years to promote non-motorized transport and reduce the carbon footprint.

Goal 14: Conserve and sustainably use the oceans, seas and marine resources

A clear agenda has been formulated for promoting ocean ecology with the name 'Blue Revolution'. For tracking the marine pollution along the coastline and Exclusive Economic Zones (EEZs), the country has developed the Coastal Ocean Monitoring and Prediction System. An oil spill management system is also placed for responding to emergencies arising out of oil spills by crude oil movements.

A new era of port-led development was accepted and as a result, the 'Sagarmala' project was commissioned for improving- port connectivity, port-linked industrialization, coastal community development and reducing waiting time for cargos.

Goal 17: Revitalize the global partnership for sustainable development

While working with the global partnership for the achievement of the SDGs, India expressed its solidarity for the principle of 'common but differentiated responsibilities'. India is trying to gather sufficient revenues from domestic resource mobilisation and from foreign aids, for achieving the SDGs, especially for global public goods such as climate change mitigation and control of pandemics.

A next-generation tax reforms agenda is implied in the country to optimise domestic resource mobilization, including direct tax reforms as well as the indirect tax reforms (such as-Goods and Services Tax also known as a uniform and simplified form of indirect taxation). For certain purposes, another form of a monetary instrument like- Swachh Bharat Cess (Clean India Cess) has also been introduced for the hassle-free funding of Clean India Mission.

The Ministry of Statistics & Programme Implementation (MoSPI) is on fast-track to evolve national indicators in light of the global SDG indicators with

respect to regional characteristics. The NITI Aayog recently released a Three-Year Action Agenda covering the years 2017-18 to 2019-20. This Agenda addresses the specific challenges facing the country in real-time and the details of measures to fast track the national development agenda.

Most of the states have matched strategic insights from the national development and 2030 agendas, keeping in mind their own specific contexts and priorities.

Study Questions: 4

Match the following sentences –

Institute/ Organization	Year
1. Total numbers of SDGs are	A- 2022
2. SDG: 1	B- End poverty in all forms
3. 'Housing for all' is proposed for	C- 17
4. 'ANMOL' provides support for	D- Internet connectivity to all villages
5. 'One Stop Crisis centre'	E- To achieve gender equality (SDG: 5)
6. 'Bharat Broadband Network Limited'	F- SDG: 3
7. 'Blue Revolution' is for	G- Indirect tax
8. SDGs indicators in India	H- MoSPI
9. GST is an	I- Ocean ecology
10. 'Sagarmala' project aims for	J- Port-led development

9.7 The GAIA Hypothesis

This hypothesis is named after the Greek earth goddess and the was coined by James Lovelock in 1979. In this hypothesis proposed a different model of the Mother Earth. It establishes that the ecosphere and all creatures surviving on it were inter-dependent and thus form a complete system.

According to this, the complete system and all components of the system were interdependent and weighing equally for maintaining the Earth as a planet and make itself capable of providing sustaining life.

It is necessary to recognise and allocate the actions in which one organism affects other organisms and also inevitably affects itself. There could be many possibilities which did not necessarily have direct reflections into its actions. In other words, all actions may well have many unintended consequences.

9.8 Summary

Now it is very well established that there is no unique sustainable path and accordingly, policymakers should choose different criteria and strategies to make efficient sustainable decisions for each region (likewise- country or state).

Economic progress is visible in most of the places. For instances- cities are growing, transport systems are booming, and so on, as a result, the middle class is growing rapidly in all aspects of life.

India step-in to pursue the implementation of the SDG agenda through close collaboration between the national and sub-national governments. For this, India is following a holistic approach towards SDGs (targeted to achieve until 2030) by starting various initiatives. As a result of these efforts, India's SDG Index Score ranges between 42 and 69 for States and between 57 and 68 for UTs.

Implementations of India's Nationally Determined Contributions (INDCs) seeks investments of scale and size which is unprecedented for a developing nation. This essentially indicates that along with domestic finances, international public and private sector finances would have to be mobilized for filling the gaps.

There are quite a few challenges for the achievements of SDGs, a very visible one is air pollution, mainly due to high dependency on coal and therefore emits a lot of CO₂. So India needs to increase energy coal-based efficiency and move to harness more renewable energy sources. Many parts of India face drastic resource scarcities especially natural resources such as- water pollution (sometimes toxic) and shortages.

9.9 Glossary

Manipulate:	Influence to others in a skilful manner
Intensified:	Boosted
Ancestors:	An early version of humankind
Indigenous:	Local people
Irreversible:	Unable to undone
Embraced:	Ready to accept enthusiastically
Intrinsic:	Essential
Eradicate:	Fully erased
Pavement:	Smooth way for people
Cess:	Tax for certain objective

9.10 Answers of Study Questions

Answers of study questions: 1

- | | | | |
|----------|----------|---------|----------|
| 1- False | 2- True | 3- True | 4- False |
| 5- False | 6- False | 7- True | 8- True |

Answers of study questions: 2

- | | | |
|-----------|------------------------|--------------|
| 1- Indian | 2- moral and spiritual | 3- Aranyakas |
| 4- sages | 5- natural | 6- practices |

Answers of study questions: 3

- | | | |
|----------|----------|----------|
| 1- True | 2- True | 3- False |
| 4- False | 5- False | 6- True |

Answers of study questions: 4

- | | | | |
|------|------|------|------|
| 1- C | 2- B | 3- A | 4- F |
| 5- E | 6- D | 7- I | 8- H |

9- G

10- J

9.11 References

- Andriantatsaholiniaina, L. A., Kouikoglou, V. S., & Phillis, Y. A. (2004). Evaluating strategies for sustainable development: fuzzy logic reasoning and sensitivity analysis. *Ecological Economics*, 48(2), 149–172. <https://doi.org/10.1016/j.ecolecon.2003.08.009>
- Bhalachandran, G. (2011). Kautilya's model of sustainable development. *Humanomics*, 27(1), 41–52. <https://doi.org/10.1108/08288661111110169>
- Chen, H., & Yada, R. (2011). Nanotechnologies in agriculture: New tools for sustainable development. *Trends in Food Science & Technology*, 22(11), 585–594. <https://doi.org/10.1016/j.tifs.2011.09.004>
- Dev, R. (n.d.-a). Corporate Social Responsibility (CSR) in Indian Banking Sector: An analytical study of ICICI bank limited.
- Dev, R. (n.d.-b). Corporate Social Responsibility in India: Reaching to Unreached?
- Environment and Education: a view of a changing scene: Environmental Education Research: Vol 1, No 1. (n.d.). Retrieved February 7, 2020, from <https://www.tandfonline.com/doi/abs/10.1080/1350462950010101>
- India follows a holistic approach towards its 2030 Sustainable Development Goals (SDGs). (n.d.). Retrieved February 13, 2020, from <https://pib.gov.in/newsite/PrintRelease.aspx?relid=191192>
- Kaygusuz, K. (2012). Energy for sustainable development: A case of developing countries. *Renewable and Sustainable Energy Reviews*, 16(2), 1116–1126. <https://doi.org/10.1016/j.rser.2011.11.013>
- Oparaocha, S., & Dutta, S. (2011). Gender and energy for sustainable development. *Current Opinion in Environmental Sustainability*, 3(4), 265–271. <https://doi.org/10.1016/j.cosust.2011.07.003>

- Smyth, J. C. (1995). Environment and Education: a view of a changing scene. *Environmental Education Research*, 1(1), 3–120.
<https://doi.org/10.1080/1350462950010101>
- 9.12 Suggestive Readings
 - 15836India.pdf. (n.d.). Retrieved February 13, 2020, from <https://sustainabledevelopment.un.org/content/documents/15836India.pdf>
 - Aras, G., & Crowther, D. (2016). *The durable corporation: Strategies for sustainable development*. Routledge.
 - Browder, J. O. (2019). *Fragile Lands Of Latin America: Strategies For Sustainable Development*. Routledge.
 - Jordan, A., & Lenschow, A. (2009). *Innovation in Environmental Policy?: Integrating the Environment for Sustainability*. Edward Elgar Publishing.

Unit-10: Sustainable Development II

Unit Structure

10.0 Learning objectives

10.1 Introduction

10.2 Demographic Dynamics

10.2.1 Sustainability and Demographic Dynamics

10.2.2 Demographic dynamics In Indian context

10.3 Sustainability and Developing nations

10.3.1 Sustainability and India's efforts

10.4 Sustainability and Developed nations

10.5 International contributions towards Sustainability

10.5.1 Solutions towards Sustainability

10.6 Summary

10.7 Glossary

10.8 Answers of Questions

10.9 References

10.0 Learning objectives

Reading this unit will develop an understanding for-

- Demographic dynamics and characteristics.
- Exponential law of population growth.
- Interdependence between demography and sustainable development.
- Efforts for a sustainable future in developing and developed nations.
- International organised efforts for sustainable development.

10.1 Introduction

In previous units, you learnt that sustainable development is a broader concept that requires rational and effective management of resources so that these resources will be available for forthcoming generations also without compromising their needs.

To achieve above-mentioned goals, it is advisable to manage all these resources according to the demographic dynamics of that particular region/regions. Demography has crucial roles as both cause and effect of/on sustainable development.

This unit will explore all root causes of sustainable development through demographic analysis and also strategies and efforts ongoing in developing nations. Developed nations have better technologies to achieve the goals of sustainability, even they have fewer targets to achieve as many of the targets, these countries achieved in past. To

acquire knowledge about all efforts made by developed countries will be fruitful for formulating strategies in developing nation like India.

This unit will also explore the international organisations' efforts towards a sustainable future for the people on the planet. Some remarkable efforts will be discussed here for the evaluation of individual countries contributions.

10.2 Demographic Dynamics

The '**Demography**' word is a combination of two words- Demo+graphy. In ancient Greek, Demos stands for '**the people**' and graphy stands for '**the description or measurement**'. Now it is clear that the demography encompasses the study of the size, age-structure and distribution along with changes in birth, death, migration and education level among the population.

If we consider dynamics as a suffix to the demography, it means that we have to consider time or space with respect to demographic changes. Demographic dynamics is a branch of life sciences.

The 'exponential law of population growth', as described in the Malthusian growth model by Thomas Robert Malthus, is widely considered as the first law of demography dynamics. This model was later refined and adjusted by Benjamin Gompertz and Pierre François Verhulst in the 19th century.

Thomas Robert Malthus in his book "**An Essay on the Principle of Population (1798)**" described his vision on population growth. After summarising his thoughts, the following statements are made here in simple words-

- He observed that the population would tend to increase at a geometric rate- 2, 4, 8, 16, 32, 64,
- While the food supply would tend to increase at an arithmetic rate- 2, 4, 6, 8, 10, 12,

Above statements, if calculated further, clearly shows that at the end of two hundred years population would ultimately outstrip the food supply.

Now, you understood that for sustainable development, environmental management is a precondition. It affects the feeding system on the earth and also the resources which we are dependent upon. Several other factors are in existence and crucial for life on

the earth but the environment is a key factor among all those and got adverse effect by human approach and responded alarmingly for all living beings.

10.2.1 Sustainability and Demographic Dynamics

Vogt in his book “Road to Survival” which was published in 1948, first time focused on an urgent concern for the fact that ‘the tide of the earth’s population is rising’. He proposed many instances that would form the theoretical basis of the environmental movement that arose in later decades.

The determinants that are triggering the people’s demographic characteristics are correlated in both positive and negative manner. These determinants are found their roots in cultural traditions, religious worship, economic conditions, stability in nature.

Today, the relationship between population growth and increased pressure on natural resources, the loss of biodiversity, and the changing balance in the environmental dynamics at the global level are clearly recognized. The demographic dimension should also represent at least one of the key priorities for sustainability.

In the report “Limits to Growth” by the Club of Rome (1972), it was concluded that it is necessary to intervene to manipulate and modify the world demographic trends in order to establish a better condition of ecological and economic stability for the better survival of the future generation.

Now it is easy to understand for you that there are a number of helpful tips through a process of change in social values such as- the use of alternative energy sources and the development of economic processes of an ecological type and so on.

In the 1987 report “Our Common Future,” the demographic topic is addressed directly in the fourth chapter as a common challenge and recognized as a key factor in the process of consumption and gradual deterioration of environmental resources. It shows that it is indispensable to curb population growth through family planning and birth control.

The contraction in population growth if considered at a global level has been primarily witnessed with the gradual decline in fertility rates that began in the 1960s, with particular dynamism, especially in Asian and South American continents. In these regions, total fertility rates were 5.82 and 5.89, respectively, in the five-year period of 1950–1955. But by the end of the 1990s, they had almost halved and values continue

to fall gradually. Now, these continents are closer to the replacement level of 2.1

The founder of the World Watch Institute, Lester R. Brown in his book, 'Building a Sustainable Society' (1981), warned the readers about dire consequences if the population did not decrease its growth pace.

Another point we should consider in this chapter is, 'Earth's carrying capacity'. This can be described as- 'the number of people that our planet could feed at a particular time'. Both the size of the population and the choices that human makes in dealing with the environment and also the pattern of using resources, determine a change in the ecosystem and its capacity to degrade carrying capacity. The impact that population has on the environment depends both on its total size and the per capita consumption of resources, as well as the per capita production of non-biodegradable wastes.

The cycle of environment and sustainability can be better depicted in a manner-

As the human population grows, there will be a greater need of farmlands to grow food, which will lead to the destruction of new forest areas or vegetation, as a result of a biased dietary system with an increase in animal-based foods would be seen in near future.

Environmental issues like global warming along with population growth will pose a greater threat to sustainability. An increase in average global temperatures will lead to the expansion of drylands and this phenomenon, combined with population growth, will lead to an increase in the demand of water from inhabitants all over the world (especially in arid and semi-arid regions of continents). This demand will take place from all aspects of life, i.e. agriculture, livestock breeding, and industrial and energy production. Groundwater extraction will become faster than fossil aquifers can recharge and there will be an increase in the number of people living in conditions of water scarcity, with tremendous consequences for a decrease in agricultural productivity.

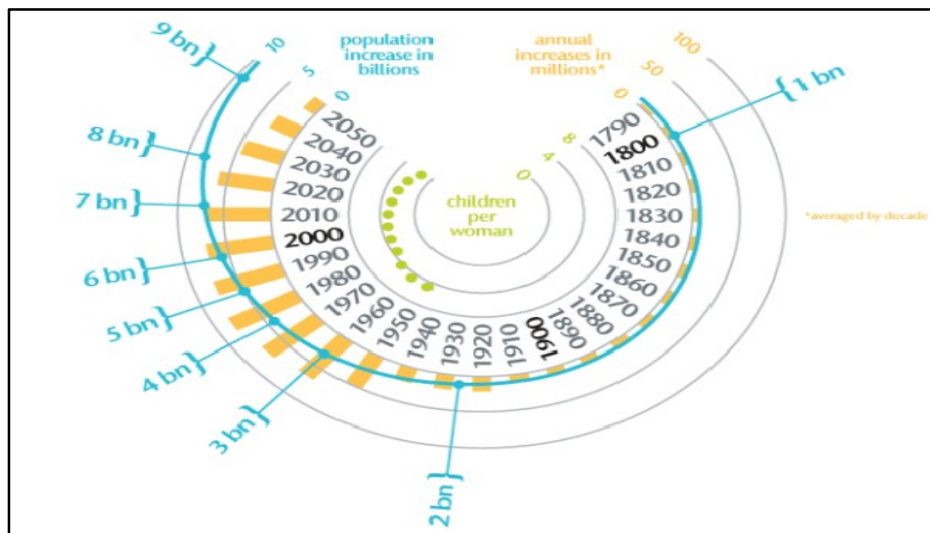
To prevent the delicate ecological balances from being irreparably damaged and the changes from being catastrophic. Policymakers should redirect global society toward a more sustainable future. For this, we need to act on multiple levels because science and technology alone cannot act in facing and solving environmental problems, it will be necessary to transform societal and economic values and shift away from the view

that holds individuals as isolated actors in a competitive world, to one where human beings believe to be an integral part of a unique and interconnected biosphere.

We should remember that the problem does not lie only in the size of population growth in the next 50 years but rather in the imbalance in the distribution through which this growth will occur in some regions of the Earth, and the consequences that this imbalance could generate for the globe.

The concentration of population growth in the poorest countries (can be addressed as 'growing spots') will certainly make it more and more difficult for the governments to eradicate poverty and inequality, fight hunger and malnutrition and guaranteed education to new generations and other basic services for the well beings of their citizens.

The decrease in fertility foreseen by the long-term scenarios for the stabilization of population in 2100 is reachable with a high probability in many areas of the world. The stabilized world population would value between 9.6 and 12.3 billion people. This projection is summarised in the following graph.



Graph: 10.1: Projection of Population Growth/ Source: Living Green Magazine

10.2.2 Demographic dynamics In Indian context

India accounts for nearly 17% of the world's population and is undergoing rapid demographic changes, with wide implications not only for the country but also for the world. India's population stands at 1210 million (2011). One can say that currently, one out of every six persons in the world lives in India.

The first indication of a decline in fertility in India was in the state of Kerala in the 1960s. It had higher social development indicators, among which higher rates of female literacy found to be more effective. This has established that social development itself can trigger the fertility transition. Fertility is declining in India primarily because of the decline of fertility among illiterate women, and this is due to the diffusion of a new reproductive idea of having 'children lesser but investing greater' in their future. India is now entering into the final stages of demographic transition, with the country nearing replacement-level fertility

An important demographic pattern emerging in India is heterogeneity across regions and states. The TFR in 2008 varied from as low as 1.7 in Andhra Pradesh to 3.9 in Bihar, and infant mortality varied from 12 in Kerala to 70 in Uttar Pradesh.

India's huge demographic disparity across many states has serious implications at all levels. The demographic disparity may cause considerable social turbulence and may even pose a threat to the political stability, as the representation in Indian parliament will undergo rapid changes if the freeze on the number of seats is withdrawn. This demographic heterogeneity is also able in providing a unique opportunity to fill the labour deficit within the country through interstate migration.

The ultimate size of India's population when the population stabilization is achieved will be about 1.72 billion around the year 2060, according to the latest population projection released by the United Nations.

Study Questions: 1

Answer the following questions as True/ False –

1. Demography only studies about population growth.
2. Exponential law of population growth was propounded by Thomas Robert Malthus.
3. The report "Our Common Future" was published in the year 1987.
4. World Watch Institute was founded by Lester R. Brown.
5. Growing spots refer to a population with less birth rate.
6. According to the United Nations, India's population will stabilise in the year 2045.
7. First-ever declining in fertility rates among Indian states was shown in Uttarakhand.
8. Societal values are important for ecological balance.

10.3 Sustainability and Developing nations

People around the world depend heavily on nature for their health and livelihoods. But if developing countries are considered, this dependency goes far beyond. A sustainable environment nurtures the necessities of life like- water, food, air and transportation. It also provides resources for economic growth and the means for survival according to natural cycles. The economic health of the developing countries has strong links to the state of the natural environment and the opportunities it offers for their citizens.

There are several inter-connected environmental issues have emerged in developing countries, which requires immediate attention-

- All types of pollution
- Climate change and extreme weather conditions
- Soil degradation
- Over-exploitation of natural resources
- Biodiversity loss
- Deforestation and desertification
- Ocean acidification

Many efforts are made by respective governments to mitigate the worsening situation of above-mentioned issues. But there are some complications also persist in the form of lack of coordination among various implementing agencies especially in the developing countries.

10.3.1 Sustainability and India's efforts

Sustainability has deep roots in Indian culture. Indian philosophy and values have underscored a sustainable way of life. As an example-

The yogic principle of Aparigraha, which is a virtue of being non-attached to materialistic possessions, keeping only what is necessary for the survival of a certain stage of life.

National Geographic and Globescan measured the consumers' behaviour in response to environmental concerns, namely **Greendex** (as an international report on sustainable living). Among 18 participants, which also include China and the US, India able to stand on top of this report. This report clearly established that now the people

are accepting that development is more than economic performance, and sustainable development is a collective responsibility.

India chooses a holistic approach towards its 2030 Sustainable Development Goals (SDGs) by launching various flagship projects/schemes. These include Swachh Bharat Mission, Beti Bacho Beti Padhao, Pradhan Mantri Awas Yojana, Development of Smart Cities, Pradhan Mantri Jan Dhan Yojana, Deen Dayal Upadhyay Gram Jyoti Yojana and Pradhan Mantri Ujjwala Yojana, among others.

Some of these policies are discussed below-

Namami Gange Mission- This mission is a key policy priority towards achieving the SDG-6. This was launched as a priority programme with a budget outlay of Rs.20,000 crores for the period of 2015-2020.

National Clean Air Programme was launched in 2019 in a pan India and time-bound manner, it drafts a national-level strategy for prevention, control and abatement of air pollution besides augmenting the air quality monitoring network across the country, which is available to all citizens in a digitally.

National Policy on Resource Efficiency (RE) This plan was drafted as an umbrella concept for the existing policies to address multiple sectors simultaneously and devised for mainstreaming Resource Efficiency approach in the development pathway for achieving SDGs in a phased manner.

India's Nationally Determined Contribution- India has continuously demonstrated its responsibilities towards participation in global climate actions on the basis of the principles of equity and common but differentiated responsibilities.

UNCTAD in a report in 2014 stated that there is a shortfall of US\$2.5 trillion per year in current investments in developing countries for achieving SDGs. This essentially means that along with domestic, international and private sector resources would have to be mobilized from a variety of sources.

Study Questions: 2

Fill in the blanks in the following sentences –

1. Aparigraha is a principle of sustainability.
2. is at the top in the Greendex.
3. SDGs stands for Goals.
4. National Clean Air Programme was launched in the year of

10.4 Sustainability and Developed nations

While dealing with sustainability, it is perceived that developed nations have less population, highly educated people and high-end technologies, so they are the mild culprits for unsustainable future. But the real situation has differences to this phenomenon.

Some examples are –

The concept of the '**ecological footprint**' measures the biological space (area) required to produce the resources that a person consumes and to absorb the waste that his/ her consumption generates within a period of time.

Earth's bio-capacity is limited to 11.5 billion hectares of biologically productive space. With the current population standing at 6.4 billion, means only 1.8 hectares (referred to as global hectares (gha)) of ecological footprint per person.

The ecological footprint (measured in gha) per person has already exceeded this limit and continuously increasing. The average ecological footprint in developing countries is 1.8 gha, which is equal to the global average. While the ecological footprint in developed countries increased to 5.3 global hectares (2007). The per capita ecological footprint in developing countries increased to 1.8 global hectares (2007).

Measurement of per capita greenhouse gas emissions is also the most acceptable unit for sustainability. Researches show that 3 tCO₂ as the per capita annual emissions level that needs to be achieved by 2050. But in developed countries it about 10 tCO₂ per person. These differences illustrate the enormity of the challenge faced by developed countries to deescalate the levels of CO₂ emission.

Human development has generally been understood as consistency in the reduction of poverty, mortality rates, gender disparities, etc. The concept has therefore been perceived to be relevant to develop countries only. Recent movements have pushed towards sustainable and equitable consumption will require significant changes in lifestyles and reorganization of the economy and society in developed countries too.

The consumption pattern in developed countries is proved as unsustainable. But focus on technology is taken as a remedy to move away from this unsustainable pattern. Genuine movement by developed countries towards sustainable consumption pattern will require sweeping changes in these countries. Here, some efforts are mentioned -

1. Non-material consumption (reading e-books)

2. Public modes of consumption (transportation)
3. Reversal of the “one-time-use” mode of consumption.
4. Natural or biodegradable materials consumptions.

Genuine moves towards sustainable and equitable consumption by developed countries may give rise to a new aspiration model for developing countries.

Prices can play an important role in diverting consumption towards sustainability. For this, commodities and services involving high levels of greenhouse gas emissions need to be priced in such a way as to reflect the cost they impose through climate change. Again, products and services having high plastic contents need to be priced so as to reflect the cost that the disposal of plastic waste imposes on the environment.

Study Questions: 3

Tick mark the correct answers for each question below –

1. The term ‘Ecological footprints’ measures the –
A. Carbon emission B. Forest area C. Biological space
2. Ecological footprints are measured in the units of –
A. Global hectares B. Hectares C. Weight
3. These countries have more unsustainable consumption pattern –
A. Developed B. Developing C. Both
4. A sustainable consumption pattern can be achieved through –
A. Disposable water bottle B. Private transportation C. Public transportation
5. Prices of items have a divertive effect on –
A. Consumption pattern B. Development C. Sustainability
6. Per capita greenhouse gas emissions should be limited until the year–
A. 2050 B. 2045 C. 2060

10.5 International contributions towards Sustainability

Adverse global climate change is one of the biggest challenge facing humanity in the 21st century. Climate change threatens all aspects of our life including- living habits, security and economy.

Rio Earth Summit was organised in Rio de Janeiro, Brazil on 5 June 1992. This summit gave birth to three conventions. These are –

1. UN Framework Convention on Climate Change (UNFCCC)

2. Convention on Biological Diversity (CBD)
3. UN Convention to Combat Desertification (UNCCD)

The United Nations Framework Convention on Climate Change (UNFCCC) enacted from on 21 March 1994. Around the globe, 197 countries that have ratified the Convention are called Parties to the Convention.

The United Nations observes each June 21, as World Climate Change Day every year.

The Convention on Biological Diversity (CBD) came into force on 29 December 1993 and till the date, it has 193 Parties. This Convention covers biodiversity at all levels: ecosystems, species and genetic resources. Through the Cartagena Protocol on Bio-safety, this convention also covers biotechnology.

The CBD's apex governing body is the Conference of the Parties (COP). This Conference of the Parties (COP) is the ultimate authority of all governments (or Parties).

The Convention on Biological Diversity (CBD) is an international and rectified treaty among all member parties with an overall objective to encourage the actions which will lead to sustainable living and future.

The United Nations has declared 22 May, as International Day for Biological Diversity.

The United Nations Convention to Combat Desertification (UNCCD) is the first legal-binding international agreement (1994) between the parties (nations) that links both, environment and development to sustainable-land-management and in turn, serves the earth atmosphere. This Convention's has 197 parties working for the betterment of the living conditions for people in drylands.

This Convention addresses specifically the arid, semi-arid and dry sub-humid areas across the globe with the particular commitment of a bottom-up approach which encourages the participation of local residents in combating desertification and land degradation. UNCCD launched a new Strategic Framework for the duration of 2018-2030. This is the most comprehensive global commitment to achieve Land Degradation Neutrality (LDN).

The United Nations observes each June 17, as World Day to Combat Desertification and Drought.

The Stockholm Convention on Persistent Organic Pollutants (POP) was adopted by the Conference of Plenipotentiaries organised in Stockholm (Sweden) on 22 May 2001 and entered into force on 17 May 2004.

It is also a global treaty to protect human health and the environment from harsh chemicals that remain intact in the environment for long periods and spreads in wide geographical areas, accumulate in the fatty tissue of living beings and have harmful impacts on living beings or on the environment. Due to their long-range transporting nature, the alone government is not capable to protect its citizens or its environment from POPs.

The Minamata Convention on Mercury is a global treaty to protect health and environment from the adverse effects of mercury on human life for their signatories. This convention entered into force on 16 August 2017. This Convention draws the attention of the entire global community towards a global and ubiquitous metal, if disposed of in an inappropriate manner in the atmosphere, soil and water from different sources cause implications to the entire food cycle.

The Minamata Convention bans on –

1. New mercury mines
2. The phase-out of existing mercury mines
3. Deescalate the use of mercury in products and processes

This Convention also addresses the interim storage of mercury and its safe disposal, sites contaminated by mercury as well as health issues.

The Montreal Protocol on Substances that Deplete the Ozone Layer, famously known as the 'Montreal Protocol' is an international agreement signed in 1987. The purpose behind its design is- 'To stop the production and movement of ozone-depleting substances and develop their substitutes which would be helpful in reducing their concentration in the atmosphere to help protect the earth's ozone layer with an objective of reducing global warming'.

This Protocol is considered as the most effective and successful environment protection agreement as it paved a mandatory timetable for all its signatories for the phase-out of ozone-depleting substances.

The Montreal Protocol targets 96 ozone-depleting chemicals. This Protocol sets progressive and legal obligations for developed and developing countries for the many

ozone-depleting substances. These include – Chloro-Fluoro-Carbons (CFCs), Halons and Hydro-Chloro-Fluoro-Carbons (HCFCs).

Through six Amendments, the Montreal Protocol has been further strengthened. These are as follows –

1. London 1990
2. Copenhagen 1992
3. Vienna 1995
4. Montreal 1997
5. Beijing 1999
6. Kigali 2016

16 September is declared as International Day for the Preservation of the Ozone Layer.

Due to the interdisciplinary nature of ecology, ecologists are now partnering with scientists and non-scientists as well and expanding their scope of study beyond geopolitical boundaries. This will not only redefines the policy but also pushes positive attitudes among people.

Several international efforts are based on similar partnerships, and further should be supported and expanded at each level.

Examples of such programmes are –

The International Geosphere-Biosphere Programme (IGBP) has been in existence for some time and plays an important role in bringing together scientists from diverse disciplines and countries to address environmental problems that are multivariate in scale and hence require a global research approach.

Millennium Ecosystem Assessment (MA), a program launched by the Kofi Annan (UN Secretary-General) in June 2001, focused on providing valid, scientific information on changing pattern of the ecosystem for the decision-makers and the public.

Next example is the **Resilience Alliance started in 2004**, an international program promoting theory and solutions for social-ecological systems' planning

But still, there is a pressing need for further collaborations between ecologists and corporations, governmental agencies and other civil society groups; both at local and international levels.

10.5.1 Solutions towards Sustainability

This heightened ecological understanding and the improved communication among the disciplines will enable ecologists to play a pivotal role in all levels of decision making that affects the sustainability of the earth. Some of these outcomes are described below–

1. The **search for other relevant means of ecological knowledge transmission**

It is no longer enough to just do scientific experiments. Knowledge must be conveyed in a manner that allows policymakers and the people to translate the science into action. For this, discoveries of other relevant means required rather than just communication.

2. **Advancing innovative ecological research**

Generating and sharing new knowledge are the fundamentals for developing solutions that will escalate the process of sustainability in the biosphere.

Anticipatory, analytical and interdisciplinary frameworks must be developed to address the complex interactions expected to influence ecological function at all scales, including the influences and feedbacks of all stakeholders on ecological processes.

3. **Stimulate cultural changes for international ecological balance**

The future culture of ecology will need to encompass new ways of work culture, expanded reward systems for bottom level works, more diverse interactions new partners, nationally and internationally.

Promote ethnic and gender diversity and equality in the ecological sciences by forming partnerships with parallel societies in other countries and enhancing programs to limelight under-represented groups.



Graph; 10.2: SDG Goals/ Source: 3-mob.com

These agreements underscore the connection between poverty, equity and environmental sustainability, these elements got reflected in the United Nations' 2030 Agenda for Sustainable Development. The environment is an integral and intrinsic part of sustainable development. Accepting this fact, over a third of the agenda's 17 Sustainable Development Goals focused directly on environmental outcomes. These include the outcomes on water (Goal 6), climate change (Goal 13), oceans (Goal 14) and land (Goal 15), while all others are contributing indirectly. These goals highlight the interdependence of economic, social and environmental issues in broader aspects.

Inter-Governmental Panel on Climate Change (IPCC) also the winner of Nobel Prize in 2007, warned the governments across the globe that a truly sustainable planet would be possible only when the average global warming temperature get down by 2°C.

For the broad adoption of sustainable solutions, the right economic framework and political will power needed. Kyoto Protocol was the first step towards this solution adopted in Kyoto (Japan) on 11 December 1997 and entered into force on 16 February 2005. The implementation of the Protocols was adopted at COP-7 in Marrakesh (Morocco) in 2001 and referred as the "**Marrakesh Accords**", first commitment period for this protocol was started in 2008 and ended in 2012. This Protocol placed heavier burdens on developed nations under the principle of "**common but differentiated responsibilities**", because developed nations injected more Green House Gases GHGs into the atmosphere resulted from 150 years of industrial activity.

In Doha (Qatar) on 8 December 2012, the **"Doha Amendment to the Kyoto Protocol"** was adopted with the aim of extension of commitments for a second period from 1 January 2013 to 31 December 2020.

During the first phase of the commitment period between 2008 to 2012, 37 highly industrialized countries and the European Community member countries committed to reducing GHG emissions to an average of 5% against 1990 levels. During the second phase of the commitment period (2013-2020), Parties committed to reduce GHG emissions by at least 18% below against 1990 levels.

5th June is observed as World Environment Day every year. This is the United Nations' flagship vehicle for increasing awareness, participation and action for the protection of our environment through all means available.

Study Questions: 4

Match the following sentences –

Institute/ Organization	Year
1. Convention on Biological Diversity (CBD)	A- 2001
2. Minamata Convention on Mercury	B- 2012
3. World Climate Change Day	C- 21 June
4. Millennium Ecosystem Assessment (MA)	D- 1993
5. Doha Amendment to the Kyoto Protocol	E- 2017
6. Montreal Protocol on Substances that Deplete the Ozone Layer	F- 1987

10.6 Summary

An understanding of the differences between population and demography. Further interdependence among demography, development and Ecology is also very well established and recognized by various studies.

Efforts of developing nations for sustainability has tangled in many limitations like finance and technological progress, etc. To remove this blocked, many international organizations are established and the responsibilities of each country are fixed in a differentiated manner.

If hurdles of developed countries are concerned then it is clear that consumption pattern and shift towards durable goods would be fruitful. Monetary measures are also valuable.

Now, countries across the globe have accepted their responsibility in ecological balance and also start providing funds for sustainable projects. Communications on ecology also prompted the transfer of technology for SDGs goals.

10.7 Glossary

Resources:	Collective wealth of a country
Arid:	Climate having little or no rain
Growing spots:	Population with a high birth rate
Protocol:	Official procedure
Convention:	An agreement between states
Apex:	Highest part of something
Deplete:	To reduce something in size
Interdisciplinary:	Exploring with more than one branch of knowledge
Resilience:	The capacity to recover/ rebound quickly
Stakeholder:	Concerning person

10.8 Answers of Questions

Answers of study questions: 1

- | | | | |
|----------|----------|----------|---------|
| 1- False | 2- True | 3- True | 4- True |
| 5- False | 6- False | 7- False | 8- True |

Answers of study questions: 2

- | | |
|----------------------------|----------|
| 1- Yogic | 2- India |
| 3- Sustainable Development | 4- 2019 |

Answers of study questions: 3

- | | | |
|------|------|------|
| 1- C | 2- A | 3- A |
| 4- C | 5- A | 6- A |

Answers of study questions: 4

- | | | |
|------|------|------|
| 1- D | 2- E | 3- C |
| 4- A | 5- B | 6- F |

10.9 References

- Bergaglio, Maristella. "The Contemporary Illusion: Population Growth and Sustainability." *Environment, Development and Sustainability*, vol. 19, no. 5, Oct. 2017, pp. 2023–38. DOI.org (Crossref), doi:10.1007/s10668-016-9842-3.
- Demographic Change and Local Development.Pdf. <http://www.carltd.com/sites/carwebsite/files/Demographic%20Change%20and%20Local%20Development.pdf>. Accessed 3 Jan. 2020.
- <http://www.carltd.com/sites/carwebsite/files/Demographic%20Change%20and%20Local%20Development.pdf>. Accessed 5 Jan. 2020.
- James, K. S. "India's Demographic Change: Opportunities and Challenges." *Science*, vol. 333, no. 6042, July 2011, pp. 576–80. DOI.org (Crossref), doi:10.1126/science.1207969.
- Palmer, Margaret A., et al. "Ecological Science and Sustainability for the 21st Century." *Frontiers in Ecology and the Environment*, vol. 3, no. 1, Feb. 2005, pp. 4–11. DOI.org (Crossref), doi:10.1890/1540-9295(2005)003[0004:ESASFT]2.0.CO;2.
- "The Contemporary Illusion: Population Growth and Sustainability." *Environment, Development and Sustainability*, vol. 19, no. 5, Oct. 2017, pp. 2023–38, doi:10.1007/s10668-016-9842-3.
- Understanding Migration and Return | Environmental Law Institute. 21 Feb. 2017, <https://www.eli.org/migration/understanding-migration-and-return>.
- 10.11 Suggestive Readings

- López, Ramón, and Michael A. Toman. Economic Development and Environmental Sustainability: New Policy Options. OUP Oxford, 2006.
- Mancebo, François, and Ignacy Sachs. Transitions to Sustainability. Springer, 2015.
- Smith, Peter. Sustainability at the Cutting Edge. Routledge, 2007.
- Vereinte Nationen, editor. Sustainable Development Challenges. United Nations, 2013.

Unit-11: Sustainable Development III

Unit Structure

11.0 Learning objectives

- 11.1 Introduction
- 11.2 Environmental Laws: Dimensions
- 11.3 Environmental laws: Challenges
- 11.4 Environment: Indian Constitutional measures
 - 11.4.1 Environment: Indian Legislative measures
 - 11.4.2 Other Measures
- 11.5 Indian Judiciary and Environmental Issues
 - 11.5.1 The Court activism on Environmental issues
 - 11.5.2 The National Green Tribunal (NGT)
- 11.6 Future Perspective on the Environmental Issues
- 11.7 Summary
- 11.8 Glossary
- 11.9 Answers of Questions
- 11.10 References
- 11.11 Suggestive Readings

11.0 Learning objectives

After reading this unit, you will have an understanding of -

- What are environment laws?
- The Perspectives of environment values?
- Scope of environmental laws.
- International environmental laws and efforts.
- National environmental laws and efforts.

11.1 Introduction

In the previous unit, you learnt that sustainable development is broader and interdisciplinary in nature. Efforts for the management of resources is now recognised and widely accepted through the nations across the world. Natural resources are proved limited in stock with the help of science.

Environmental law is not a uniform system of the law neither in a country nor among countries. Some of the issues are – overlapping of jurisdictional laws, policy lag due to interchangeability.

Many countries including India, have welfare government structure which often comprises two or more tier of governments like – Central, State, Local. Certainly, these

types of government structure are in favour of marginalised people's upliftment but sometimes it constitutes mishmash of the legal environment.

This unit responds to the students by linking legal issues with environment persisting today's vicinity. Environmental law is an ever-growing field for all stakeholders like – animals, ecosystem and human.

This unit will also explore the issues, environmental laws currently seek to address. Currently, environment laws begin to address the built environment like – Mass Mobility System, Parking systems, Green Space in a city, Smoke-Free Zones, etc. Here, you are going to learn about recent developments in the environment also.

11.2 Environmental Laws: Dimensions

If you carefully consider the past decades, you will notice that environmental laws have both types of evolution roots. These are discussed below –

Proactive Approach – Any human activities which are going to cause damage to the environment in near or far-future but the damage is not done until the law comes into force, comes into a proactive approach. These are the laws stands to anticipate and mitigate the adverse effects of current activities on the environment in the future. These laws have to curb environmental degradation at the micro-level.

Example – E-Waste policy of the Indian government deals with all kinds of wastes including many types of batteries' disposal. This policy was introduced much before the extension of e-mobility in India.

Reactive Approach – Any human activities which already damaged the environment and then caught the attention of policymakers, would certainly be the part of the reactive approach. These laws have to curb environmental degradation at the macro level.

Example – Odd-Even scheme of the Delhi government was introduced to improve the air quality of Delhi from being worsen further.

The classification of the above approaches is based on - the time of evaluation of the environmental problem and the time when the law-making process got to begin. The proactive approach to environmental issues can minimise the damage until the law is passed. The environmental laws have to address the concerns related to past harms, prevent new harms and other emerging harms.

The **Precautionary Principle** emphasis that if a full impact or near to full impact assessment of a particular action or series of actions, is difficult to evaluate then it would be better to stay away than taking risks. But the lack of scientific research at the time of taking actions should not be presented as a scapegoat to avoid or delay actions. This principle is also termed as '**Better safe than sorry**'.

Some examples of this principle in international agreements are –

1. **Rio declaration on environment and development (1992)** states the words – 'In order to protect the environment, the precautionary approach shall be widely applied by states according to their capabilities
2. **Cartagena Protocol on bio-safety**
3. **Montreal Protocol**

Now, you have learnt that for sustainable development, environmental laws must have a balance in their approaches. To let access the resources of basic livings for future generations, it is necessary to implement eco-friendly policies, sometimes it requires a proactive approach and sometimes reactive approach but the target is clear and only sustainability.

11.3 Environmental laws: Challenges

While considering environmental laws, you should keep in mind the uncertainty that persists in the environment. With the help of science, you can not understand the complexities of the environment.

Example – If a dam is proposed in a forest, scientific researches will help you to access the impact on species categorised in wildlife schedule but non-scheduled species habitats also get distorted and science would be no longer helpful for these species.

Enforcement challenges – To make a law effective on the ground level, only the existence of law is not required, rather time-bound evaluation and monitoring are also important. Digital enforcement would produce better results but it requires heavy initial investments. Some cases also witness legal and constitutional barriers while enforcing environmental laws.

Intergenerational responsibility – The fact that humans have to bear the responsibility of future generations' survival and have to utilise resources in manner

which is fruitful, enjoyable and benefit-providing to the forth comers is based on the logic that 'natural environment on earth does not belong to only one generation but also to the generations going to live till the existences of earth'.

Many people have to pay for the cleanup of environment damages done by our ancestors. If the same process moves on then our next generations would certainly be going to pay for the misbehaves doing by ourselves with the environment. This theory also leads to the role of the present generation.

Equated responsibility – A universal concern for the environmental laws is that who should pay for the risks to the environment presently. Here, payment for the environment has two effects- Firstly, It creates awareness among consuming generation and secondly, it prevents polluters to go ruthlessly.

The '**Polluter Pays Principle**' clearly states that recovery, remediation and reductions of the damages should be borne by the polluter. This is a universal and well-accepted formula worldwide but the problem arises when the polluter is unable to reach. This may happen due to various reasons – pollution made by the who are died, business lock-down, sometimes trans boundary activities propel the pollution and expel the liability.



Graph: 11.1: Balancing between environment and industries / Source: alamy.com

Balancing between environment and industries / Source: alamy.com

While considering about environmental laws, you must establish in your mind that industrial activities are a necessary part of our day to day life and the expected role of laws are to find a balance between these two edges.

Study Questions: 1

Answer the following questions as True/ False –

1. Damage already done to the environment is considered for Reactive laws.
2. With the help of science, environment complexities can be described completely.
3. Montreal Protocol is based on the Precautionary Principle.
4. Environmental laws should not care about industrial establishments.

11.4 Environment: Indian Constitutional measures

In the past, the law pertaining to the environment was mainly concentrated in cities and it seemed to be less focused on individuals or collective rights rather was more about civic sense and geo-security. The then governments were recognising this as both an essential resource for individuals living and societal heritage for public good and welfare.

The Government of India Act -1935, added key dimensions to the development of ideas about the environmental issues and its governance in India by inserting them into the shape of Indian federalism.

In recent times, the conservation, protection and improvement environment emerged as a major issue through the world. An environment consists of the physical environment as well biological environment; both are inter-dependent

One country's contribution to the degradation of the environment reflects as degradation in the global environment for the rest of the world. In days back, you can observe that the Stockholm Declaration (1972) was perhaps the first international and comprehensive attempt to conserve and protect the environment.

According to the above-mentioned declaration, Indian Parliament introduced two articles in the constitution, 48A and 51A in 1976.

Article 48A of the Indian Constitution directs the State to endeavour the protection and improvement of the environment and safeguard forests and wildlife of the country.

Article 51A of the Indian Constitution directs that it is the duty of every citizen, to protect and improve the natural environment consisting of forests, lakes, river, wildlife and further have compassion for living creatures.

Constitution handed an elaboration of rights to the citizens and also gave responsibility to the government to bring about the social revolution necessary for the effective exercise of a respectful life.

In short, it seems to be that the 'State' as well as the 'citizens' both, are now under constitutional obligation to conserve, protect and improve the environment in India.

11.4.1 Environment: Indian Legislative measures

Apart from the constitutional measures for the protection and improvement of the environment, there are also plenty of legislations on the environment. Some major legislation are discussed below -

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

The Act prohibits all poisonous chemicals, polluting matter from discharging into any water stream or well. The Act mandates for the formation of the **Central Pollution Control Board (CPCB)** at the central level and the **State Pollution Control Board (SPCB)** at the state level. The new industries, as well as continuing industries, are required to obtain prior approvals of the Boards under whom jurisdiction establishment falls, before discharging any wastage. This law also prohibits sewages outflow into the water bodies.

Example – While hearing the Ganga Water Pollution case of Kanpur, the Supreme Court upheld that the financial status of the polluting tanneries should be considered as irrelevant while requiring them to establish Primary Treatment Plants (PTPs).

2. Water (Prevention and Control of Pollution) Cess Act, 1977

With an aim to realize money from those whose activities lead to pollution and who must bear the expenses of the maintaining and running of revival programs, this act was introduced. This act aims to provide levy and collection of a cess on water consumed by persons running certain industries.

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

The air pollution adversely affects all parts of living creatures especially heart and lung and reacts with haemoglobin in the blood. The CPCB and the SPCB constituted under the Water Act shall also perform the power and functions under the Air Act, with the purpose to improve the quality of air and to control and abate air pollution in their respective jurisdictions.

Under this act, an air pollutant is described as any 'solid, liquid or gaseous substance including noise present in the atmosphere; in such concentration, as may be or tend to be injurious to humans or other living creatures or plants or property or environment.'

Example - After a lot of resistance from bus and taxi operators of Delhi. Now these stakeholders themselves realise that the CNG propelled vehicles are not only environment-friendly but also economical in the long run.

4. Environment (Protection) Act, 1986

The Act was repellent of the direct consequences of the Bhopal Gas Tragedy. The term 'environment' has been defined vastly to include water, air and land, and the inter-relationship which exists among and between water, air and land and human beings, other living creatures, plants, micro-organisms and even properties.

The Act is considered as an 'umbrella' legislation designed carefully to provide a nation-wide framework for Central Government in coordination with the various Central and State authorities. This Act has given vast powers to the Central Government to take necessary steps with respect to the planning and execution of a nation-wide programme for the prevention, control of environmental pollution.

5. Public Liability Insurance Act, 1991

This act provides for mandatory public liability insurance for installations handling any hazardous substance to provide a minimum relief to the external stakeholders through the mechanism of a competent authority. Such remedies will be based on the principle of 'No-Fault' liability as it is limited to only relief on a limited scale.

You should keep in mind that the availability of immediate relief under this law would not prevent the victims or survivors to approach the Courts for claiming heavier compensation.

6. Wild Life (Protection) Act, 1972

This act prohibits hunting of animals and birds as specified in the schedules of the act. It also prohibits picking, uprooting, damaging, destroying and other harms to any specified plant from any protected forest.

The Act empowers the State Wildlife Advisory Board (SWAB) to advise the respective State Governments in the formulation of the policy for protection and conservation of the wildlife and specified plants. This board also suggests for the selection of areas to be declared as Sanctuaries, National parks, etc. within their jurisdiction.

7. Forest (Conservation) Act, 1980

The Act states that destruction of forests or use of forestland for non-forest purposes can not be permitted without the prior approvals of the Central Government. The conservation of forests act includes not only preservation and protection of existing forests but also the reforestation of already blown areas. The process of reforestation should be carried out as a continuous and integrated manner to replace the vanishing forests.

11.4.2 Other Measures

8. Environment Impact Assessment (EIA)

Environmental Impact Assessment (EIA) is a process of evaluating the possible environmental impacts of a proposed project. It takes into account inter-related socio-economic, cultural and human-health impacts.

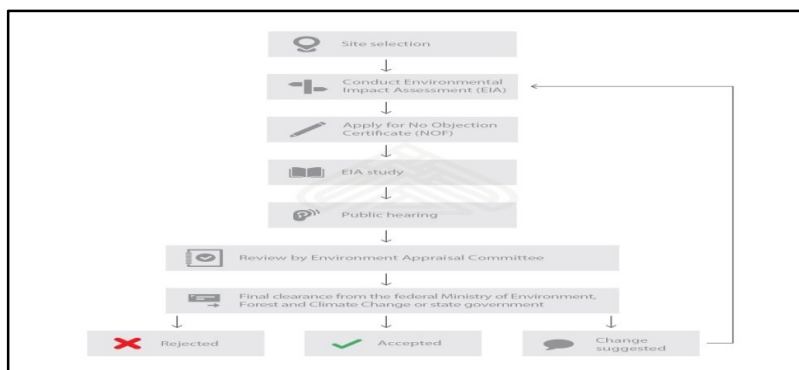
All benefits including, environmental and economic can be achieved with the implementation of EIA, such as reduced cost and time of project implementation and design, avoided treatment costs and impacts of regulations.

The key components of an EIA evaluation would necessarily involve the following steps -

- **Screening**
- **Scoping**
- **Assessment and evaluation of the impacts of alternatives**
- **Review of the Environmental Impact Assessment**
- **Monitoring, Compliance, Enforcement**

In recent times, the Strategic Environmental Assessment (SEA) has rapidly developed and expanded. It covers a wider range of - activities, area and time span than the environmental impact assessment (EIA) of the projects.

In recent times, the strategic Environmental Assessment (SEA) has rapidly developed and expanded. It covers a wider range of - activities, area and time span than the environmental impact assessment (EIA) of the projects. SEA might be applied to an entire sector (national policy on energy) or to a geographical area (regional development scheme).



Graph: 11.2: Environment Clearance in India/ Source: AsiabriefingLtd

Study Questions: 2

Answer the following questions as True/ False –

1. Article 48A directs the state for environment protection.
2. Article 51A directs the citizens for environment protection.
3. The Wild Life Protection Act was passed in 1980.
4. SEA has a wider scope than EIA.

11.5 Indian Judiciary and Environmental Issues

As the 1960s shaded into the 1970s, it was visible that political parties proliferated and so did the NGOs. Along with these trends, varied social movements captured the imagination and energy of the urban middle classes and varied groups across the country. Indian Courts entered this ferment through their own defined and foreign-courts inspired judicial activism, with the initiation of public interest litigation soon after the political Emergency (1975–77) and they used their activist persona to focus on the socio-economic rights and the quality of life.

The judges began incorporating rights to health, food, education, and so forth, into the constitution provisions of- fundamental rights to equality (Article 14) and life and liberty (Article 21) and so forth.

Due to their growing court rulings and many originating Public Interest Litigations (PILs), potable water, a clean environment, and sanitation became a part of the right to life while getting industries like- stone crushing units, rice mills, and brick kilns to move out of urban and residential areas was deemed crucial to all these basic rights.

The first cases (from the early and mid-1980s) have focused more on pollution; by the 1990s the implementation of the Forest Conservation Act (1980) became the vehicle for a series of significant interventions and the creation of a governance apparatus that is of particular interest.

Key orders passed on December 1996, and November 2000, prevented states' authorities and even statutorily authorized federal agencies from denotifying forests, parks and other green-lands without due review by the Courts.

There is also a sound empirical justification arising from the fact that the majority of public interest litigation or judicial activism has involved cases arising from environmental problems like forest and wildlife conservation, water and air pollution, relocation of industries, protection of marine habitats and the livelihoods of millions of tribal's and rural poor for whom sustainable livelihoods seem increasingly threatened by both industrialization and nature-conservation activities that have gained momentum.

11.5.1 The Court activism on Environmental issues

The Indian Supreme Court has skilfully reinvented itself as a constitutional alchemist, transforming all problems of life into the problems of the constitution and then into the problems of law.

This **Life–Law** transformation was abetted by 'Social-Action Litigation' initiated in the year of 1979 and institutionalised later in the year of 1981. This duration witnessed four crucial events that completely reinvented India's judicial functioning. These are-

1. The Court treated a postcard addressed to a Judge of the Supreme Court as a writ petition (1978).
2. The Court delivered a judgement on a habeas corpus petition filed on the basis of a newspaper report (1980).

3. The Supreme Court in 'Minerva Mills v Union of India' held Part III and Part IV as '**the core of social revolution**' under the Indian Constitution (1980).

4. The Supreme Court in 'S.P. Gupta v Union of India' the Court widened the principle of locus-standi under the Constitution (1981).

These events established and widened some main features of the Indian constitution. As a result, Article-21 became the repository of all socio-economic rights mentioned in Part IV and public-spirited individuals/ institutions got new constitutional roles.

The **creative role of the judiciary** for the cause of environment is significant due to – the recognition of the elevated status of the directive principles of state policy and also due to the expansion in the meaning of the right to life under Article 21. The Court observed that the relationship between directive principles in Part IV and fundamental rights in Part III should be taken as one of harmony and not conflict. Some cases of this creative role are below –

- Maneka Gandhi v Union of India
- Minerva Mills v Union of India
- M.C. Mehta v Kamal Nath
- Subash Kumar v State of Bihar

The **Lawmaking role** of the judiciary was characterised by a 'deep anguish' on the part of the Court to provide a direction to environmental lawmaking in India. The Court observed that, as new situations arise the law has to be evolved in order to meet the challenges of the new situations. Law cannot afford to remain static.

The Court regarded the 'polluter pays' principle as part of the law of the land. The principle establishes that the financial costs of preventing or remedying the damage caused by the pollution should lie with the units that caused the pollution or its produce caused pollution.

After some time the court regarded both the precautionary principle and the 'polluter pays' principle as part of environmental law in India. Expanding the scope of environmental law, the Court upheld the '**doctrine of public trust**' as being applicable to India. Some cases of this lawmaking role are below –

- M.C. Mehta v Union of India
- Indian Council for Environ-Legal Action v Union of India
- S. Jagannath v Union of India
- Vellore Citizens Welfare Forum v Union of India

The **Executive role of judiciary** reflected as, the increasing acts of the courts as the executive. Rather than interpreting laws, the courts making environmental policies on behalf of the state and taking steps for their implementation. Some examples of this executive role are below –

- **Kanpur Tanneries case**, the Court asked the Central Government to direct all the educational institutions throughout India to teach for one hour in a week lesson relating to the protection and improvement of the natural environment.
- Noting that the harmful consequences of vehicular pollution on the general health of people, the court introduced CNG as the alternative fuel in New Delhi. Also, they ordered the implementation of directions to restrict plying of commercial vehicles that were fifteen years old plying during the daytime.

By the year 2000, the number of cases listed as environmental issues had grown drastically. So the Supreme Court reserved Fridays for environmental public interest litigation (PIL). The Supreme Court in 2000, in an important order, clarified its role in environmental protection and elaborated the jurisprudence on sustainable development.

Recognizing the growing volume and justice-confounding delays of the environmental cases, in 2010 (after ten years), green benches started sitting on both Mondays and Fridays.

The court ruled that where an attempt has been made by state legislature and state government to balance the need for environmental protection and economic development, and impoverished areas are likely to benefit, it would not be proper to apply a principle of prohibition, rather principles of protection, polluter pays, sustainable development and inter-generational equity must be applied.

11.5.2 The National Green Tribunal (NGT)

The importance of environment courts or tribunals in the last decade has grown due to the demand for greater justice and the growing complexity of environmental law. More than 300 dedicated environmental courts or tribunals have been established in many countries.

The principle-10 of the Rio Declaration 1992 (also known as earth summit), which was adopted by the participating nations, draws attention to the fact that environmental

decisions are best made with the participation of all relevant stakeholders, supported by access to information and backed by access to remedies and relief. Access to justice, besides allowing the public to participate meaningfully, promotes governmental accountability.

The NGT was established under the National Green Tribunal Act 2010 (NGT Act, 2010) as an alternate forum to deliver speedy and inexpensive justice and as a specialised body equipped with the specific expertise to handle the environmental disputes having multidisciplinary nature. It was meant to reduce the burden on the different Courts in the country and provide speedy justice in matters relating to environmental protection, conservation of forests and other natural resources.

The NGT follows a circuit procedure for making itself more accessible in terms of geographical area. It has five benches on a zone basis- Delhi, Bhopal, Pune, Kolkata and Chennai. The NGT has jurisdiction only in civil and administrative matters.

Some remarkable interventions made by NGT are as follows –

To control air pollution in Delhi which had reached alarming proportions affecting the health of the people, the NGT prohibited 10-year-old diesel vehicles and 15-year-old petrol vehicles including light and medium vehicles (LMV) from plying in the capital. The NGT gave the central and state governments two weeks to submit 'reasoned and scientifically supported views' on a range of issues including a congestion tax and a cap on the number of vehicles allowed to ply in Delhi. The government is yet to come up with a comprehensive policy.

Dolomite mining a threat to Tiger corridor in Kanha (Madhya Pradesh)– Foresters want a ban on mining in Mandla District. The NGT, taken suo moto cognisance of the matter published in a newspaper and issued a notice to **MoEF&CC** and other concerned departments to place on record the particulars of Mining Leases (ML) mentioned in the news item.

Violation of the CRZ Notification 1991- The construction of a hotel in violation of Coastal Regulation Zones (CRZ) Regulations and environmental norms the NGT held that the respondent (M/s Kyle-San Holidays Private Limited) had violated the CRZ

Notification and subsequent notifications for coastal zone management. The NGT ordered the immediate demolition of the impugned building and that the land is restored to its original condition.

The Sand Mining order of August 2013, was a landmark decision of the tribunal to place a ban on the illegal extraction of sand from the seabed of rivers in violation of the CRZ Notification.

Sand mining activities were rampant across the country as a huge commercial practice. On the basis of photographic evidence presented to the NGT, the tribunal, in a series of orders, banned the mining and called upon the state authorities to show cause why illegal sand mining had been going on without Environmental Clearances.

Above discussion makes it clear that there is no dearth of legislation on environmental issues in India. But the enforcement and monitoring of these legislations have been far from satisfactory. So the effective and efficient enforcement of the constitutional mandate and the other environmental legislations is highly needed.

Study Questions: 3

Fill in the blanks in the following sentences –

1. Majority of the PILs filed for issues.
2. Part III and Part IV of the Indian Constitution are the core of revolution.
3. Article became the repository of rights.
4. National Green Tribunal Act passes in the year
5. Environmental disputes are of nature.
6. Coastal Regulation Zones was notified in the year of

11.6 Future Perspective on the Environmental Issues

Government of India have focused on achieving high growth in terms of **Gross Domestic Product (GDP)**. It is assumed that it will help for reducing - poverty, social and economic equality. The economist favouring growth rate, argue the importance of maximising the exploitation of a country's resources in order to achieve economic development (Trickle-down effect).

The target of high GDP within this development agenda indicates worrying trends for the social and environmental aspects. The convergence of the right to environment and the right to development has created a nationwide policy paradox. The right to

development is commonly perceived as being a reflection of powerful commercial activities rather than promoting equitable social welfare.

The World Health Organisation (WHO) Urban Ambient Air Pollution database (2016), India has 16 of the world's 30 most-polluted cities. Also, the levels of ultra-fine particles of less than 2.5 microns (PM_{2.5}s) causing fatal damage to the heart and lungs of the people in India.

Striking a checkmate between human needs, economic growth and the environment is required to create an '**inclusive development**', which represents facilities and opportunities for the welfare of people to feel and live with dignity.

Indian environmental regulations have become stronger in the 25 years since Bhopal Gas tragedy but still enforcing them remains a challenge.

'Access to justice is a primary step to the achievement of environmental balance'. Keeping this in mind, the NGT faced major institutional challenges due to limited co-operation and hesitant operational commitment of all three tiers of governments- federal, state and local.

The High-Level Committee (HLC) recommended the establishment of special environmental courts in every district of the country.

It has also recommended a new '**Umbrella Law**' namely- **Environmental Laws Management Act (ELMA)**. This act provisions for the creation of two institutions, at the central level- National Environment Management Authority (NEMA) and at the state level- State Environment Management Authority (SEMA).

But these recommendations if implemented, will certainly strip of the NGT of its first instance hearing powers and restricted to act as an appellate court and will also lead inability to exercise suo moto. These proposed provisions were regressive in nature as they would have reduced the powers of the NGT. The exercise of suo moto powers by the NGT was challenged by the MoEF&CC. The ministry had refused to confer this power on the Tribunal, despite requests to do so.

The aforesaid study leads us to the following suggestions –

Currently, we have nearly 200 Central and State legislations to deal with environmental issues. More legislation means more difficulties in enforcement and monitoring. To avoid this mess, a comprehensive and integrated law on environmental protection law must be invoked. Also, a positive attitude on the part of everyone is essential for effective and efficient enforcement of environmental legislation.

In the Indian scenario, there is a multiplicity of environmental standards for the homogeneous industries. However, the Environment (Protection) Act, 1986 established a good example and as a result, now the power has been conferred upon the Central Government for laying down the standards for the quality of air, water and soil. It is hoped that this will ensure uniformity (one India one standard) of standards throughout the country.

A need for social awareness from the below line is an essential need of the present time. No law can produce results smoothly unless the interaction is based on self-esteem. To educate people about environmental issues, there should be the use of educational resources in regional languages at schools and televisions. The magnitude of finance required, a judicious mix of incentives, phasing and awareness creating, programmes about cost-effective technologies is essential as the first prong of the strategy to control environmental degradation.

As directed by the Supreme Court of India, Environment studies shall be made a compulsory paper at school and college levels to promote a general growth of awareness.

The concept that development and environment are different ends, is no longer acceptable, as solution appears in the form of **sustainable development**. The Supreme Court has accepted sustainable development as part of the laws of the land and has affirmed that the 'precautionary principle' and the 'polluter pays principle' are its essential features.

The tapping of natural resources must be done with requisite attention and participation of all stakeholders to avoid damage to ecology and the environment. Long-term planning must be practised by the Central Government in consultation with the State Governments to protect and improve the environment.

Study Questions: 4

Tick mark the correct answers for each question below –

1. The Government of India focused more on GDP, to out root -
A. Poverty B. Hunger C. Both
2. According to WHO, India has Cities out of world's 30 most polluted cities.
A. 16 B. 21 C. 11
3. Better results of environmental policies would be possible by –
A. Legal Awareness B. Social Awareness C. None

4. Sustainable development has features of –
A. Precautionary principle B. Polluter pays principle C. Both
5. Measures of the environmental awareness is/are –
A. Compulsory paper B. Optional paper C. None
6. Environment (Protection) Act, 1986 is a type of law–
A. Unified B. Federal C. Decentralized

11.7 Summary

Relationship of cause and effect about the nature of environmental laws and its effect on growth and development is described in a holistic approach. Also, the understandability of the complex nature of environmental issues is presented in a simple way. The complexities and multidisciplinary nature of environmental problems lead the laws to be framed in a manner which would help justice to be delivered in a limited time.

Developing nations are struggling hard to achieve a higher growth rate but in this process sustainable development lost its ground. Many legislative and judicial efforts are going with pace in India. It is now clear that economic growth and environment protection can go hand in hand. Establishment of Environmental Courts and Tribunals (ECTs) across many countries shows a brighter future.

The Supreme Court defined the constitutional rights and duties for the environment protection. The court formulated PILs as quick remedies for this purpose and also played the role of legislative and enforcing agencies.

Establishment of NGT has opened the doors for both opportunity and challenges to make a healthier environment, the effort of NGT, seemed beyond expectations many times.

The protection of the environment and keeping ecological balance intact is an important task, not only for the government but also for every individual and corporation.

11.8 Glossary

Enforcement:	Compliance with a law
Obligation:	A duty or commitment
Accountability:	Responsibility
Tribunal:	A body established to settle certain types of disputes
Convention:	An agreement between states
Apex:	Highest part of something
Plying:	Travel regularly over a route
E-Waste:	Discarded electrical or electronic devices
Dearth:	A scarcity or lack of something
suo moto:	On its own motion

11.9 Answers of Questions

Answers of study questions: 1

1- True 2- False 3- True 4- False

Answers of study questions: 2

1- True 2- True 3- False 4- True

Answers of study questions: 3

1- environmental 2- social 3- 21 & socio-economic
4- 2010 5- multidisciplinary 6- 1991

Answers of study questions: 4

1- C 2- A 3- B
4- C 5- A 6- A

11.10 References

- Agarwal, V. K. (n.d.). Environmental Laws in India: Challenges for Enforcement. 12.
- Dam, S. (2005). Polluting Environment, Polluting Constitution: Is a "Polluted" Constitution Worse than a Polluted Environment? *Journal of Environmental Law*, 17(3), 383–393. <https://doi.org/10.1093/jel/eqi029>
- Mejia, R. (2009). The Challenge of Environmental Regulation in India. *Environmental Science & Technology*, 43(23), 8714–8715. <https://doi.org/10.1021/es903239b>

Shrotria, S. (2015). Environmental justice: Is the National Green Tribunal of India effective? *Environmental Law Review*, 17(3), 169–188.
<https://doi.org/10.1177/1461452915595548>

Sivaramakrishnan, K. (2011). Environment, law, and democracy in India. *The Journal of Asian Studies*, 70(4), 905–928.

Unit, B. (2010, April 27). What is Impact Assessment?
<https://www.cbd.int/impact/whatis.shtml>

11.11 Suggestive Readings

- Birnie, P. W., & Boyle, A. E. (1994). *International law and the environment*.
- Gill, G. (2016). *Environmental Justice in India: The National Green Tribunal* (1st ed.). Routledge. <https://doi.org/10.4324/9781315686592>
- Johnson, L., & Powell, F. (2015). *Environmental Law*. Cengage Learning.
- Sagoff, M. (2007). *The economy of the earth: philosophy, law, and the environment*. Cambridge University Press.