University Grants Commission

Subject: Economics Code: 01

Unit-9: Environmental Economics and Demography

Sub-Unit 1: Environment Economics

SL. No.	Topics: Environment Economics
1	9.1.1. Meaning
2	9.1.2. Some Basic Concept of Environmental Economics
3	9.1.3. Environment and Economy Interaction
4	9.1.4. Sustainable Development
5	9.1.5. Strong and weak Sustainable Development
6	9.1.6. Market Failure
7	9.1.7. Causes of market failure
8	9.1.8. Incomplete markets
9	9.1.9. Indivisibilities
10	9.1.10. Common Property Resources
11	9.1.11. Imperfect Markets
12	9.1.12. Asymmetric Information
13	9.1.13. Externalities
14	9.1.14. Public Goods
15	9.1.15. Public Bads
16	9.1.16. Solution for Market Failure
17	9.1.17. Measurement of Economic Value
18	9.1.18. Method of Measuring Environment Values
19	9.1.19. Hedonic Pricing Method
20	9.1.20. Dose Response Method
21	9.1.21. Averting Expenditure Avoided Cost Method
22	9.1.22. Travel Cost Method
23	9.1.23. Contingent Valuation Method

Sub-Unit 2: Cost-Benefit Analysis and Compensation Principle:

SL. No.	Topics: -Benefit Analysis and Compensation Principle
1	9.2.1. Meaning of Cost-Benefit analysis
2	9.2.2. Origin of Cost Benefit Analysis
3	9.2.3. Types of Cost Benefit Analysis
4	9.2.4. Pareto Optimality
5	9.2.5. Compensation Principle
6	9.2.6. Kaldor-Hicks Welfare Criterion
7	9.2.7. Scitovsky's Paradox
8	9.2.8. Scitovsky Double criterion
9	9.2.9. Dr. Little Criterion

Sub-Unit 3: Population Theory and Demographic Dividend:

SL. No.	Topics: - Population Theory and Demographic Dividend
1	9.3.1. Population theory
2	9.3.2. Thomas Doubleday's Diet Theory
3	9.3.3. Jouse De Castro's Protein Consumption Theory
4	9.3.4. Michael Thomas Sadler's Destiny Theory
5	9.3.5. Herbert Spencer's Biological Theory
6	9.3.6. Corrado Ginnis's Biological Population Theory
7	9.3.7. Dumont's Theory of Social Capillarity
8	9.3.8. Leibenstein's Motivational Theory of Population Growth
9	9.3.9. Demographic Dividend
10	9.3.10. Types of Demographic Dividend
11	9.3.11. Dependency Ratio

Sub-Unit 4: Concepts and Measures: Fertility, Morbidity, Mortality and Life Table:

SL. No.	Topics: - Fertility, Morbidity, Mortality and Life Table
1	9.4.1. Measure of Fertility
2	9.4.2. Measure of Mortality
3	9.4.3. Life Table
4	9.4.4. Classification of life table
5	9.4.5. Construction of Life table
6	9.4.6. Migration
7	9.4.7. Meaning of Migration
8	9.4.8. Kinds of Migration
9	9.4.9. Factor Leading to Migration
10	9.4.10. Impacts of Migration
11	9.4.11. Theory of Migration
12	9.4.12. Ravenstein's Laws of Migration
13	9.4.13. Gravity Model
14	9.4.14. Stouffer's Theory of Mobility

Sub-Unit – 1: Environment Economics

9.1.1. Meaning:

Environmental economics is a subfield of economics concerned with environmental issues. Quoting from the National Bureau of Economic Research Environmental Economics program: Environmental Economics undertakes theoretical or empirical studies of the economic effects of national or local environmental policies around the world.

In the words of D.W. Pearce, ―Environmental Economics brings the discipline of economic analysis to environmental issues such as pollution, the rate of use of renewable and non-renewable natural resources, conservation of living species and resources, and the choice of policy to achieve environmental ends.

9.1.2. Some Basic Concept of Environmental Economics:

I. Environment:

The word environment has been derived from the French word 'Environer'which means to surround. Environment includes water, air and land, and their inter-relationships with human beings, other living creatures, plants and microorganisms. Environment provides basic services essential to humanity such as supporting life, supplying materials, energy and absorbing waste products.

II. Environmental Pollution

A change in the physical, chemical or biological characteristics of the air, water or soil that can affect the health, survival or activities of human beings or other living organisms in a harmful manner. In economics, pollution is termed as any loss of human well-being arising from physical environmental changes.

III. Natural Resources

Anything obtained from the physical environment to meet human needs relates to natural resources. Basic human needs are fulfilled by materials provided by nature itself.

They are air, water, soil, minerals, coal, petroleum, animals and plants. These stocks of the nature, useful to mankind are called natural resources. In the primitive age, man had used only those resources that supported his life. But the process of economic growth and increase in population have led to mismanagement of natural resources.

There are two types of natural resources:

(i) Non-renewable resources

(ii) Renewable Resources.

(i) Non-renewable Resources

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

(ii) Renewable Resources

These resources are present in unlimited quantity in the nature. They are solar radiation, air and water. These are not likely to be exhausted by human activities. Some examples are fresh water, fertile soil, forest (yielding wood and other products), vegetation, wildlife, etc.

IV. Ecology

Ecology and economics share the same etymology—OIKOS (House). In Ecology, it represents the study of our house, whereas in economics, it ensures the management of that place. Ecology is concerned with the relationship between the physical environments
(Soil, water and air), and organism environment (plant and animal life etc.).
Ecological economists have analysed the interdependence between the physical environment and economic activities in their models. According to them, some economic activities may be the cause of environmental degradation.

V. Ecosystem

Ecosystem is a term applied to a particular relationship between living organism and their environment. An eco-system has two main components: (a) Abiotic, and (b) Biotic. All the non-living components of environment present in an ecosystem are known as abiotic components.

9.1.3. Environment and Economy Interaction:

The environment supports economic activity by man in four ways: it provides life support, supplies natural resources for production and consumption, absorbs waste products and supplies amenity services. The economy works from inside the environmental system and its activities affect the environment and the latter also affects the economy. For the production of goods and services, the economy uses man-made capital, labour and natural resources (such as coal, oil, petroleum and diesel, CNG gas), minerals and metals etc from environment. Resources can be renewable or non-renewable. The renewable resources are those whose quantity can be increased when they are depleted. Forests and fishing come in this category. On the other hand, the non-renewable resources are those resources whose exhaustion as a result of their use cannot be made up. Coal, iron ore, crude oil come in this category of non-renewable resources. These resources cannot be produced by man. Hence, they are also called exhaustible resources. How the economy is related to the environment is depicted in the following figure. The environment in the figure is represented by the whole big circle. The environment means all natural resources such as land, ecosystem, all mineral and metals deposited under the land surface, World's Ocean and atmosphere and natural climate. The economy is shown inside the environment system in which works.

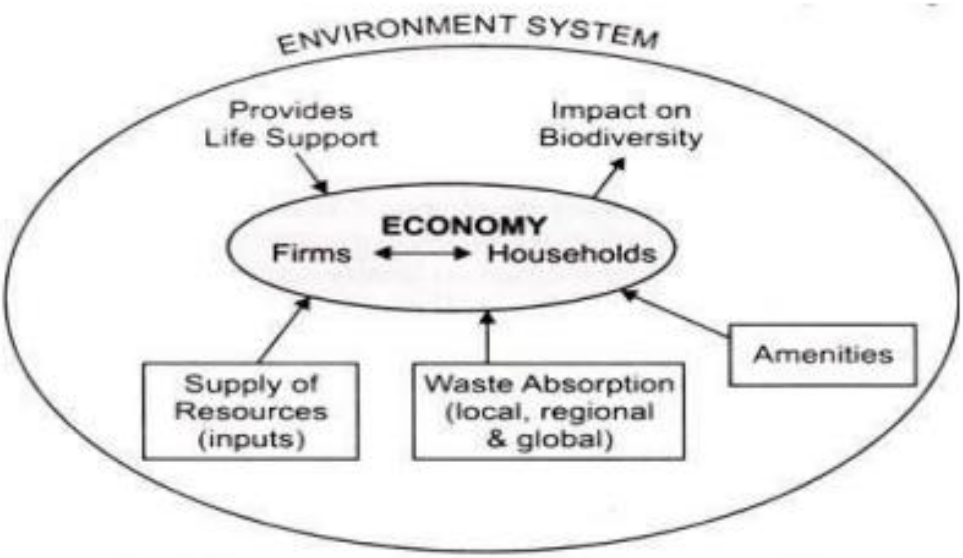


Figure 1 Economy-Environment Linkages

In the economy the firms produce goods and services with the use of natural resources, man-made capital and labour to satisfy the consumption wants of households. There are many relations between the environment and the economy.

First, the environment system that includes the air and atmosphere, rivers, the fertility of the soil and biodiversity (i.e. various types of plant and animal life) on which life of households depends. They are essential and necessary for their existence of human beings to live. If there is any large reduction in these conditions provided by environment system, there will be highly devastating effect on human life. This life-support function of the environment system is shown by the arrow towards the economy in the upper part of Fig. 1.

Second, the environment provides raw materials and energy resources such as minerals, metals, food, wood and cotton for production and use by the firms and households in the economy. These natural resources may be renewable or non-renewable. Some non-renewable resources must be preserved for future generations and in this regard efforts should be made to find their man-made substitutes. For example, to save coal, solar energy can be used. Besides, even renewable resources can be used in sustainable manner. For example, to ensure deforestation should not result in desertification, new trees be planted to make up the loss of trees. The use of renewable resources is shown in the above diagram by opposite flow of resources from the economy to the environment. As regards non-renewable resources such as coal and crude oil, their use causes permanent reduction in their stock.

Third, important function of environment is to absorb the waste products such as carbon dioxide (CO_2) which originates from the production processes of the firms, from power plants or the consumption activities of the households which originate garbage for collection and disposable. Thus, the environment is used as a waste sink. Wastes may be in a variety of forms, such as solid, air and water-borne. It is important to note that environment has a limited assimilative capacity to absorb these wastes or to dispose of them safely. That is to transform them into some harmless substances.

9.1.4. Sustainable Development:

Meaning:

The Brundtland Report is most often cited for its definition of sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Sustainable development constantly seeks to achieve social and economic progress in ways that will not exhaust the earth 's finite natural resources. The needs of the world today are real and immediate, yet it's necessary to develop ways to meet these needs that do not disregard the future. The capacity of our ecosystem is not limitless, meaning that future generations may not be able to meet their needs the way we are able to now.

Example:

Some of the more common examples of sustainable development practices are:

I. **Solar and wind energy:** Energy from these resources is limitless, meaning we have the ability to eliminate dependence on non-renewable power sources by harnessing power from renewable resources.

II. **Sustainable construction:** Homes, offices and other structures that incorporate recycled and renewable resources will be more energy efficient and stand the test of time.

III. **Crop rotation:** Many farmers and gardeners are using this method as a chemical free way to reduce diseases in the soil and increase growth potential of their crops.

9.1.5. Strong and weak Sustainable Development:

Economists have thought about SD from this viewpoint in terms of the concept of capital. Four forms of capital may be distinguished.

(a). Man-made, or produced, capital, (Km): It comprises the results of past production, as the excess of output over consumption. Km includes factories, machinery, roads, bridges, phone networks and satellites, and may be used up (depreciated) in the production of consumption goods and services.

(b) Human capital, (Kh): Human capital is people, their skills and knowledge.

(c) Natural capital, (Kn): Natural capital comprises all gifts of nature, and so includes renewable and non-renewable energy and material resources, clean air and water, nutrient and carbon cycles and biodiversity.

(d) Social capital, (Ks): Social capital as comprising certain features of social organisation - norms of behaviour, networks of interactions between people and between institutions and trust between people.

I. **Weak Sustainable Development:**

It requires that the real value of the total capital stock K, where (K = Kn +Kh +Km), be non-declining (note that we ignore social capital from now on). This permits natural capital to be run down (through using up oil stocks, say) so long as human and man-made capital are increased sufficiently. Maintaining the overall asset balance implies consuming merely the interest on this aggregate capital.

II. Strong Sustainable Development:

An alternative view has been to maintain that SD requires that some part of the stock of Kn itself has to be prevented from declining. This view has been called 'strong sustainability', and derives primarily from the view that reductions in Kn cannot be substituted for by increases in Kh, Km or any other forms of capital.

9.1.6. Market Failure:

In economics, market failure is a situation in which the allocation of goods and services is not efficient. That is, there exists another conceivable outcome where an individual may be made better-off without making someone else worse-off. (The outcome is not Pareto optimal.) Market failures can be viewed as scenarios where individuals' pursuit of pure self-interest leads to results that are not efficient – that can be improved upon from the societal point of view.

9.1.7. Causes of market failure:

Some of the major causes of market failure are:

1. Incomplete markets,
2. Indivisibilities,
3. Common Property Resources,
4. Imperfect Markets,
5. Asymmetric Information,
6. Externalities,
7. Public Goods
8. Public Bads.

9.1.8. Incomplete markets:

Markets for certain things are incomplete or missing under perfect competition.

The absence of markets for such things as public goods and common property resources is a cause of market failure.

9.1.9. Indivisibilities:

The Paretian optimality is based on the assumption of complete divisibility of products and factors used in consumption and production. In reality, goods and factors are not infinitely divisible. Rather, they are indivisible. The problem of divisibility arises in the production of those goods and services that are used jointly by more than one person.

An important example is of road in a locality. It is used by a number of persons in the locality. But the problem is how to share the costs of repairs and maintenance of the road. In fact, very few persons will be interested in its maintenance. Thus, marginal social costs and marginal social benefits will diverge from each other and Pareto optimality will not be achieved.

9.1.10. Common Property Resources:

Another cause of market failure is a common property resource. Common ownership when coupled with open access, would also lead to wasteful exploitation in which a user ignores the effects of his action on others. Open access to the commonly owned resources is a crucial ingredient of waste and inefficiency.

Its most common example is fish in a lake. Anyone can catch and eat it but no one has an exclusive property right over it. It means that a common property resource is non-excludable (anyone can use it) and non-rivalries (no one has an exclusive right over it).

Example: The lake is a common property for all fishermen. When a fisherman catches more fish, he reduces the catch of other fishermen. But he does count this as a cost, yet it is a cost to society. Because the lake is a common property resource where there is no mechanism to restrict entry and to catch fish. The fisherman who catches more fish imposes a negative externality on other fishermen so that the lake is overexploited.

This is called **the tragedy of the commons** which leads to the elimination of social gains due to the overuse of common property. Thus, when property rights are common, indefinite or non-existent, social costs will be more than private costs and there will not be Pareto Optimality.

9.1.11. Imperfect Markets:

Pareto efficiency increases under perfect competition. But it declines under market distortions or imperfections. Let us consider a case of monopoly. Initially, monopoly equilibrium is at point E where the private marginal cost curve, PMC, cuts the marginal revenue curve, MR, from below.

The monopolist produces OQ_1 output at OP_1 price. But the production process generates smoke in the air. Therefore, the pollution board levies a tax equal to TE on the monopoly firm. The imposition of a pollution tax is, in fact, a fixed cost to the monopoly firm. Now the social marginal cost curve cuts the marginal revenue curve at point e.

The monopolist increases the price of his product from OP_1 to OP_2 and restricts output to OQ_2 and thereby reduces consumers' surplus to $Q_2 MLQ_1$ (= $OQ_1 LP_1 - OQ_2 MP_2$). In fact, $Q_2 MLQ_1$ is the social cost of OQ_2 output. But the net loss to society is $Q_2 MLQ_1 - TE = eMLT$, the shaded area in the below figure.

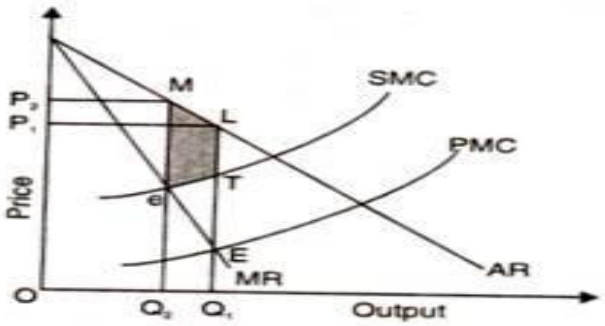


FIGURE 18.1 : (IMPERFECT MARKETS)

9.1.12. Asymmetric Information:

Pareto optimality assumes that producers and consumers have perfect information regarding market behaviour. But according to Joseph Stiglitz, "In the real world, there is asymmetric (incomplete) information due to ignorance and uncertainty on the part of buyers and sellers. Thus, they are unable to equate social and private benefits and costs."

Suppose a producer introduces a new antipollution device in the market. But it is very difficult for him to predict the current demand of his product. On the other hand, consumers may be ignorant about quality and utility of this anti-pollution device. In some cases, information about market behaviour in the future may be available but that may be insufficient or incomplete. Thus, market asymmetries, fail to allocate efficiently.

9.1.13. Externalities:

The presence of externalities in consumption and production also lead to market failure. Externalities are market imperfections where the market offers no price for service or disservice. These externalities lead to malallocation of resources and cause consumption or production to fall short of Pareto optimality.

Externalities, lead to the divergence of social costs from private costs, and of social benefits from private benefits. When social and private costs and social and private benefits diverge, perfect competition will not achieve Pareto optimality.

Because under perfect competition private marginal cost (PMC) is equated to private marginal benefit (i.e. the price of the product). We discuss below how external economies and diseconomies of consumption and production affect adversely the allocation of resources and prevent the attainment of Pareto optimality.

I. Positive Externalities of Production:

According to Pigou, when some firm renders a benefit or cost of a service to other firms without appropriating to itself all the benefits or costs of his service, it is an external economy of production. External economies of production accrue to one or more firms in the form of reduced average costs as a result of the activities of another firm.

In other words, these economies accrue to other firms in the industry with the expansion of a firm. They may be the result of reduced input costs which lead to pecuniary external economies. Whenever external economies exist, social marginal benefit will exceed private marginal benefit and private marginal cost will exceed social marginal cost.

This is illustrated in Figure 18.2 where PMC is the private marginal cost curve or supply curve of firms. The demand curve D intersects the PMC curve at point E and determines the competitive market price OP and output OQ.

SMC is the social marginal cost curve which intersects the demand curve D at point E_1 and determines the social optimum output level OQ_1 at price OP_1. Since for every unit of output between OQ and OQ_1 social marginal cost (OP_1) is less than the competitive market price OP, its production involves a net social gain equal to QQ_1.

Diagram:

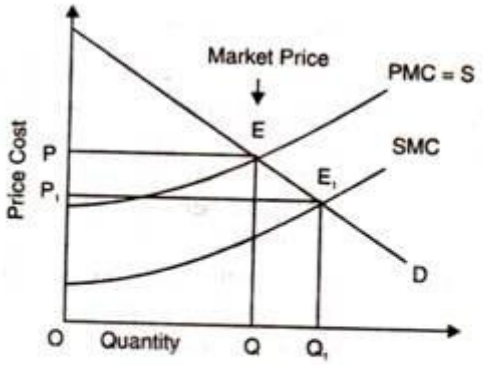


FIGURE. 18.2 : (POSITIVE EXTERNALITIES OF PRODUCTION)

II. Negative Externalities of Production:

When the production of a commodity or service by a firm affects adversely other firms in the industry, social marginal cost is higher than social marginal benefit. Suppose, a factory situated in a residential area emits smoke which affects adversely health and household articles of the residents.

In this case, the factory benefits at the expense of residents who have to incur extra expenses to keep themselves healthy and their households clean. These are social marginal costs because of harmful externalities which are higher than private marginal cost and also social marginal benefit.

This is illustrated in Fig. 18.3 where the PMC curve which intersects the D curve at point E and determines the competitive price OP and output OQ. But the socially optimum output is OQ_1 and price is OP_1, as determined by the intersection of SMC and D curve at point E_1.

Thus, the firms are producing Q_1 Q more than the social optimal output OQ_1. In this case, for every unit between Q_1 and Q, social marginal cost (SMC) is more than the competitive market price OP. Thus, its production involves a social loss i.e. $OQ - OQ_1 - QQ_1$.

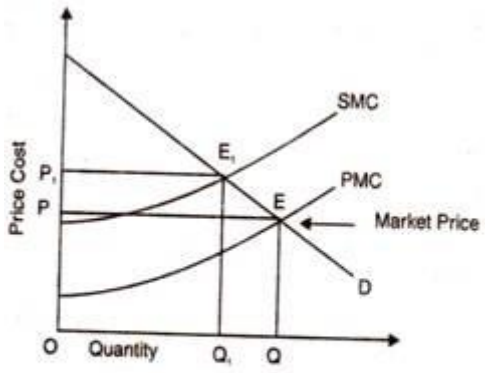


FIGURE 18.3 : (NEGATIVE EXTERNALITIES OF PRODUCTION)

III. Positive Externalities in Consumption:

Externalities in Consumption lead to non-attainment of Pareto optimality. External economies of consumption arise from non-market interdependences of the satisfactions enjoyed by different consumers. An increase in the consumption of a good or service which affects favorably the consumption patterns and desires of other consumers is an external economy of consumption.

When an individual installs a TV set, the satisfaction of his neighbors increases because they can watch TV programmes free at his place. Here social benefit is larger and social cost is lower than the private benefit and cost. But the TV owner is likely to use his TV set to a smaller extent than the interests of society require because of the inconvenience and nuisance caused by his neighbors to him.

IV. Negative Externalities in Consumption:

Negative externalities in consumption arise when the consumption of a good or service by one consumer leads to reduced utility (dissatisfaction or loss of welfare) of other consumers. Negative externalities in consumption arise in the case of fashions and articles of conspicuous consumption which reduce their utility to some consumers. For example, smokers cause disutility to non-smokers, and noise nuisance from stereo systems to neighbors etc. Such diseconomies of consumption prevent the attainment of Pareto optimality.

Suppose there are two room-mates A and B. Individual A likes to smoke while individual B likes clean air. Further, B's utility of consuming clean air is affected by individual A's smoking. This is explained in terms of Figure 18.4 (A) & (B). Initially, individual A's utility from smoking gives him 50 utilis at point A while individual B's consumption of clean air gives him 80 utilis at point B. When there are no externalities in consumption, the tangent at point A and point B are parallel to each other.

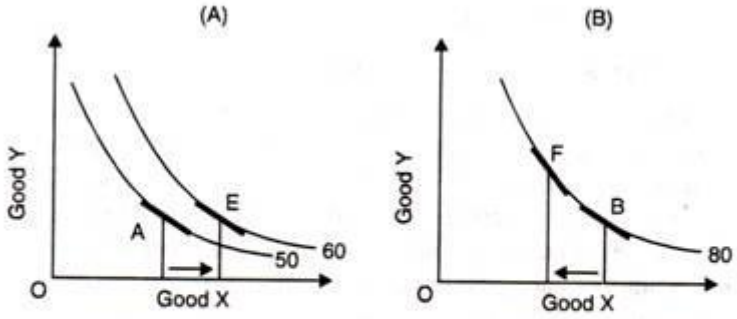


FIGURE 18.4

9.1.14. Public Goods:

Another cause of market failure is the existence of public goods. A public good is one whose consumption or use by one individual does not reduce the amount available for others. An example of a public good is water which is available to one person and is also available to others without any additional cost. Its consumption is always joint and equal.

It is non-excludable if it can be consumed by anyone. It is non-rivalrous if no one has an exclusive rights over its consumption. Its benefits can be provided to an additional consumer at zero marginal cost. Thus public goods are both non-excludable and non- rivalrous. Moreover, environmental quality is generally considered as a public good and when it is valued at market price, it leads to market failure.

The Paretian condition for a public good is that its marginal social benefit (MSB) should equal its marginal social cost (MSC). But the characteristics of a public good are such that the economy will not reach a point of Pareto optimality in a perfectly competitive market. Public goods create externalities.

The externality starts when the marginal cost of consuming or producing an additional unit of a public good is zero but a price above zero is being charged. This violates the Paretian welfare maximization criterion of equating marginal social cost and marginal social benefit. This is because the benefits of a public good must be provided at a zero marginal social cost.

Suppose potable water is supplied by the municipal corporation. There are two individuals A and B who use it. Both consume the same quantity of water. But they differ in how much they are willing to pay for any given quantity.

This is illustrated in Figure 18.5. where D_a and D_b are the demand curves of two individuals A and B respectively. Therefore, demand prices are OP_a and OP_b corresponding to a given quantity OW of water. The curve ΣD is the vertical summation of D_a and D_b curves.

But each consumer is being charged a different price. This is a case of price discrimination because price OP_a is greater than price OP_b for the same quantity of water OW. Hence there is market failure.

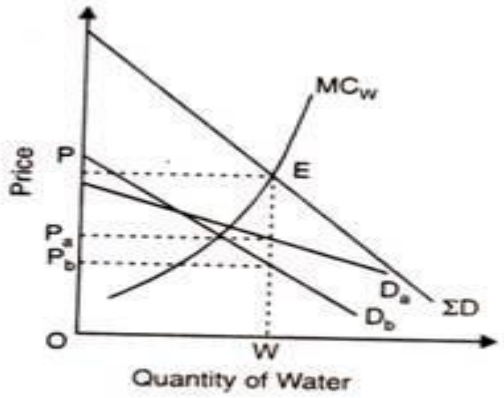


FIGURE 18.5

9.1.15. Public Bads:

There are also public bads in which one person experiencing some disutility does not diminish the disutility of another, such as air and water pollution. Public goods and public bads cannot be handled by the institution of private property. K.E. Boulding has explained public bads with the following example: “If someone drives his car into my living room and pollutes it, I can sue him for damages. This is a private bad. But if someone congests the roads or pollutes the air, however, there is not much I can do about it as an individual. This is public bad.”

9.1.16. Solution for Market Failure:

As referred to in the Introduction there are two influential approaches to the market failures problem, more precisely to the externalities.

I. Pigou Tax system

The first one is influenced by Arthur Cecil Pigou, who wrote his "The Economics of Welfare" in the thirties. Pigou proposed that in case of negative externalities the government should impose a tax equivalent to the amount of its cost. As far as the problem of the externality is the lack of a signal of the scarcity of a natural resource or of the cost of pollution, the effect of such tax would be the correction of the price of the good and a decrease in its consumption. The opposite but similar policy should be addressed for positive externalities. A subsidy should be given for its producer in order to incentive the production of the good or service with social benefits cannot be reaped by the producer in the price.

II. Coase Theorem:

In 1960, however, Ronald Coase criticized the so-called Pigouvian approach to the externalities problem. He argued basically that not so much governmental intervention was necessary to deal with externalities "if zero transaction costs exist".

According to the Coase theorem, in the face of market inefficiencies resulting from externalities, private citizens (or firms) are able to negotiate a mutually beneficial, socially desirable solution as long as there are no costs associated with the negotiation process. The result is expected to hold regardless of whether the polluter has the right to pollute or the average affected bystander has a right to a clean environment**.**

Consider the negative externality example above, in which parents face soaring health care costs resulting from increased industrial activity. According to the Coase theorem, the polluter and the parents could negotiate a solution to the externalities issue even without government intervention. For example, if the legal framework in society gave the firm the right to produce pollution, the parents with sick children could possibly consider the amount they are spending on medical bills and offer a lesser sum to the firm in exchange for a reduced level of pollution. That could save the parents money (as compared with their health care costs), and the firm may find itself more than compensated for the increased costs that a reduction in emissions can bring.

Unfortunately, because the Coase theorem's fundamental assumption of costless negotiation often falls short, the theorem is not commonly applicable as a real-world solution. Nevertheless, the Coase theorem is an important reminder that, even in the case of complex environmental problems, there may be room for mutually beneficial compromises.

9.1.17. Measurement of Economic Value:

Understanding value of Environmental Goods requires understanding of the notion of values of environmental goods

There are two types of values – **I. Use Value and II. Non-use Value.**

I. Use Value: Use Value could include current use (—I am currently visiting the park), expected use (—I plan to visit the park later this year) and possible use

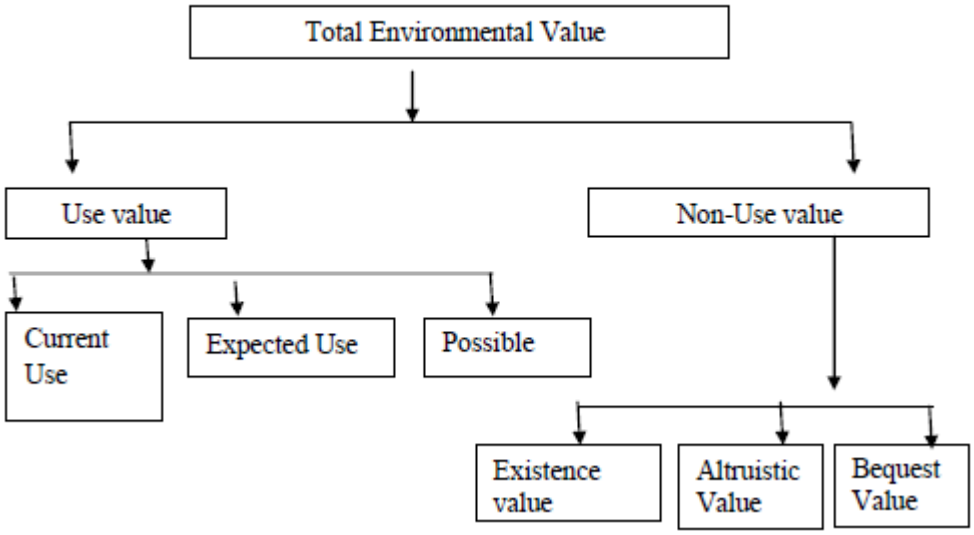
(I might visit the park within next 10 years).

II. Non-Use Value: A non-use value (feel good or warm glow) is a value associated that does not concern our use, either direct or indirect, of the environment, its resources or services.
There are three basic types of non-use value: Existence value, Altruistic vale and Bequest value:

i. Existence value: The value a consumer attaches to knowing something exists (e.g. One-horned rhinoceros in Kaziranaga National Park)

ii. Altruistic value: It's a value that the consumers derive from not consuming the goods themselves but from the fact they derive the benefit when someone else gains utility. (e.g. If person A's neighbour derives benefit from his cleaning his front yard, person A obtains utility from the fact that his neighbours are better off.

iii. Bequest value: It is associated with the well-being of the descendants. For example, if one values passing a wilderness area on to the next generation that wilderness area has a bequest value to the person even if he or she never uses it or intends to use it.



9.1.18. Method of Measuring Environment Values:

Methods of measuring environment values are generally two types – I. Revealed Preference Method, and II. Stated Preference Method.

i. **Revealed Preference:** In revealed preference approach real choices of people are observed in some market and information are inferred on the trade-offs between money and the environmental good.

ii. **Stated Preference:** It basically involves asking people how much an environmental good is worth.

Methods	Revealed Preference	Stated Preference
Direct		Contingent Valuation Method
Indirect	Hedonic Price Method Travel Cost Method Does Response Method Averting Expenditure Avoided Cost Method	

9.1.19. Hedonic Pricing Method:

Hedonic Pricing (HP) Approach is derived from the characteristic theory of value first proposed by Lancaster (1966) and Rosen (1974). This seeks to explain the value of a commodity as a bundle of valuable characteristics (e.g. the price/rent of house depends on number of rooms, availability of garden in the campus, proximity to shops, noise level in the neighbourhood, air quality levels etc.).

HP was first applied to environmental valuation by Ridker and Henning (1967) HP proceeds on three stages:

- First, hedonic price function is estimated.
- Second, implicit prices are calculated.
- Third, a demand curve for this variable may be estimated.

Application of the Hedonic Pricing Method:

Step-1:

The first step is to collect data on residential property sales in the region for a specific time period (usually one year). The required data include:

- Selling prices and locations of residential properties
- Property characteristics that affect selling prices, such as lot size, number and size of rooms, and number of bathrooms
- Neighbourhood characteristics that affect selling prices, such as property taxes, crime rates, and quality of schools
- Accessibility characteristics that affect prices, such as distances to work and shopping centers, and availability of public transportation
- Environmental characteristics that affect prices

In this case, the environmental characteristic of concern is the proximity to open space. The researcher might collect data on the amount and type of open space within a given radius of each property, and might also note whether a property is directly adjacent to open space. Often, this type of data may be obtained from computer-based GIS (geographical information systems) maps. Data on housing prices and characteristics are available from municipal offices, multiple listing services, and other sources.

Step-2:

Once the data are collected and compiled, the next step is to statistically estimate a function that relates property values to the property characteristics, including the distance to open space. The resulting function measures the portion of the property price that is attributable to each characteristic. Thus, the researcher can estimate the value of preserving open space by looking at how the value of the average home changes when the amount of open space nearby changes.

Limitations of Hedonic Pricing Method:

i. **Omitted variable bias:** if some variable that significantly affects house price is omitted from the HP equation and is in addition correlated with one of the included variables, then the coefficient on this included variable will be biased. this included variable will be biased.

ii. **Multi-collinearity:** some environmental variables (such as alternative air pollution indicators) may be highly collinear. This means that separate equations for each may need to be estimated, otherwise the implicit prices will be difficult to entangle.

iii. **Choice of functional form for the HP function**. Economic theory does not specify which non-linear function should be used for the HP equation function should be used for the HP equation.

iv. **Expected versus actual characteristics levels:** house sale may be a function of expected future environmental conditions in addition to current observed conditions.

9.1.20. Dose Response Method:

Dose response method involves finding a link between environmental change and production conditions for some marketed goods. Depending on the behavioural assumptions made and the statistical techniques employed, welfare estimates are then calculated using changes in, e.g., profits from the production of marketed goods.

9.1.21. Averting Expenditure Avoided Cost Method:

This method tries to measure welfare loss to a household due to increase in averting or preventing expenditure arising out of decrease in environmental quality. The main notion is that a household produces flow of certain services or goods combining various inputs, one of which is environmental quality. For example, a rural household might combine water taken from its well with purification equipment to produce water potable.

Now, if water quality in the well declines, the household must increase its expenditure on other inputs to maintain quality of drinking water constant. This averting expenditure, as Cournot and Potter (1981) showed, can be used to measure welfare loss to the household of the decline in environmental quality.

9.1.22. Travel Cost Method:

One of the oldest approaches to environmental valuation Proposed in a letter from Harold Hotelling to the US Forest Service in the 1930‘s, first used by Wood and Trice in 1958, popularized by Clawsen and Knetsch (1966).

The travel cost method is used to estimate economic use values associated with ecosystems or sites that are used for recreation.

The method can be used to estimate the economic benefits or costs resulting from:

- changes in access costs for a recreational site
- elimination of an existing recreational site
- addition of a new recreational site
- changes in environmental quality at a recreational site

The basic premise of the travel cost method is that the time and travel cost expenses that people incur to visit a site represent the "price" of access to the site. Thus, peoples' willingness to pay to visit the site can be estimated based on the number of trips that they make at different travel costs. This is analogous to estimating peoples' willingness to pay for a marketed good based on the quantity demanded at different prices.

Step of Evolution Travel Cost Method:

The travel cost method is applied by collecting information on the number of visits to the site from different distances. Because the travel and time costs will increase with distance, this information allows the researcher to calculate the number of visits purchased at different prices: the demand function and the consumer surplus, or economic benefits, for the recreational services of the site.

Step 1: The first step is to define a set of zones surrounding the site. These may be defined by concentric circles around the site, or by geographic divisions that make sense, such as metropolitan areas or counties surrounding the site at different distances.

Step 2: The second step is to collect information on the number of visitors from each zone, and the number of visits made in the last year.

Step 3: The third step is to calculate the visitation rates per 1000 population in each zone. This is simply the total visits per year from the zone, divided by the zone's population in thousands.

Step 4: The fourth step is to calculate the average round-trip travel distance and travel time to the site for each zone, using average cost per mile and per hour of travel time.

Step 5: The fifth step is to estimate, using regression analysis, the equation that relates visits per capita to travel costs and other important variables. From this, the researcher can estimate the demand function for the average visitor. In this simple model, the analysis might include demographic variables, such as age, income, gender, and education levels, using the average values for each zone.

Step 6: The sixth step is to construct the demand function for visits to the site, using the results of the regression analysis. The first point on the demand curve is the total visitors to the site at current access costs (assuming (assuming there is no entry fee for the site), which in this example is 1600 visits per year.

Step 7: The final step is to estimate the total economic benefit of the site to visitors by calculating the consumer surplus, or the area under the demand curve.

9.1.23. Contingent Valuation Method:

Contingent Valuation Method (CVM) was first used by Davis (1963) in a study of hunters in Maine and it was widely developed with Bohm (1972), Randal et.al. (1974),
Brookshire et. al. (1976) etc. The essence of CVM method involves asking
The essence of CVM method involves asking individual to imagine some situation
that is typically outside the individual‘s experience and speculate on how he or she would act in such a situation.

It is called 'contingent valuation' because the valuation is contingent on the hypothetical scenario put to respondents.

The contingent valuation method (CVM) is used to estimate economic values for all kinds of ecosystem and environmental services. It can be used to estimate both use and non use values, and it is the most widely used method for estimating non-use values. It is also the most controversial of the non-market valuation methods.

The contingent valuation method involves directly asking people, in a survey, how much they would be willing to pay for specific environmental services. In some cases, people are asked for the amount of compensation they would be willing to accept to give up specific environmental services. It is called ―contingent valuation, because people are asked to state their willingness to pay, contingent on a specific hypothetical scenario and description of the environmental service.

The contingent valuation method is referred to as a ―stated preference‖ method, because it asks people to directly state their values, rather than inferring values from actual choices, as the ―revealed preference‖ methods do. The fact that CV is based on what people say they would do, as opposed to what people are observed to do, is the source of its greatest strengths and its greatest weaknesses.

CVM exercise can be split in to five stages:

- 2. Setting up the hypothetical market
- Obtaining bids
- Estimating mean WTP and or WTAC
- Estimating bid curves
- Aggregating the data

Sub-Unit 2: Cost-Benefit Analysis and Compensation Principle

9.2.1. Meaning of Cost-Benefit analysis:

The most popular method of project evaluation is to consider the cost benefit analysis of different projects and then to select involving lesser cost and yielding greater benefit.

It provides superior criteria for project evaluation in planned economy. It helps the planning authority in making correct investment decisions to achieve optimum resource allocation by maximizing the difference between present value of benefits and costs of a project.

Thus, cost benefit analysis "purports to describe and quantify the social advantages and disadvantages of a policy in terms of a common monetary unit." The objective function can be expressed as Net Social Benefit (NSB)=Benefits—Costs, where benefits and costs are measured in terms of shadow or accounting prices of inputs and not of actual market prices.

9.2.2. Origin of Cost Benefit Analysis:

The origin of cost benefit analysis can be traced back to welfare economics of 19th century. The first practical embodiment of the maximization of net benefit occurred in 1930s in the realm of water resources. According to Flood Control Act of 1936, "The principle of comparing benefits to whomsoever they may accrue with the estimated costs." This reveals unmistakably the social nature of the public investment decision.

Cost-Benefit analysis also used in financial Economic to estimate the benefit of investment in a project.

9.2.3. Types of Cost Benefit Analysis:

There are different types or methods of analysis to determine the economic efficiency of a project. The types that will be covered in this section are:

I. **Benefit Cost Ratio (BCR)**
II. **Incremental Benefit Cost Ratio**
III. **Net Present Value (NPV)**
IV. **Internal Rate of Return (IRR)**
V. **Payback Period**

❖ **Discount Rate**

The value of money or goods in the present is viewed as higher than the expected value of goods and financial returns in the future. The further a potential benefit or cost is in the future, the less its value. This concept is made tangible by a process called discounting. This is where a discount rate is applied to anticipated costs and benefits of a project over the duration or 'life span' of the project to convert the value of a return in the future into today's value. Hence, for instance, the returns of a multiyear project are usually referred to as discounted returns. The lower the discount rate sometimes referred to as interest rate, the higher the return value of the project's future costs and benefits. Conversely, the higher the discount/ interest rates the lower the future return value will be. The selection of the appropriate discount rate is important to ensure that future project returns are not being over- or under-estimated in today's value.

I. Benefit Cost Ratio (BCR) : This is the ratio of project benefits versus project costs. It involves summing the total discounted benefits for a project over its entire duration/life span and dividing it over the total discounted costs of the project.

Formula:

$$BCR = \frac{\sum_{i=0}^{n} Bi(1+d)\hat{}i}{\sum_{i=0}^{n} Ci(1+d)\hat{}i}$$

Where: Bi = the project's benefit in year i, where i = 0 to n years
Ci = the project's costs in year i, where i = 0 to n years
n = the total number of years for the project duration/ life span
d = the discount rate

The simple steps in this methodology are:

1. Determine the discounted benefits for each year of the project
2. Determine the discounted costs for each year of the project
3. Sum the total discounted benefits for the entire project duration
4. Sum the total discounted costs for the entire project duration
5. Divide the total discounted benefits over the total discounted costs

Decision Rule:

i. If BCR <1, in economic terms, the costs exceed the benefits. Solely on this criterion, the project should not proceed.

ii. If BCR = 1, Costs equal the benefits, which means the project should be allowed to proceed, but with little viability.

iii. If BCR > 1 The benefits exceed the costs, and the project should be allowed to proceed.

I. Limitation: This method does not give a result of the projected total gains or losses of one project compared with another project. This can be done using the incremental BCR methodology.

II. Incremental Benefit Cost Ratio (ICBR):

This method helps to determine the margin by which a project is more beneficial or costly than another project. It is used to compare alternative options to help determine which is more feasible over the other(s).

The steps in this methodology are:

i. List the projects from the least costly to the most expensive in ascending order.

ii. Take the least costly project and compare it to the second cheapest option by subtracting the total discounted benefits for each project and dividing this by the difference in the total discounted costs for each project.

Formula:

$$IBCR = \frac{\sum B1 - \sum B2}{\sum C1 - \sum C2}$$

Where: ΣB1 = total benefits for project '1'
ΣC1 = total costs for project '1'

Decision Rule:

iii. If the incremental BCR obtained is higher than the target incremental BCR, then discard the lower-cost option (project 1 in this case) and use the higher-cost option (project 2) to compare with the next project on the ascending cost list.

iv. If the incremental BCR obtained is lower than the target incremental BCR, then discard the higher-cost option (project 2 in this case) and use the lower-cost option (project 1) to compare with the next project on the ascending cost list.

v. Repeat these steps (2-4) until all of the project options have been analysed. 6. The project which has the highest cost and an incremental BCR equal to or greater than the target incremental BCR.

II. Net Present Value (NPV):

Net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. NPV is used in capital budgeting and investment planning to analyze the profitability of a projected investment or project.

The following formula is used to calculate NPV:

Formula:

$NPV = \sum_{t=1}^{n} \frac{Rt}{(1+i)^t}$

Where: Rt=Net cash inflow-outflows during a single period

ti=Discount rate or return that could be earned in alternative investments

t=Number of timer periods

Decision Rule:

i. If the NPV > 0NPV > 0, we should invest in the project.

ii. If the NPV < 0NPV < 0, we should reject the project.

IV. Internal Rate of Return (IRR):

The internal rate of return is a metric used in financial analysis to estimate the profitability of potential investments. The internal rate of return is a discount rate that makes the net present value (NPV) of all cash flows equal to zero in a discounted cash flow analysis. IRR calculations rely on the same formula as NPV does.

Formula:

$NPV = \sum_{t=1}^{n} \frac{Rt}{(1+IRR)^t} - C_0$

Where: Ct=Net cash inflow during the period t

C_0= total initial investment costs

IRR= the internal rate of return

t= the number of time periods

Decision Rule:

i. If IRR is greater than required rate of return, the company should invest in the project.

ii. If IRR is lower than required rate of return, the company should reject the project.

V. Payback Period:

This is the time period required for the total discounted costs of a project to be surpassed by the total discounted benefits. This can be easily done, say in excel, by calculating the cumulative discounted benefits and cumulative discounted costs of a project for each consecutive year of a project. The year that the cumulative benefits exceed the cumulative costs is the payback period year of the project. In other words, the year following the project payback period will see net profits or benefits to the project.

9.2.4. Pareto Optimality:

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

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

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

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

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

I. Exchange efficiency

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

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

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

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

II. Production efficiency

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

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

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

III. Output efficiency

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

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

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

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

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

9.2.5. Compensation Principle:

Pereto Criteria states that simply that an economic change which harms on one and make someone better off indicated an increase in social welfare. Thus, this criterion does not apply to those economic changes which harm some and benefit others.

Kaldor, Hicks and Scitovsky have given their tests for judging an increasing in welfare. Like Pareto, they isolate the problem of production from that of distribution. They deal with policy change with ambiguous welfare effects saying that if the people benefiting from it can gainfully compensate the losers, then the policy change is desirable otherwise not. This extension is popularly called the compensation principle

9.2.6. Kaldor-Hicks Welfare Criterion:

Nicholas Kaldor was the first economist to give a welfare criterion based on compensating payments. Kaldor's criterion helps us to measure the welfare implications of a movement in either direction on the contract curve in terms of Edgeworth box diagram.

According to Kaldor's welfare criterion, if a certain change in economic organization or policy makes some people better off and others worse off, then a change will increase social welfare if those who gain from the change could compensate the losers and still be better off than before. In the words of Prof. Baumol, "Kaldor's criterion states that a change is an improvement if those who gain evaluate their gains at a higher figure than the value which the losers set upon their losses."

Prof. J.R. Hicks supported Kaldor for employing compensation principle to evaluate the change in social welfare resulting from any economic reorganization that benefits some people and harms the others. This criterion states that, "If A is made so much better by the change that he could compensate B for his loss and still have something left over, and then the reorganisation is unequivocal improvement."

9.2.7. Scitovsky's Paradox:

Scitovsky has pointed out that the Kaldor – Hicks compensation test has a contradiction. He pointed out that it is possible according to Kaldor-Hicks criteria that state B is better than state A, but once the society moves to the state B, the same criteria may reveal that the return move from B to A is also desirable on welfare grounds. This contradiction has been called the 'Scitovsky Paradox'. Scitovsky pointed out that to get at the correct criterion of welfare we must remove this contradiction. He has therefore offered his own criterion called the "Scitovsky Double criterion".

9.2.8. Scitovsky Double criterion:

Scitovsky wanted an economic change to satisfy double test-the fulfillment of Kaldor-Hicks test plus the non-fulfillment of the reversal test. This means, that a movement from state A to state B must be desirable in terms of the Kaldor-Hicks criteria but a return from B to A should not be an improvement on these criteria.

9.2.9. Dr. Little Criterion:

Dr. Little has developed a reaction against the compensation criteria proposed by Kaldor, Hicks and Scitovsky. In form, it is also a compensation criterion, but in spirit, it differs markedly from the earlier Kaldor-type criteria. Dr. Little asserts that neither the Kaldor-Hicks test nor the Scitovsky double test, either alone or together, can possibly be taken as a criterion of welfare.

Since little believes that value judgements are essential in welfare economics, he bases his criterion on two value premises. 1. The wellbeing of an individual is supposed to be greater in a chosen position that it is in any other position. 2. Any social alternation that makes everybody better off is a good thing.

Based on these value judgements, the criterion can be stated in this way: An economic change constitutes social improvement (a) if the resulting redistribution is no worse than the old and (b) if it is impossible to make the community as well off in the initial position as it would be after the change.

Sub-Unit 3: Population Theory and Demographic Dividend

9.3.1. Population theory:

9.3.2. Thomas Doubleday's Diet Theory:

Thomas Doubleday, a social philosopher and an English economist, was born in 1790. He expressed his views regarding various natural laws which govern population. According to him, the rate of population increase will be less when the quantity of food supply is greater.

It means that the increase in population and food supply are inversely related. Doubleday mentions two states of food supply, i.e., (i) The Plethoric state having good food supply where the fertility is low, and (ii) the Deplethoric state in which due to food shortage we find diminution of proper nourishment where the fertility is high.

According to Doubleday, fertility is affected by leanness in all plants and animals. An overfed plant can be revived only when the plants are depleted either by ringing the bark or by extreme lopping or the trenching of the roots.

Besides, the sterility in plant life is possible when the application of fertilizers is excessive. He also believes that thin birds or animals give birth to more offspring, while bulky or fat birds or animals give birth to less. Similarly, this becomes true about trees and plants. It means that fertility depends on the fatness of living beings.

9.3.3. Jouse De Castro's Protein Consumption Theory:

Jouse De Castro expressed his views in his famous book The Geography of Hunger regarding the correlation between the fertility and the consumption of protein. Castro accepted the findings of R.J. Solankar who conducted experiments on rats in 1920. In these experiments Solankar found that with the increase in protein consumption in diet, the fecundity will decrease and it will increase with low protein content in diet.

His experiment led to the following conclusions:

(i) When 10 per cent protein was given to a female rat, per mated female rat gave 23.3 births;

(ii) When 18 percent protein was given to each female rat, per mated female rat gave 17.4 births; and

(iii) When the quantity of protein was increased to a level of 22 percent to each female rat, the birth per mated female rat reduced to 13.8 births.

Through these experiments Castro came to the conclusion that the fatness is affected by the consumption of protein. The fatness increases with the protein rich diet, which leads to lower fertility. This concept of Castro is similar to the Doubleday's diet theory that the rate of population increase is influenced by food supply.

9.3.4. Michael Thomas Sadler's Destiny Theory:

Michael Thomas Sadler, an Economist and a British social reformer, was born in 1780. He was a contemporary of Malthus. He expressed his ideas about population in his book The Law of Population. According to Sadler, the law which regulates the growth of animals and plants is primarily the same as the law which regulates the growth of human population.

He was of the opinion that "The fecundity of human beings is in the inverse ratio of the condensation of their numbers."

Moreover, the fertility rate decreases with the increase in the density of population. In the agriculture based or pastoral countries where the density of population is low, the fertility rate of the population becomes high. In such countries, people have the capacity to work hard and hardworking people give birth to more children.

With the passing of time, when there is industrialisation and the population becomes more civilized and literate, the density of population increases. Here people would limit the size of family and in such socio-economic conditions they will be happier and there will be prosperity.

9.3.5. Herbert Spencer's Biological Theory:

Herbert Spencer, a famous English philosopher and sociologist, propounded the biological theory of population in his book The Principles of Biology. Spencer argued that fecundity decreases when the complexity of life increases.

According to him, changes in the growth of population occur due to natural change in the reproductive capacity of human beings. Therefore, his theory has been known as a natural theory of population which is similar to the theory of Sadler and Doubleday.

Spencer believed that "there exists antagonism between individuation (survival) and genesis (reproduction)". When any individual does hard work for his personal development at his work place, the desire for reproduction decreases.

In other words, when more energy has been utilised for one's self-development, the energy available for reproduction will be less and consequently the population growth will be less. Thus, with the development of society and for one's success and survival (individuation), life becomes more complex which results in reduction in the capacity of reproduction.

This is observed from the fact that fertility is more in rural individuals whose life is not complex, whereas fertility is low in an industrial society where life is more complex, the pressure of education is more and the brains are overtaxing.

9.3.6. Corrado Ginnis's Biological Population Theory:

Corrado Ginnis, a sociologist, was born in Italy in 1884. He had deep interest in the study of population changes which affect the evolution of society and that of a nation. According to Ginni, fertility will be very high in a nation when it is in the primary stage. Due to high fertility, the population increases and consequently social and economic problems become complex.

Further, the problems of trade and industry also become more complex.

At this time, fertility starts declining. "He thought that the evolution of a nation or any society was closely linked to the changes in their rates of population growth and to the varying propositions of this growth coming from the different social classes."

Ginni was of the opinion that only biological factors are responsible for the increase in population and therefore his theory of population can be characterised as a natural law theory.

According to Thomson and Lewis, "Ginni invokes some mystical biological changes, quite beyond man's control, as the basic factors determining not only man's quantitative growth, i.e., his fertility, fecundity, and survival but also his qualitative development, i.e., the distinctive characteristics of man's different civilization."

9.3.7. Dumont's Theory of Social Capillarity:

Arsene Dumont (1849-1902) has propounded the Theory of Social Capillarity. Social attraction or repulsion to a thing is known as Social Capillarity. Dumont studied the growth of population in France in the later part of nineteenth century and found that the reason for low fertility in France was high intellectual and aesthetic development.

According to Dumont, there are three principles of population that are related to the stages of social development:

i. In the preventive stage, the Malthusian theory of population applies where human beings live like animals. On what they can find, they increase in geometrical progression.

ii. In the intermediate stage, Quillard's principle of population applies. According to this, "Population proportions itself automatically." In such a society, population increases as food supply increases because population can produce food itself. Here positive checks do not become necessary.

iii. In a modern civilised society, Dumont applies his social capillarity principle. In such a society, every individual wants to achieve higher economic and social status. For this, a small family is imperative, because one cannot climb high on the social ladder with the burden of more children on its back.

9.3.8. Leibenstein's Motivational Theory of Population Growth:

Leibenstein's theory recognizes population growth as a function of per capita income. It is related to the various stages of economic development. At the subsistence equilibrium level of income, fertility and mortality rates are the maximum consistent with the survival rate of population. Now if the per capita income is raised above the subsistence equilibrium position the mortality rate falls without any drop in the fertility.

The result is an increase in the growth rate of population. Thus, an increase in the per capita income tends to raise the growth rate of population. It is only up to a point. Beyond that the increase in the per capita income lowers the fertility rate and as development gains momentum, the rate of population growth declines.

The Leibenstein argued that with the increase in per capita income, the desire to have more children declines. Specialization leads to increasing income levels and the consequent-social and economic mobility make it a difficult and costly affair to support a large family.

Hence, growth rate of population becomes constant and then starts declining gradually as the economy gradually advances towards the path of sustained development. According to Leibenstein, a biologically maximum growth rate may be about 3 or 4 per cent. Leibenstein, thus suggests to make sufficiently the necessary critical minimum effort so as the control such a very high population growth.

The relationship between population growth and per capita income is illustrated in the diagram 2.

Diagram:

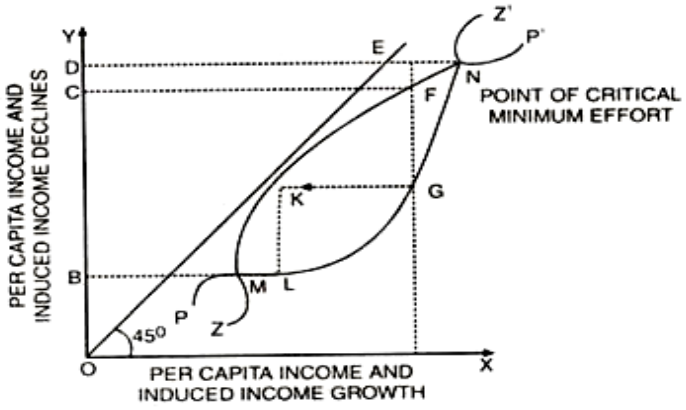


Fig. 1.

Diagrammatic Representation:

In figure 2, rate of population growth or rate of national income growth is shown on the horizontal scale and per capita income on the vertical scale. Curve P indicates the population growth and curve N indicates the level of per capita income. Let us start from the point which represents the subsistence equilibrium point.

Here the population growth or national income growth is zero. When the per capita income rises to by, the population growth rate and national income growth rate both are equal to 1%. When per capita income rises to yc, we have the points c and g on curves N and P respectively. These points signify that at the yc, level of per capita income, the population growth rate is 2% whereas national income growth rate is 1%. Thus, this is a disequilibrium state and cannot represent a level of income that can sustain itself.

Therefore, the level of per capita income should be raised to that level at which population growth rate starts declining and national income growth rate starts rising. The only such point is y. At this level of per capita income the population growth rate is 3%. The growth rate of population, according to Leibenstein is maximum biologically determined.

After ye level of per capita income, the population starts declining and national income starts rising. Thus ye level of per capita income is critical minimum per capita income which can sustain itself or which can generate the process of self-sustained growth. According to Leibenstein, the less developed countries must raise their per capita income to this level, if they want to achieve the sustained growth.

9.3.9. Demographic Dividend:

A demographic dividend is the accelerated economic growth that can result from improved reproductive health, a rapid decline in fertility, and the subsequent shift in population age structure. With fewer births each year, a country's working-age population (15 to 65) grows larger relative to the young dependent population. With more people in the labor force and fewer children to support, a country has a window of opportunity for economic growth if the right social and economic investments and policies are made in health, education, governance, and the economy.

Demographic dividends are occurrences in a country that enjoys accelerated economic growth that stems from the decline in fertility and mortality rates. A country that experiences low birth rates in conjunction with low death rates receives an economic dividend or benefit from the increase in productivity of the working population that ensues. As fewer births are registered, the number of young dependents grows smaller relative to the working population. With fewer people to support and more people in the labor force, an economy's resources are freed up and invested in other areas to accelerate a country's economic development and the future prosperity of its populace.

9.3.10. Types of Demographic Dividend:

The first dividend period generally lasts for a long time—typically five decades or more. Eventually, however, the reduced birth rate reduces labor force growth. Meanwhile, improvements in medicine and better health practices lead to an ever-expanding elderly population, sapping additional income and putting an end to the demographic dividend. At this stage, all else being equal, per capita income grows at a decelerated rate and the first demographic dividend becomes negative.

An older working population facing an extended retirement period has a powerful incentive to accumulate assets to support themselves. These assets are usually invested in both domestic and international investment vehicles, adding to a country's national income. The increase in national income is referred to as the second dividend which continues to be earned indefinitely.

The benefits gotten from a demographic transition is neither automatic nor guaranteed. Any demographic dividend depends on whether the government implements the right policies in areas such as education, health, governance, and the economy. In addition, the amount of demographic dividend that a country receives depends on the level of productivity of young adults which, in turn, depends on the level of schooling, employment practices in a country, timing, and frequency of childbearing, as well as economic policies that make it easier for young parents to work. The dividend amount is also tied to the productivity of older adults which depends on tax incentives, health programs, and pension and retirement policies.

There are four main areas where a country can find demographic dividends:

i. **Savings**—During the demographic period, personal savings grow and can be used to stimulate the economy.
ii. **Labor supply**—More workers are added to the labor force, including more women.
iii. **Human capital**—With fewer births, parents are able to allocate more resources per child, leading to better educational and health outcomes.
iv. **Economic growth**—GDP per capita is increased due to a decrease in the dependency ratio.

9.3.11. Dependency Ratio:

The dependency ratio is a measure of the number of dependents aged 0 to 14 and over the age of 65, compared with the total population aged 15 to 64. This demographic indicator gives insight into the number of people of non-working age, compared with the number of those of working age.

Sub-Unit 4: Concepts and Measures of Fertility, Morbidity, Mortality and Life Table:

9.4.1. Measure of Fertility:

I. Crude Birth Rate (CBR): The number of births occurring in a year per 1,000 populations. The rate is crude in that it related to the total population without regard to age and sex.

$$\textbf{CBR} = \frac{Total\ number\ of\ births\ during\ the\ period}{Total\ population\ at\ the\ middle\ of\ the\ period}$$

II. General Fertility Rate (GFR): The number of births occurring annually per 1,000 women of childbearing ages (usually 15-44 years or 15-49 years).

$$\textbf{GFR} = \frac{Total\ Number\ of\ live-births}{No.of\ women\ in\ the\ child-bearing\ ages}$$

III. Age – Specific Fertility Rate (ASFR): The number of births occurring annually (or in a specified period) per 1,000 women of specific age (usually in terms of 5 – year age groups within the childbearing ages, i.e. 15 – 49 years).

$$\boldsymbol{ASFR} = \frac{number\ of\ births\ occurring\ to\ women\ in\ the\ age\ group\ x\ to\ x\ +\ n}{number\ of\ females\ in\ the\ age\ group\ x\ to\ x\ +\ n}$$

IV. Total Fertility Rate (TFR): The sum of annual age – specific fertility rates computed for each age group in the childbearing period. This measure indicated the number of children that would be born to a hypothetical cohort of 1,000 women who follow a set of a current schedule of age – specific fertility rates, assuming that none of the women die before reaching the end of the childbearing period.

$$\textbf{TFR} = \sum_{x=15}^{49} ASFRx$$

V. Gross Reproduction Rate (GRR): The average number of daughters born to a cohort of 1,000 women who follow a set of a current schedule of age – specific fertility rates, assuming that none of the women die before reaching the end of childbearing period.

$$\text{GRR} = \sum_{x=15}^{49} \frac{No.of\ female\ births\ during\ the\ year\ from\ women\ aged\ x\ i.b.d.}{No.of\ women\ aged\ x\ i.b.d.at\ the\ middle\ of\ the\ year}$$

VI. Net Reproduction Rate (NRR): The average number of daughters that a hypothetical cohort of females starting life together would bear if they experienced a given set of age – specific mortality and fertility rates.

NRR = $\frac{1}{L0}\sum_{x=15}^{49} Lx * Fx * K$

Where, L0 = Cohort of the Life table foe female

Lx = Stationary life table population for females at ages x

Fx = Age-specific fertility rate at age x.

K = Proportion of female births to total births.

9.4.2. Measure of Mortality:

I. Crude Death Rate (CDR): The number of deaths occurring in a year per 1,000 average or mid – year population within a given or population group. As with the crude Birth Rate, it related to the total population without regard to age and sex.

$$CDR = \frac{Total\ number\ of\ deaths\ during\ the\ period}{Total\ population\ at\ the\ middle\ of\ the\ period}$$

II. Age – Specific Death Rate (ASDR): The number of deaths occurring annually (or in a specified period) per 1,000 population of specific age (usually in terms of 5 years age group).

ASDR = $\frac{No.\ of\ deaths\ in\ a\ specfic\ class\ of\ population\ during\ the\ period}{Total\ no.of\ persons\ in\ the\ specific\ class\ of\ population\ at\ the\ middle\ of\ the\ period}$

III. Infant Mortality Rate (IMR): The number of infant deaths (death occurring within 1 year after birth) per 1,000 live births for the given year.

IMR = $\frac{number\ of\ infant\ deaths\ occurring\ within\ a\ year}{number\ of\ live\ births\ for\ a\ given\ year}$

9.4.3. Life Table:

Life table is the one of the oldest statistical techniques and is extensively used by medical statisticians and actuaries. It is also the scheme for expressing the form of mortality in terms of probabilities. The life table is constructed from census data and death registration data, it can also be constructed from vital registration or retrospective surveys. Generally, they are constructed for age, gender, ethnic groups and occupational groups and so on.

In 1693, the first mortality table is usually credited to Edmund halley who constructed a life table base on the data from Breslau city in Poland. Milne in 1815 was the first to prepare and published a scientifically correct life table classified by age based on both population and death data.

9.4.4. Classification of life table:

Life table can be classified as cohort or current life table according to the reference year of the table, unabridged (complete) or abridge life table according to length of age interval and single or multiple decrement life table according to the number of characteristics considered.

I. Cohort life table: A cohort life table is also called generation life table or longitudinal life table, because the cohort is constructed on the basis of sequence Q0, Q2, Q3,…,Qn. The cohort life table reflects the mortality experience of an real cohort from birth until no lives remain in the group. Its main advantage is its conceptual simplicity and in fact agrees with the definition of a life table but its major disadvantage is the very long term for which data are required and to which mortality risks are referred.

II. Current life table: This is also referred to as cross sectional life table, period life table or specified life table. It employs data for a single cross section of time to represent an entire generation.

III. Complete life table: Complete life table contains data for every single years of age from birth to the last applicable age, it is also called unabridged life table. In order to economize space, sometime the basic values from a complete life table are presented only for every fifth age.

IV. Abridge life table: Abridge table contains the data by intervals of five or ten-years, except in the initial years. This is the abridged life tables that most users frequently encounter.

V. Single decrement life table: In this life table only one cause of death and only one characteristic are considered at a time, and are concerned with general experience of a cohort by age.

VI. Multiple decrement life table: This table described the separate and combined effects of more than one characteristic; it may consider more than one cause of death and or more than one characteristic at a time.

9.4.5. Construction of Life table:

Explanation of symbol used in the life table:

i. X = Age in years

ii. l_x = Number of persons out of the cohort, who are expected to complete exactly x years of life.

iii. d_x = Number of persons out of l_x who die before completing age x+1 i.e. $d_x = l_x - l_{x+1}$

iv. q_x = Probability that a person who attains ages x will be before reacning age x+1.

$q_x = d_x / l_x$

v. L_x = Total numbers of years lived, in the aggregate, by the cohort between ages x and x+1. It is called the life table stationary population at age x

$$L_x = \frac{1}{2}(l_x + l_{x+1})$$

vi. T_x = Total number of years lived by the cohort after age x years.

$T_x = l_x + l_{x+1} + l_{x+2} + l_{x+3} + ...$

vii. e_x = Average number of years lived after age x, by each of the l_x persons. This is called expectations of live at age x.

Table: Extract from All –India Life table (Females) 1951-60

x	l_x	d_x	q_x	L_x	T_x	e_x
0	100000	13826	.1383	89631	4055487	40.55
1	86174	3119	.0362	83390	3965856	46.02
2	83055	2378	.0286	80950	3882466	46.75
3	80677	1797	.0223	79100	3801516	47.12
4	78880	1343	.0170	77708	3722416	47.19
10	74600	261	.0035	74470	3266067	43.78
30	66235	825	.0125	65823	1845620	27.86
50	42690	1274	.0298	42053	745184	17.46
70	16599	1167	.0703	16016	154053	9.28
90	1325	344	.2596	1153	3303	2.49
98	8	6	.7982	5	5	0.63
99	2	2	.9086	--	--	--

9.4.6. Migration:

9.4.7. Meaning of Migration:

Migration refers to permanent or semi-permanent change in the place of residence of an individual or a group of individuals from one location to another. Hence, it is different from the more general term mobility, which refers to all types of movements of people (Rubenstein and Bacon, 1990:75). Thus, the term mobility includes both permanent (and semi-permanent) and temporary movements of people over the earth. With regard to temporary movements, the examples of which have already been cited above, a distinction is generally made between a cyclic and a periodic movement.

9.4.8. Kinds of Migration:

Migration can be voluntary and involuntary. People migrate for economic benefits under voluntary migration and involuntary includes social, religious and political. It can be short-term where people move for short periods and long-term where they move for good. The long-term migration is called emigration.

Migration may be international, inter-regional, inter- urban or intra-urban. On the basis of time, it may be temporary or permanent. On basis of number it can be individual or mass, it may be politically sponsored or voluntary. On the basis of social organisations it can be family, clan or individual. Migration can be internal (within the country) and external (outside the country).

9.4.9. Factor Leading to Migration:

There are a number of factors which lead to the migration of people within a country. We will explain them under push and pull factor.

I. Push factors are the reasons why people leave an area. They include:

i. lack of services
ii. lack of safety
iii. high crime
iv. crop failure
v. drought
vi. flooding
vii. poverty
viii. war

II. Pull factors are the reasons why people move to a particular area. They include:

i. higher employment
ii. more wealth
iii. better services
iv. good climate
v. safer, less crime
vi. political stability
vii. more fertile land
viii. lower risk from natural hazards

9.4.10. Impacts of Migration:

Migration is becoming a very important subject for the life of cities. Many opportunities and attraction of big cities pull large numbers of people to big cities. Migration can have positive as well as negative effects on the life of the migrants.

I. Positive Impact:

- Unemployment is reduced and people get better job opportunities.
- Migration helps in improving the quality of life of people.
- It helps to improve social life of people as they learn about new culture, customs, and languages which helps to improve brotherhood among people.
- Migration of skilled workers leads to a greater economic growth of the region.
- Children get better opportunities for higher education.
- The population density is reduced and the birth rate decreases.

II. Negative Impact

- The loss of a person from rural areas, impact on the level of output and development of rural areas.
- The influx of workers in urban areas increases competition for the job, houses, school facilities etc.
- Having large population puts too much pressure on natural resources, amenities and services.
- It is difficult for a villager to survive in urban areas because in urban areas there is no natural environment and pure air. They have to pay for each and everything.
- Migration changes the population of a place, therefore, the distribution of the population is uneven in India.
- Many migrants are completely illiterate and uneducated, therefore, they are not only unfit for most jobs, but also lack basic knowledge and life skills.
- Poverty makes them unable to live a normal and healthy life.
- Children growing up in poverty have no access to proper nutrition, education or health.
- Migration increased the slum areas in cities which increase many problems such as unhygienic conditions, crime, pollution etc.
- Sometimes migrants are exploited.
- Migration is one of the main causes of increasing nuclear family where children grow up without a wider family circle.

9.4.11. Theory of Migration:

9.4.12. Ravenstein's Laws of Migration:

The first attempt to spell out the 'laws of migration' was made by E.G. Ravenstein as early as in 1885. Using the birthplace data, Ravenstein identified a set of generalizations, which he called as 'laws of migration' concerning inter-county migration in Britain in the nineteenth century. Most of these generalizations hold good even today.

There is an inverse relation between distance and volume of migration. Majority of migrants moves to short distance only. Migrants going long distance generally go by preference to the large centres of commerce and industry.

9.4.13. Gravity Model:

One of the most important contributions of geography in the field of migration analysis is with respect to the relationship between distance and migration. A clear and persistent inverse relationship between the two has been established in several studies (Woods, 1979). Gravity model, based on Newton's law of gravitation, goes one step further and states that the volume of migration between any two interacting centres is the function of not only distance between them but also their population size.

In other words, migration is directly proportional to the product of their population size and inversely proportional to the square of the distance separating them. The model was initially proposed by the exponents of social physics in the nineteenth century, and was later revived in the middle of the twentieth century Johnston et al, 1981).

9.4.14. Stouffer's Theory of Mobility:

S.A. Stouffer, an American sociologist, introduced one such modification in the gravity model. Stouffer formulated his intervening opportunity model in 1940, and claimed that there is no necessary relationship between mobility and distance (Stouffer, 1940). Instead, the observed decline in the volume of migration is due to an increase in the number of intervening opportunities with increasing distance. Stouffer's model suggests that the number of migrants from an origin to a destination is directly proportional to the number of opportunities at that destination, and inversely proportional to the number of intervening opportunities between the origin and the destination.