UNIT – IV

- **Cost – Benefit Analysis:** Economic value of environmental resources and environmental damage – Concept of Total Economic Value-Alternative approaches to valuation–Cost-benefit analysis and discounting

Introduction

•Cost-Benefit analysis in environmental economics refers to the examination of the financial expenses associated with various environmental activities, projects, or policies.

•It helps policymakers, businesses, and researchers make informed decisions by understanding the economic implications of their actions on the environment.

1. **Costs:** In any environmental project or policy, there are costs involved. These costs can be categorized into two main types:
   i. **Explicit Costs:** These are the direct, tangible expenses that are easy to measure and account for. For example, the cost of purchasing equipment, hiring labor, or buying raw materials for an eco-friendly manufacturing process.

Cont

ii. **Implicit Costs:** These are indirect or hidden costs that are not as apparent but still impact the project or policy's overall economic feasibility.

- For instance, the loss of revenue due to reduced production during the transition to a greener technology.

2. **Marginal Cost:** In environmental economics, analysts often focus on the concept of "marginal cost."

- This represents the additional cost incurred by producing one more unit of a good or service, while keeping all other factors constant.

Cont

- Marginal cost is essential in understanding the trade-offs involved in environmental decision-making.

3. **Externalities:** Environmental cost analysis also takes into account externalities, which are the costs or benefits that affect third parties not directly involved in a transaction.

- For instance, pollution from a factory might impose health costs on nearby communities, even though they don't participate in the production process.

4. **Opportunity Cost:** This refers to the potential benefits foregone when choosing one environmental project or policy over another.

Cont

- Environmental economists analyze opportunity costs to assess the most efficient use of resources in achieving environmental goals.

5. **Discounting:** In long-term environmental projects, such as climate change mitigation or biodiversity conservation, costs and benefits may occur over extended periods.

- Discounting is used to convert future costs into their present value, allowing for easier comparison and decision-making.

6. **Cost-Benefit Analysis:** This is a widely used approach in environmental economics to evaluate the efficiency of a project or policy.

Cont

- It involves comparing the total costs with the total benefits to determine whether the project is economically viable and whether its benefits outweigh the costs.

7. **Sustainability:** In environmental economics, sustainability is a crucial consideration.

- Projects or policies may seem cost-effective in the short term but could lead to negative consequences in the long run.

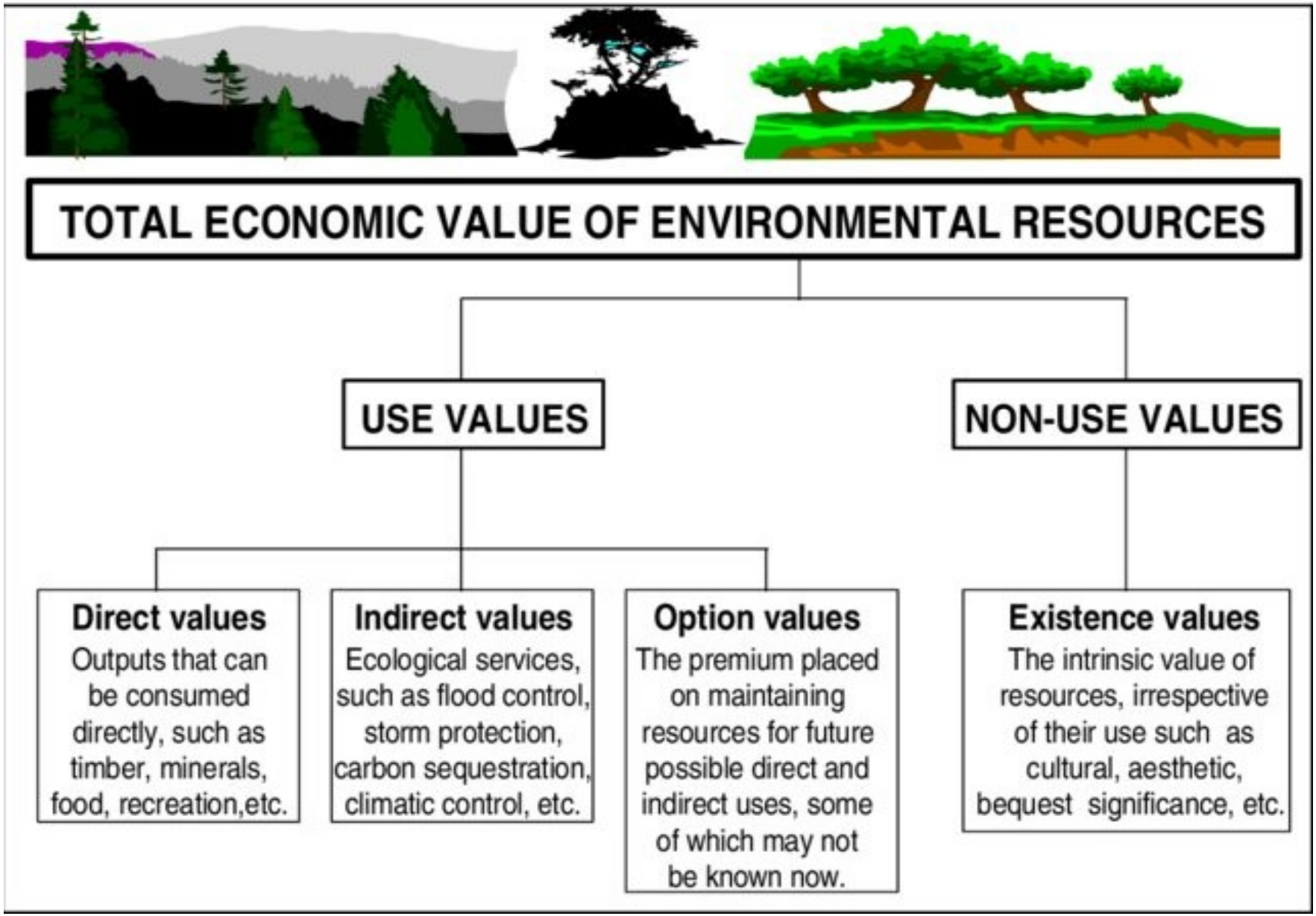
- Therefore, cost analysis also involves assessing the environmental impact and durability of the actions taken.

Cont

8. **Policy Recommendations:** Based on the cost analysis, policymakers can make informed decisions regarding regulations, subsidies, taxes, or incentives to promote environmentally friendly practices and internalize the external costs.

•Overall, cost analysis in environmental economics provides a structured approach to understanding the financial implications of environmental actions and helps society strike a balance between economic development and environmental protection.

Economic value of environmental resources



Economic value of environmental resources

•Environmental resources refer to the natural assets and services provided by the environment, such as clean air, water, forests, biodiversity, and natural landscapes.

•These resources have economic value because they contribute to human well-being and support various economic activities.

•The economic value of environmental resources refers to the monetary and non-monetary benefits that these resources provide to individuals, communities, and society as a whole.

1. **Direct Use Value:** This represents the most apparent and tangible economic value of environmental resources.

Economic value of environmental resources

- It refers to the benefits derived directly from using the resource for consumption or production. For example:
  i. **Agricultural Resources:** The economic value of fertile soil for growing crops or water for irrigation.

  ii. **Forests:** The economic value of timber and non-timber forest products, such as fruits, nuts, and medicinal plants.

  iii. **Fisheries:** The economic value of fish and other aquatic species for food and livelihoods.

2. **Indirect Use Value:** Environmental resources often provide services that indirectly benefit human well-being.

Economic value of environmental resources

- These services are not directly consumed but support various activities and ecosystems. Examples include:

  i. **Ecosystem Services:** The economic value of services like pollination, water purification, flood control, and climate regulation that ecosystems provide.

  ii. **Biodiversity:** The economic value of maintaining diverse plant and animal species that contribute to ecosystem resilience and potential future benefits.

3. **Option Value:** This represents the economic value people place on preserving environmental resources for potential future use or benefits. For instance:

Economic value of environmental resources

i. **Conservation of Endangered Species:** The economic value of preserving a rare animal species for future research, potential medical discoveries, or ecological stability.

4. **Existence Value:** This is a non-use value that reflects the economic value people attach to knowing that certain environmental resources exist, even if they don't directly use or interact with them. For example:

   i. **Natural Landscapes:** The economic value people place on knowing that pristine landscapes like national parks and scenic areas exist for recreational or aesthetic enjoyment.

Economic value of environmental resources

5. **Cultural and Recreational Value:** Environmental resources contribute to cultural identity and recreational opportunities, which have their economic value:
   i. **Cultural Heritage Sites:** The economic value of preserving historical and cultural sites that attract tourists and contribute to local economies.

   ii. **Recreational Activities:** The economic value of activities like hiking, bird watching, and eco-tourism that rely on well-preserved natural environments.

6. **Regulating Services:** The economic value of environmental resources that help regulate natural processes and maintain ecological balance:

Economic value of environmental resources

i. **Carbon Sequestration:** The economic value of forests and other ecosystems that absorb and store carbon dioxide, mitigating climate change impacts.

ii. **Wetlands:** The economic value of wetlands in mitigating floods and acting as natural water filters.

•Understanding the economic value of environmental resources is crucial for making informed decisions about conservation, sustainable development, and policies that ensure the long-term well-being of both people and the planet.

•By recognizing the various economic values, we can better appreciate the significance of environmental resources and work towards their responsible management and protection.

Environmental damage

•Environmental damage occurs when human activities negatively impact the environment, leading to the depletion of natural resources, pollution, and ecosystem degradation.

• This damage can have significant economic consequences, including:

1. **Health Costs:** Pollution and exposure to harmful substances can lead to health issues in humans and animals, resulting in increased medical expenses and reduced productivity.

2. **Resource Depletion:** Overexploitation of natural resources, such as overfishing or deforestation, can lead to decreased resource availability and potential economic losses in related industries.

Environmental damage

3. **Loss of Ecosystem Services:** Ecosystems provide crucial services like pollination, water purification, and climate regulation.

- Environmental damage can disrupt these services, affecting agriculture, water supply, and infrastructure.

4. **Cost of Remediation:** Cleaning up pollution and restoring damaged ecosystems can be expensive, and these costs often fall on governments, businesses, or communities.

5. **Opportunity Costs:** Environmental damage can lead to missed opportunities for sustainable development and economic growth, as resources must be diverted to address the consequences of the damage.

Environmental damage

Environmental damage can have several economic consequences:

1. **Direct Costs:** These are the immediate financial expenses incurred due to environmental accidents or damage, such as cleanup costs after an oil spill.

2. **Indirect Costs:** Environmental damage can result in indirect costs, such as reduced agricultural productivity due to soil degradation or increased healthcare expenses due to pollution-related health issues.

3. **Opportunity Costs:** When environmental damage occurs, it may prevent society from enjoying the full benefits of certain environmental resources, leading to opportunity costs. For example, pollution in a river may prevent fishing or recreation activities, resulting in economic

Environmental damage

Environmental damage can have several economic consequences:

1. **Direct Costs:** These are the immediate financial expenses incurred due to environmental accidents or damage, such as cleanup costs after an oil spill.

2. **Indirect Costs:** Environmental damage can result in indirect costs, such as reduced agricultural productivity due to soil degradation or increased healthcare expenses due to pollution-related health issues.

3. **Opportunity Costs:** When environmental damage occurs, it may prevent society from enjoying the full benefits of certain environmental resources, leading to opportunity costs.

Environmental damage

- For example, pollution in a river may prevent fishing or recreation activities, resulting in economic losses.

4. **Externalities:** Environmental damage often leads to negative externalities, which are the costs imposed on third parties who are not involved in the original activity.

- For instance, air pollution from a factory may harm the health of nearby residents, resulting in additional healthcare costs.

Total Economic Value

•**Total economic value** (**TEV**) is a concept in cost-benefit analysis that refers to the value derived by people from a natural resource, a man-made heritage resource or an infrastructure system, compared to not having it.

• It appears in environmental economics as an aggregation of the (main function based) values provided by a given ecosystem

•Total Economic Value (TEV) is a fundamental concept in environmental economics that seeks to comprehensively capture the overall value of environmental resources and services to society.

Total Economic Value

•It represents the total worth of an environmental asset, considering both the direct and indirect benefits it provides to people.

•TEV is a holistic approach that takes into account various dimensions of value associated with the environment.

•The TEV economic value of environmental assets can be broken down into a set of component parts. It compromises use and non-use value.

•**(i) Use value:** Use value refers to those values associated with current or future use of an environmental resource by an individual.

•Use values involve some human "interaction" with a particular resource. For example, clean water going down the stream.

Total Economic Value

- Use values are utilitarian in nature.

- Use value can be further categorized as direct use values and indirect use value.
- **(a) Direct use value:** Direct use values are fairly straight forward and relatively easy to measure.

- They involve some form of direct physical interaction with the resources and services of the system.

- They usually include the most obvious and important market-based uses such as potable water, fisheries, tourism and output of the forest.

Total Economic Value

•These can be measured from market and survey data. from something even though they accept that they will probably never get to "use" or "consume" it.

•Individuals are prepared to commit funds to the preservation of a species whose habitat is being destroyed.

•They do so for no other reason than the belief that they ought to remain in existence.

•Existence value is when an individual's satisfaction arises purely from the knowledge that the environmental resource will continue to exist.

Total Economic Value

(b) Indirect use value: Indirect use value are derived from those services such as those of the tropical forests in protecting watershed, serving the habitat function, or the mangroves forming a part of the river's ecosystems.

•All these examples provide benefits to human beings though not directly.

•Their services enhance the value of other resources that have directly measurable values e.g., property and land values or drinking water supplies.

• Indirect use value corresponds to the ecologist's concept of ecological functions.

Total Economic Value

(ii) Non-use value: On the other hand, non-use values arise from the continued existence of the resource and are unrelated to use, e.g. the existence of an owl in the forest.

- Individuals do not make use of these environmental resources but nevertheless desire to see them preserved in their own right.

- Motivations for non-use values can arise from existence, bequest and cultural or heritage values.

- **(a) Existence value:** Existence value may be valuing environmental resources for future generations or feeling good about the existence of charismatic species of animals and plants on this earth.

Total Economic Value

•Existence value is when individuals may derive value

•**(b) Bequest value:** Bequest value is when the satisfaction is attributable more to altruistic motives.

•Some individuals value the continued existence of a resource for the future possible benefit from its use by others unknown to them, or for their own future progeny.

• Bequest value is the satisfaction gained through the ability to endow a natural resource on future generations.

•This term represents people's consideration for its use by future generations.

Total Economic Value

(c) Vicarious value: Vicarious value is the welfare obtained from the indirect consumption of an environmental resource through books and other media.

•**(d) Option value:** Option value is the value attached to the potential future benefits or potential uses of a resource.

• Option value stems from the combination of the individual's uncertainty about future demand for the resource and uncertainty about its future availability.

•It relates to the amount individuals would be willing to pay to conserve e.g. a tropical forest for future use which is no use of it now but use may be made out of it in the future.

Total Economic Value

- The number of pharmaceutical and medical values being discovered from these resources is increasing now.

- The concepts of uncertainty and irreversibility are closely related to this.

- There are uncertainties about the possible future discoveries and bio-technological advances to be gained from ecosystems, which will be lost if irreversible damage is allowed to occur.

- Therefore, value can be gained by delaying any action or decision that could cause irreversible degradation.

Total Economic Value

•Within the TEV framework, an individual can hold both use and non- use values for the services e.g. of an aquatic ecosystem when an oil spill would affect ocean life.

• Those who do not visit the beach would loose on non-use value while those who frequent visit the beach loose use value.

•Thus, TEV = Direct use + Indirect use + Option values + Existence values + Bequest values.

•Each of these non-use benefits can increase welfare and so each must be recognized in any analysis.

Total Economic Value

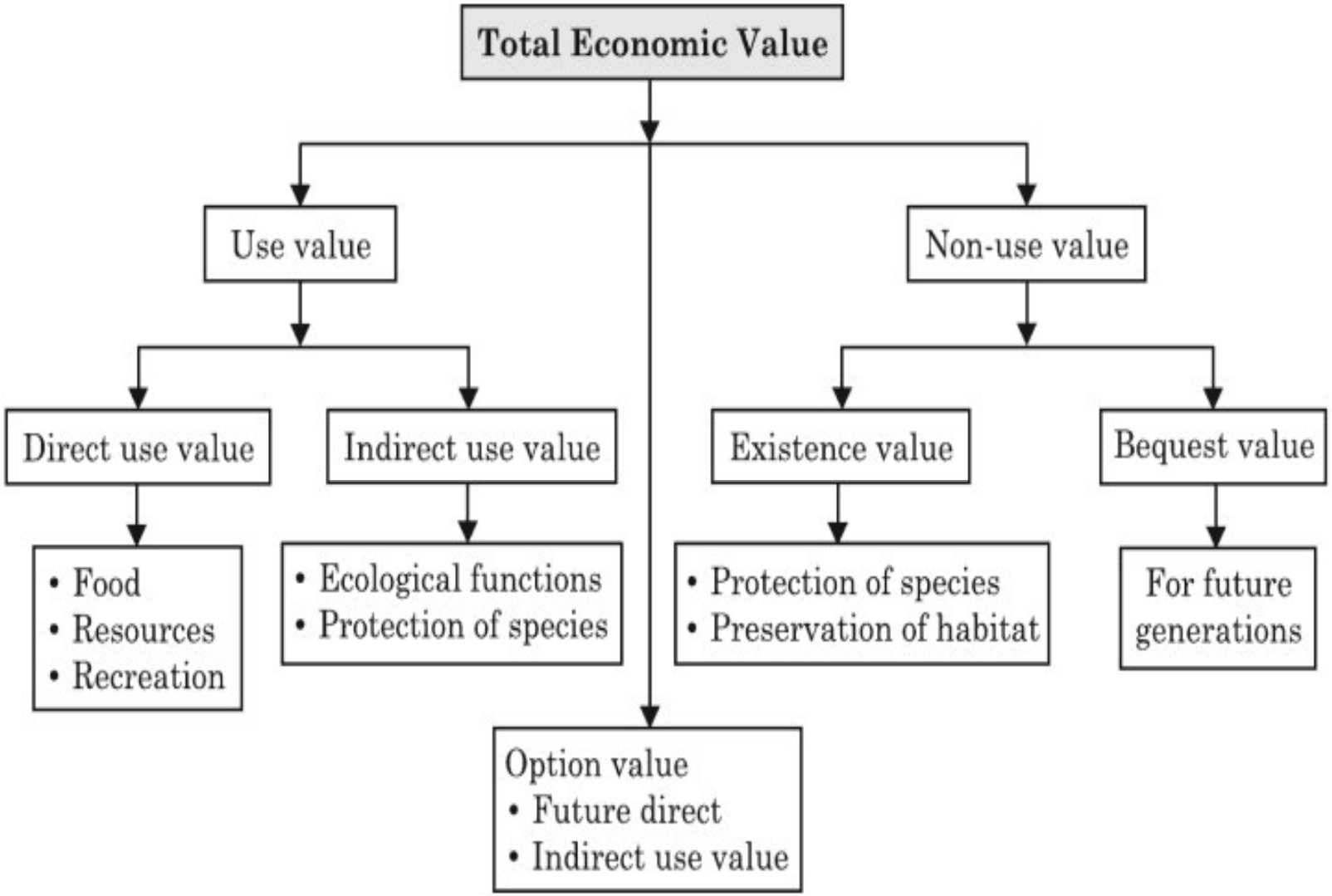


Figure 8.1 Components of total economic value.

Alternative approaches to valuation

•Environmental values are estimated by observing the values of market goods related to the non-market environmental good, such as the purchase of a home or visits to a recreational site.

•In environmental economics, various approaches are used to value environmental resources and services, as traditional market prices often fail to capture the full economic worth of these resources.

• Here are some alternative approaches to valuation in environmental economics.

•**Stated Preference Methods:** Stated preference methods involve surveying individuals and asking them directly about their preferences and willingness to pay for environmental improvements or preservation.

Alternative approaches to valuation

•For example, people may be asked how much they are willing to pay for cleaner air or the preservation of a natural park.

•These surveys help economists estimate the non-market value of environmental goods and services based on people's stated preferences.

•**Revealed Preference Methods:** Revealed preference methods are based on observing people's actual behavior in situations related to the environment.

•Economists use data from real-world choices, such as travel behavior, housing prices, or recreational activities, to infer the economic value individuals place on environmental amenities.

Alternative approaches to valuation

- For instance, by studying the housing market, researchers can estimate the value people attach to living near green spaces or water bodies.

- **Travel Cost Method:** The travel cost method estimates the value of recreational sites or natural areas by analyzing the costs individuals incur, such as transportation and entrance fees, to visit these places.

- By understanding how visitation rates change with varying costs, economists can calculate the total economic value of these environmental assets.

- **Hedonic Pricing Method:** The hedonic pricing method is commonly used to value environmental attributes in the housing market.

Alternative approaches to valuation

- It analyzes property sales data to determine how specific environmental characteristics, such as proximity to parks or pollution levels, influence housing prices.

- By isolating the impact of these environmental factors, economists can assign monetary values to them.

- **Contingent Valuation Method:** Contingent valuation involves presenting individuals with hypothetical scenarios and asking them how much they would be willing to pay or accept as compensation for potential environmental changes or improvements.

- This approach can be used to assess the value of resources that do not have an existing market, like endangered species or ecosystem services.

Alternative approaches to valuation

- **Shadow Pricing:** Shadow pricing involves estimating the economic value of environmental resources by simulating market prices for goods and services that have environmental implications.

- For example, if a factory pollutes a river, economists may estimate the cost to society of cleaning up the pollution or the value of lost fishing opportunities due to the pollution.

- **Benefits Transfer:** Benefits transfer is a cost-effective approach that uses existing valuation studies conducted in one context and applies the estimated values to similar environmental resources or services in another location or time.

- It is particularly useful when conducting original valuation studies is impractical or expensive.

Alternative approaches to valuation

•These alternative approaches to valuation provide valuable insights into the economic importance of environmental resources and help policymakers and stakeholders make informed decisions regarding environmental conservation, development projects, and policy implementations.

• By using these methods, economists can better understand the trade-offs involved in managing natural resources and achieving sustainable development.

Cost-benefit analysis

•Environmental economists have the task of recommending policies that reflect scarcity and alternative uses of a resource.

•Whenever the government has to take a policy decision, it uses a popular tool known as the Cost-Benefit Analysis (CBA).

•It provides an organizational framework for identifying, quantifying, and comparing the costs and benefits (measured in money terms) of a proposed policy action.

•The final decision is arrived at by a comparison of the total costs and benefits. This is presented in a graphical form in Figure 8.2.

•In the figure, the SMC curve shows the marginal cost of

Cost-benefit analysis

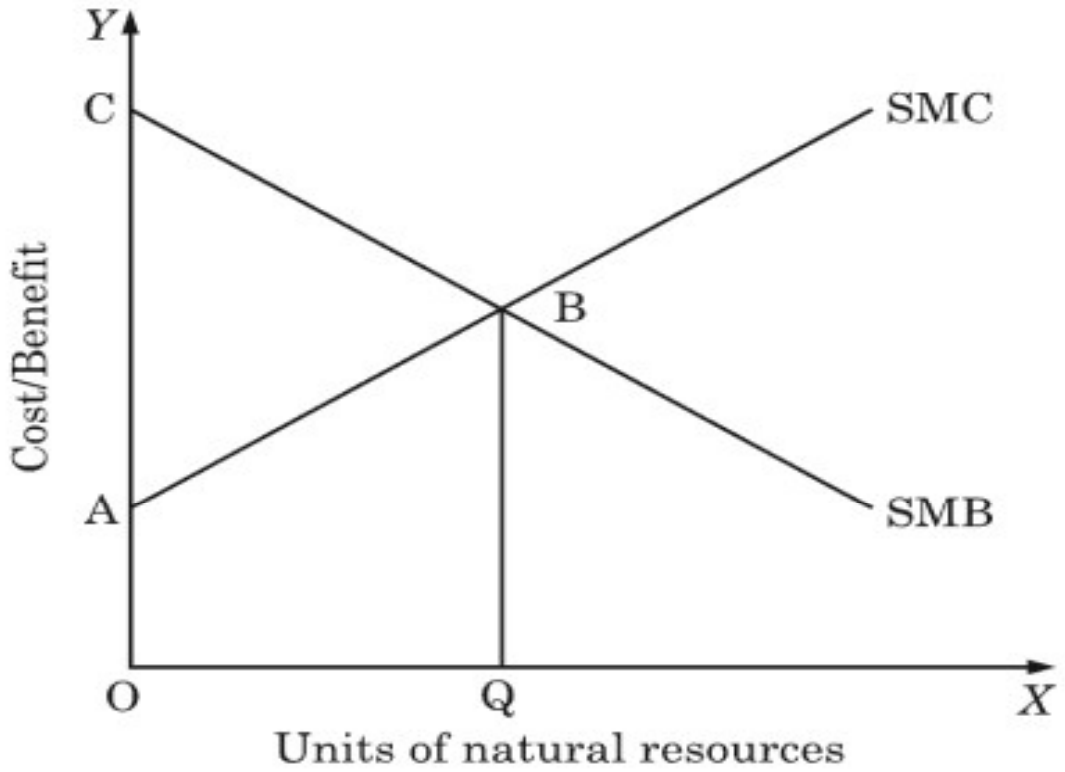


Figure 8.2 Total cost and total benefits.

Cost-benefit analysis

•In the figure, the SMC curve shows the marginal cost of carrying out an economic activity on the environment.

•It could be pollution or cutting down of trees or the cost of extraction of ore.

• It has an upward slope indicating that the more the use of environment takes place the more the marginal social cost.

•On the other hand, SMB shows the diminishing marginal benefit derived from the use of natural resources.

• Point Q presents the equilibrium of SMC and SMB giving the total surplus of CBD, which is the maximum surplus. Beyond this point the SMC is greater than SMB.

Cost-benefit analysis

•Benefits are defined as increases in human well-being (utility). The benefits of environmental regulations can include, for example, reduced human and wildlife mortality, improved water quality, species preservation, and better recreation opportunities.

• Costs are defined as reductions in human well-being. The costs are usually reflected in higher prices for consumer goods and/or higher taxes.

•Some costs may be in the form of loss of a portion of a forest.

•The basic idea is simple, government must ideally decide on a project that gives the largest surplus.

Cost-benefit analysis

- Total surplus is total benefits minus total costs. A surplus is equal to Pareto optimum.

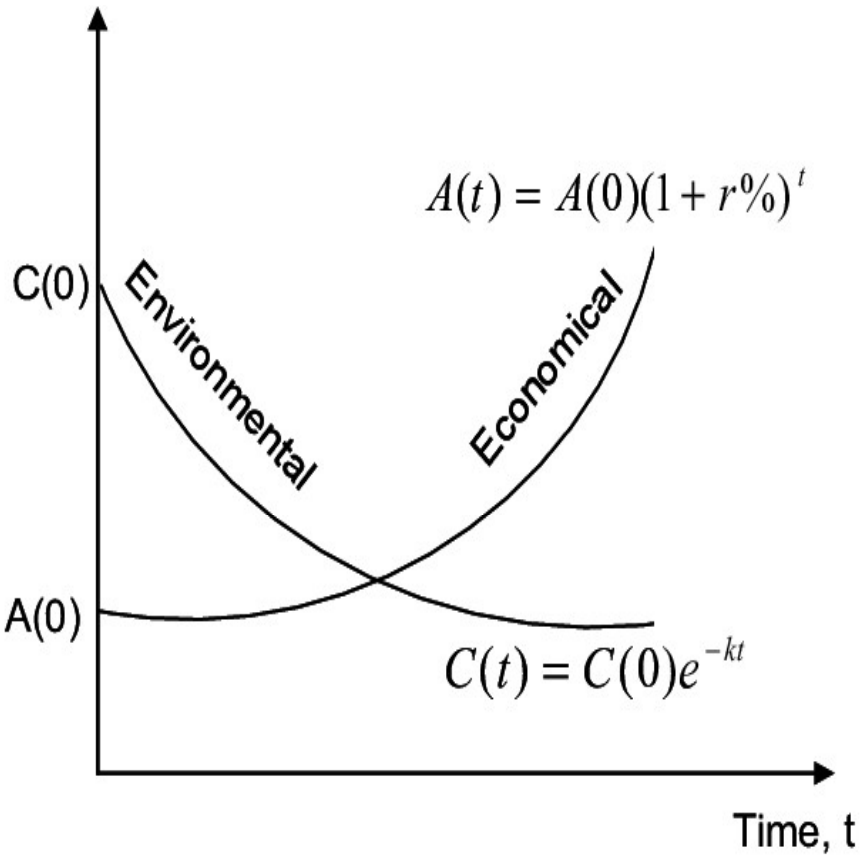
- For a project or policy to qualify on cost-benefit grounds, its social benefits must exceed its social costs.

- In real life, however, it is not so easy to implement is as quantification of most benefit and costs are difficult.

Discounting

•Discounting is a technique used to convert future costs and benefits into their present value.

• In environmental economics, this is important because environmental projects often have long time horizons, and the value of costs and benefits can change over time.



Discounting

•**Time Preference:** Discounting reflects people's time preference for immediate gratification.

• In CBA, a discount rate is applied to future costs and benefits to convert them into today's dollars.

•**Present Value:** The present value is the current worth of future cash flows.

•By discounting future costs and benefits, economists can compare them on an equal basis with the costs and benefits incurred in the present.

•**Discount Rate:** The discount rate represents the rate of return that could be earned if the funds were invested elsewhere.

Discounting

- It reflects the societal opportunity cost of spending money on the project instead of alternative investments.

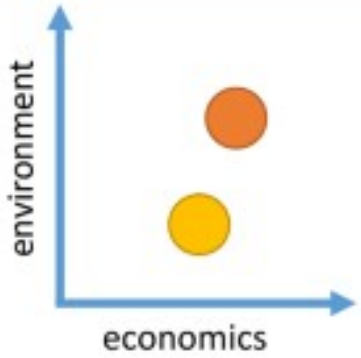
- Discounting helps decision-makers compare projects with different timeframes, ensuring that long-term environmental initiatives are evaluated appropriately.

- However, choosing an appropriate discount rate can be challenging, as it involves considering societal preferences for time and trade-offs between current and future benefits.

Discounting

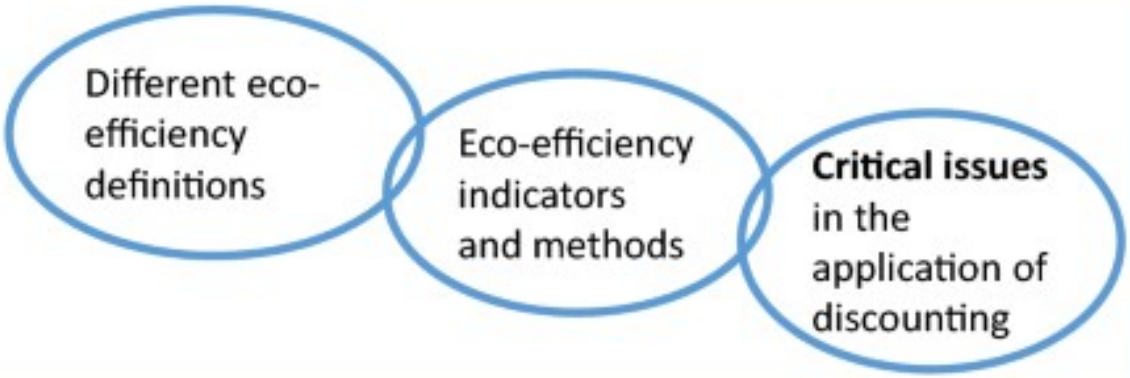
Eco-efficiency analysis is an important decision instrumentfor environmental vs. economic trade-offs.

Eco-efficiency



Environmental and economic impacts occur over time. Their current value is evaluated by **discounting**.

This **systematic literature review** of peer-reviewed journal articles reveilles:



Discounting

•It reflects the societal opportunity cost of spending money on the project instead of alternative investments.

•Discounting helps decision-makers compare projects with different timeframes, ensuring that long-term environmental initiatives are evaluated appropriately.

• However, choosing an appropriate discount rate can be challenging, as it involves considering societal preferences for time and trade-offs between current and future benefits.

•In most cases, it truly takes a long time for any environmental project to take effect and make an impact so that the much-desired benefits can be realised and distributed among society.

Discounting

- There exists a certain biophysical time and impact-lag; that is, benefits and costs occur at different times.

- Hence economists have come up with "discounting" -- comparing benefits and costs that occur at different time stages.

- The logic behind discounting is that it is used as a conservative decision-making tool for environmental projects - which projects should receive the funding and which projects would be better off financially without any funding at all.

- In doing so, discounting sets a high standard for environmental asset outcomes and their ability to pay off in the future.