Dr. Csaba FOGARASSY lecturer

CLIMATE CHANGE ECONOMICS RESOURCE CENTRE

BASICS OF ENVIRONMENTAL ECONOMICS

BASIC LITERATURE
FOR BA and ERASMUS STUDENTS

SZENT ISTVÁN UNIVERSITY GÖDÖLLŐ
2015

WHO AM I?

Dr. Csaba Fogarassy, PhD in Business, Phd in Agro

Place of birth:	Fehérgyarmat, Hungary
Date of birth:	03/05/1971
Permanent adress:	2100 Hungary - Gödöllő, Komáromi street 19.
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Work place:	Szent Istvan University, Faculty of Economics and Social Sciences, head of Research Group of Biomass Economics (from 1997), director of Climate Change Economics Research Centre (from 2005)
Present position:	head of unit
Qualifications:	dr. habil degree (management and business/2010) 2014 – **Doctor in philosophy (PhD) in Business Management**: Szent Istvan University – Business Administration and Management PhD School, Gödöllő 2000 - **Doctor of philosophy (PhD) in Agricultural Sciences**: Szent Istvan University - Agro-energy and Environmental management PhD School - Gödöllő 1996 - **Agricultural Engineer of Environmental Management (MSc)**: Gödöllő University of Agricultural Science 1996 - **Teacher in Engineering (MSc)**: Gödöllő University of Agricultural Science - School of Economics and Social Sciences Galileo Certificate in Renewable energy management and Finance - European Energy Centre, Edinburgh -Napier University, 2011 Climate Change Expert Imperial College - professional Education Program, Imperial College London, 2009
Language skills:	Hungarian (mother tongue), English (very good), Russian (good),
Research area:	cleantech innovation, environmental externalities, renewable energy utilisation, environmental economics, innovation and incubation management in the EU, transition management
Teaching:	Environmental economics, Economics of externalities, Economics of Sustainable Development, EU Low-carbon-economy, Cleantech

Main research & innovation activities:

- 2014-2016 ARTS – EU FP Accelerating and Rescaling Transitions to Sustainability – project program leader (http://acceleratingtransitions.eu/)
- 2012 – 2014 CIE – Interreg7 - Cleantech Incubation Europe program, country leader EU Incubation best practice/RubikLogicenter Model (www.rlogicenter.org)
- 2011 - Danone Hungary – Company level carbon management system development (best practice)
- 2009 - EU FP6 - HUN-HYPOS – hybrid power system development in EU - http://hae-journals.org/archives/haen_22_spcedt/hae_22_specedt_2010.pdf
- 2006 - Green Biomass Data Bank for Innovation – Renewable Energy research program proposal – project leader, Innovation research program – OTP Bank, Hungary, 2006
- 2006 - Biomass providing systems – solid biomass burning in large scale units – project manager – Pannon Power Rt., 2006
- 2005 - Complex energy saving program, investigation of the alternative energy utilisation – Innovation project/ project leader - Masterfood Hungary Ltd.,
- 2005 - new Eurobarometer Survey on Biotechnology – Social aspect of the biotechnology research group, Brussels, 2005
- 2005 – EU/Fp 6 - Leonardo Fund - Interactive Learning of Energetic Utilisation of Agricultural Products and By-products, project participant and project planner, 2005
- 2002-2006 Hungarian Scientific Research Found program: Effect of the alternative land using for the global climate change – project coordinator
- 2001-2002 SUSFill Demo project - Sustainable project evaluation process in the SMEs tender systems /East Hungarian Development Council/Phare – project coordinator
- 1998-1999 EU Phare Program: Education and information technology development in the agricultural research systems – project participant

Publications total: 225

1. Fogarassy, C. (2014) The Interpretation of Sustainability Criteria using Game Theory Models (Sustainable project development with Rubik's Cube), Budapest; Paris: L' Harmattan Publisher, p.140 (önálló) https://www.scribd.com/doc/250370912/Fogarassy-Rubik-Model-Eng-Harmattan-Publisher-2014
2. Fogarassy, C. - Neubauer, E. (2014) Water value and water resource evaluation in Hungary. In: Ugrósdy, G. - Molnár, J. - Szűcs, I. (Edited by) The Evaluation of Natural Resources. Agroinform Publising and Printing Ltd., Budapest, 2014 pp. 103-127 https://www.scribd.com/doc/251719231/Evaluation-of-Natural-Resources-2014
3. Kovacs, A. - **Fogarassy, C.** (2015) Planning Agricultural Enterprises with the Integration of Environmental Effect Interaction and GHG Calculations. Science Journal of Business and Management. Vol. 3, No. 1, 2015, pp. 33-42. doi: 10.11648/j.sjbm.20150301.15
4. **Fogarassy, C.** – Szarka, K. – Lehota, J. (2014) The "transition thinking" and 50plus generation thoughts of sustainability in different countries (case study in Hungary and Switzerland). International Journal of Advanced Research in Management and Social Sciences, Vol. 3 | No. 11 | November 2014, http://www.garph.co.uk/IJARMSS/Nov2014/4.pdf
5. Kovács, A. – Horváth, B. – **Fogarassy, C.** (2014) The influence of cultivation method on the soil's organic carbon content calculations (Hungarian SOC references values vs. IPPC defaults). COLUMELLA Journal of Agricultural and Environmental Sciences Volume 2 (2014) http://www.columella.mkk.szie.hu/?menu=page32

General description of subject

Subject: BASICS OF ENVIRONMENTAL ECONOMICS for Erasmus, FAO and other international students on BA level

Lecturer: Csaba Fogarassy PhD. agro, PhD business

Email: fogarassy.csaba@gtk.szie.hu

Assistants: Sandor Zsarnóczai PhD, Maria Böröcz PhD

Room: 303. seminar / Seminar Building

Time: on every week Monday 11.30-13.00 Length of Course: 13 Weeks

Credit value: 4

SUBJECT REQUIREMENTS:

Written examination – essay till end of the course

Oral presentation – in conjunction with the essay presentation and main topics

Topics and literature

MAIN TOPICS:

- ✓ **Introduction to Environmental & Resource Economics**
- ✓ **The Law of Diminishing Returns and Kuznets Curve**
- ✓ **Definitions of sustainable development, sustainable food and feed production**
- ✓ **Externalities, Internalisation of external cost, – environmental solutions, models**
- ✓ **Net present value, ecosystem valuation**
- ✓ **Environmental regulation and regulation policy (norms and direct regulators)**
- ✓ **Taxation system, Pigovian tax, taxation system in practice**
- ✓ **Coase theory and carbon trading system in practice**
- ✓ **Corporate environmental prevention in practice, Environmental Management Systems and solutions**
- ✓ **Alternative energy sources, energy crops production in practice (bio-oil crops, bio-ethanol crops, biogas crops).**

Basic literatue

Environmental Economics - Volume 1. The Essentials - Environmental Literacy Council, London, www.enviroliteracy.org, 2007

http://enviroliteracy.org/pdf/enviroecon-vol1.pdf

More literatures on Neptun system - link:

http://neptun.szie.hu/hu/bejelentkezes

Volume 1: The Essentials

Inside the guide:

- Easy-to-understand explanations of common economic terms
- Recommended Websites, Articles, & Case Studies
- Classroom Resources

ENVIRONMENTAL LITERACY COUNCIL

Scientists. Educators. Economists.

Table of Contents

Chapter 1: Introduction to Environmental & Resource Economics

Environmental economics is the subset of economics that is concerned with the efficient allocation of environmental resources. The environment provides both a direct value as well as raw material intended for economic activity, thus making the environment and the economy interdependent. For that reason, the way in which the economy is managed has an impact on the environment which, in turn, affects both welfare and the performance of the economy.

One of the best known critics of traditional economic thinking about the environment is **Herman Daly**. In his first book, ***Steady-State Economics***, Daly suggested that "enough is best," arguing that economic growth leads to environmental degradation and inequalities in wealth. He asserted that the economy is a subset of our environment, which is finite. Therefore his notion of a steady-state economy is one in which there is an optimal level of population and economic activity which leads to sustainability. Daly calls for a qualitative improvement in people's lives – development – without perpetual growth. Today, many of his ideas are associated with the concept of **sustainable development**.

By the late 1970s, the late economist **Julian Simon** began countering arguments against economic growth. His keystone work was ***The Ultimate Resource***, published in 1981 and updated in 1996 as ***The Ultimate Resource 2***, in which he concludes there is no reason why welfare should not continue to improve and that increasing population contributes to that improvement in the long run. His theory was that population growth and increased income puts pressure on resource supplies; this increases prices, which provides both opportunity and incentive for innovation; eventually the innovations are so successful that prices end up below what they were before the resource shortages occurred. In Simon's view, a key factor in economic growth is the human capacity for creating new ideas and contributing to the knowledge base. Therefore, the more people who can be trained to help solve arising problems, the faster obstacles are removed, and the greater the economic condition for current and future generations.

Environmental economics takes into consideration issues such as the conservation and valuation of natural resources, pollution control, waste management and recycling, and the efficient creation of emission standards. Economics is an important tool for making decisions about the use, conservation, and protection of natural resources because it provides information

about choices people make, the costs and benefits of various proposed measures, and the likely outcome of environmental and other policies. Since resources – whether human, natural, or monetary – are not infinite, these public policies are most effective when they achieve the maximum possible benefit in the most efficient way. Therefore, one job of policymakers is to understand how resources can be utilized most efficiently in order to accomplish the desired goals by weighing the costs of various alternatives to their potential benefits.

An Economic View of the Environment

Measuring society's well-being

Willingness to pay as a measure of natural resource value

Classes of environmental values

Circular flow of the economy and environment

Market allocation of natural resources

Market failure

Government responses to market failure

© NOAA Coastal Services Center

In competitive markets, information exists about how much consumers value a particular good because we know how much they are willing to pay. When natural resources are involved in the production of that particular good, there may be other factors – scarcity issues, the generation of pollution – that are not included in its production cost. In these instances, scarcity issues or pollution become **externalities**, costs that are external to the market price of the product. If these full costs were included, the cost of the good may be higher than the value placed on it by the consumer.

A classic example of an externality is discussed in **Garrett Hardin's** ***Tragedy of the Commons***, which occurs in connection to public commons or resources – areas that are open and accessible to all, such as the seas or the atmosphere. Hardin observed that individuals will use the commons more than if they had to pay to use them, leading to overuse and possibly to increased degradation.

There are three general schools of thought associated with reducing or eliminating environmental externalities. Most **welfare economists** believe that the existence of externalities is sufficient justification for government intervention, typically involving taxes and often referred to as **Pigovian taxes** after economist Arthur Pigou (1877-1959) who developed the concept of economic externalities. **Market economists** tend to advocate the use of incentives to reduce environmental externalities, rather than command-and-control approaches, because incentives allow flexibility in responding to problems rather than forcing a singular approach on all individuals. **Free-market economists** focus on eliminating obstacles that prevent the market from functioning freely, which they believe would lead to an optimal level of environmental protection and resource use. The key objective of environmental

economics is to identify those particular tools or policy alternatives that will move the market toward the most efficient allocation of natural resources.

Recommended Resources

Center for the Advancement of the Steady State Economy
www.steadystate.org
The Center for the Advancement of the Steady State Economy is a nonprofit organization that educates citizens and policy makers on the fundamental conflict between economic growth and environmental protection, economic sustainability, national security, and international stability through its promotion of a steady state economy as a sustainable alternative to economic growth.

Political Economy Research Center
www.perc.org
The Political Economy Research Center is dedicated to original research that brings market principles to resolving environmental problems. The site has an extensive publications list and an environmental education section that touches on a variety of subject areas that relate to both economics and the environment.

Protecting Ecosystem Services: Science, Economics, and Law
eprints.law.duke.edu/archive/00001071/01/20_Stan._Envtl._L._J._309_(2001).pdf
This paper is the result of a workshop that took place in December 2000 when a group of 30 scientists, conservationists, economists, lawyers, and policymakers came together at Stanford University to discuss ways to market ecosystem services.

Items for written exam

1. **GDP vs. sustainable indicators**
2. **Sustainable development vs. economic growth**
3. **Internalisation of external costs (traffic, agriculture, environmental pollutions)**
4. **Pigouan and Coase Theorem - comparison**
5. **Energy crops production (bio-oil crops, bio-ethanol crops, biogas crops)**
6. **Renewable energy source utilization (solar, wind, hydropower, wave energy)**
7. **Environmental Management Systems (ISO 14001, EMAS)**
8. **Integrated Quality Management Systems (GAP, eurepGAP) in the environmental protection**
9. **Direct and indirect regulation of the environmental protection (charges, taxes, norms etc.)**
10. **Questions of the communal waste transport and waste recycling in the EU**
11. **The management and disposal of hazardous waste**
12. **European or American Emission Trading structures**
13. **Nonrenewable alternative energy sources (oil sand, shale oil, gas hydrates, geothermal)**
14. **The environmental Kuznets curve**

Essay – formal requirements

- Total 10 pages
- Title (from the list)
- Table of content
- Introduction to the topic (1-2 pages)
- Evaluation of international literature (2 pgs)
- Evaluation of national or local literature (2 pgs)
- Conclusions (1 page)
- Summary (1 page)
- References (min. 10 pieces)

Szent István University
Faculty of Economics and Social Sciences
International BA Education Programme

Environmental Economics

HOME ASSINGMENT

„Sample"

Implications of the Emissions Trading Scheme on the Renewable Energy Sector of Hungary

Made by:
Mr. Bob Twister

Gödöllő, 2015

Table of Contents

Formal requirements:

Times New Roman, 12pt, normal space between the lines, length minimum 10 and maximum 15 pages.

The deadline for delivery to fogarassy.csaba@gtk.szie.hu **until the 01 st of Januar 2015**

Basis of environmental economics

First Part

Economic background

Environmental economics is the subset of economics that is concerned with the efficient allocation of environmental resources.

The environment provides both a direct value as well as raw material intended for economic activity, thus making the environment and the economy interdependent.

For that reason, the way in which the economy is managed has an impact on the environment which, in turn, affects both **welfare and the performance of the economy**.

Critics of traditional economic thinking

Herman Daily – he suggested that "enough is best," arguing that economic growth leads to environmental degradation and inequalities in wealth. – **it was the base of the concept of sustainable development (ISEW – index of sustainable economic welfare). Importan definition: Steady State Economy**

Julian Simon – he concludes there is no reason why welfare should not continue to improve and that increasing population contributes to that improvement in the long run.

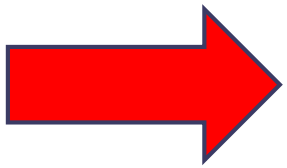
The population growth will indicate the innovations!

GDP vs. ISEW

The **Index of Sustainable Economic Welfare** (**ISEW**) is an economic indicator intended to replace the **Gross Domestic Product (GDP)**, which is the main macroeconomic indicator of System of National Accounts (SNA).

ISEW *= personal consumption*
+ public non-defensive expenditures
- private defensive expenditures
+ capital formation
+ services from domestic labour
- costs of environmental degradation
- depreciation of natural capital

Economic and environment



An Economic View of the Environment

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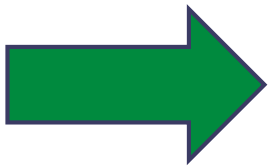


Tragedy of the common goods

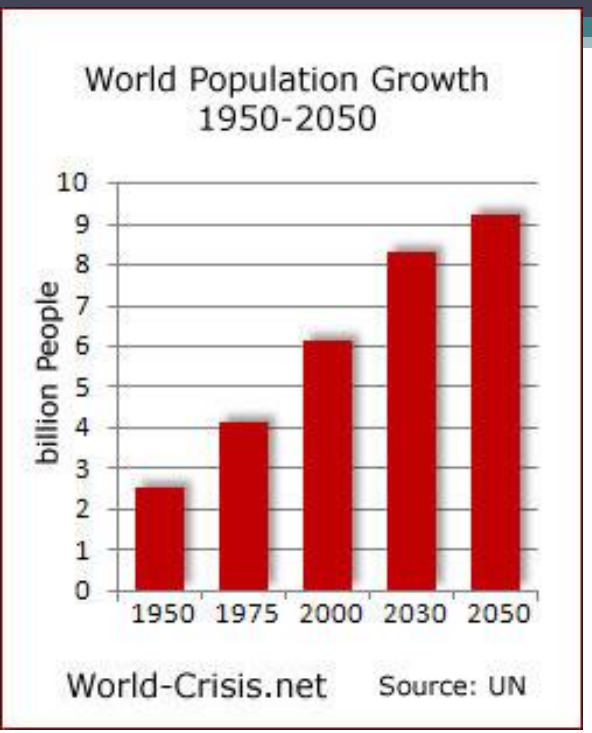
Garrett Hardin - Tragedy of the Commons, which occurs in connection to public commons or resources – areas that are open and accessible to all, such as the seas or the atmosphere. **Hardin observed that individuals will use the commons more than if they had to pay to use them,** leading to **overuse** and possibly to increased degradation.

Cows on Selsley Common. The "tragedy of the grazing" is one way of accounting for **overexploitation/overusing.**

Meaning

Hardin draws attention to **problems that cannot be solved by technical means**, as distinct from those with solutions that require "a change only in the techniques of the natural sciences, demanding little or nothing in the way of change in **human values** or ideas of **morality**".

Sigmund Freud, a familiar scientific researcher, held the belief that in order for humanity to progress, a sense of happiness should be present in one's life.



The core problem

Hardin contends that this class of problems includes many of those raised by human population growth and the use of the Earth's natural resources. **The problem of population growth.**

Externalities from the structure

- ✓ **GLOBAL AND LOCAL INTERACTIONS**: MARKET FAILURES (prices, borders, market positions)
- ✓ **ENERGY USING AND PRODUCTIONS**: POLITICAL AND ECONOMICAL PROBLEMS
- ✓ **DIFFERENT SOLUTIONS AND PRECONCEPTION**: ADDITIONAL SOCIAL AND TECHNICAL DEBATES (TECHNOLOGY AND HUMAN MIGRATIONS)

SOLUTIONS FROM THE DIFFERENT SCOOLS

General schools to reduce externalities „welfare economists”

Welfare economists – believe that the **existence of externalities** is sufficient justification for government intervention, typically involving taxes and often referred to as **Pigovian taxes** after economist Arthur Pigou (1877-1959) who developed the concept of economic externalities.

General schools to reduce externalities „market economists”

Market economists – Market economists tend to advocate the use of incentives to reduce environmental externalities, rather than **command-and control approaches**, because incentives allow flexibility in responding to problems rather than forcing a singular approach on all individuals.

General schools to reduce externalities „free market economists”

Free market economists – Free market economists focus on eliminating obstacles that prevent the market from functioning freely, which they believe would lead to an optimal level of environmental protection and resource use. The key objective of environmental economics is **to identify those particular tools or policy alternatives** that will move the market toward **the most efficient allocation of natural resources.**

Freemarket environmentalism

Julian Simon (USA) was also one of the founders of **freemarket environmentalism, finding that a** free market, together with appropriate **property rights,** was the **best tool** in order to **preserve both the health and sustainability** of the environment (end of 1970 years).

The low of diminishing return

The **”law of diminishing returns”** is one of the best-known principles outside the field of economics. It was first developed in 1767 by the French economist **Turgot** in relation to agricultural production, but it is most often associated with Thomas Malthus and David Ricardo.

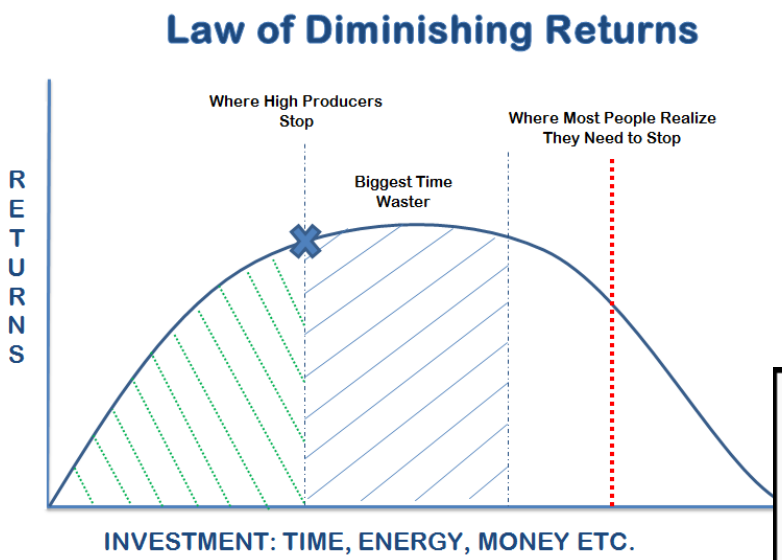
They believed that human population would eventually outpace the production of food since land was an integral factor in limited supply. In order to increase production to feed the population, farmers would have **to use less fertile land and/or increase production intensity** on land currently under production. In both cases, there would be **diminishing returns**.

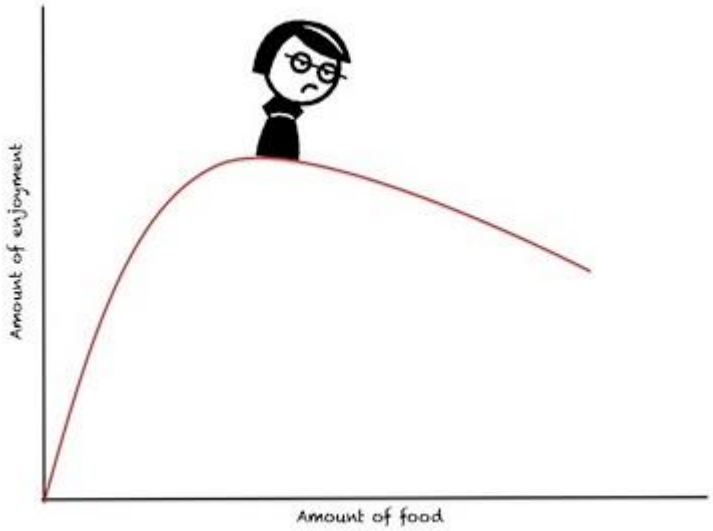
Explanation

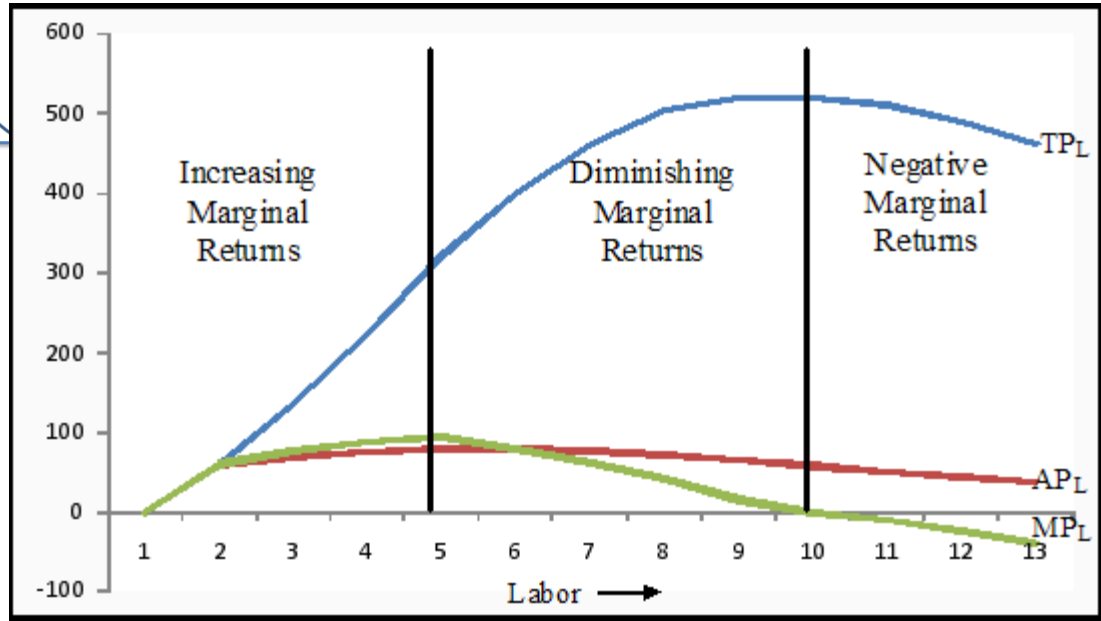
Diminishing returns reflect the point in which the marginal benefit begins to decline for a given production process. For example, the table below sets the following conditions on a farm producing corn:

Number of Workers	Corn Produced	Marginal Benefit
1	10	10
2	25	15
3	45	20
4	60	15
5	70	10
6	60	-10

Interpretations







Forexample:

1. **Number of workers**
2. **Amount of nitrogen fertilisers**

Marginal Benefit

It is with three workers that the farm production is most efficient because the **marginal benefit** is at its highest.

Beyond this point, the farm begins to experience diminishing returns and, at the level of 6 workers, the farm actually begins to see decreasing returns as production levels decline, even though costs continue to increase.

In this example, the **number of workers** changed, while the land used, seeds planted, water consumed, and any other inputs remained the same.

Carrying capacity

Changes in population can have a variety of economic, ecological, and social implications. One population issue is that of **carrying capacity – the number of individuals** an ecosystem can support without **having any negative effects.** It also includes a **limit of resources** and pollution levels that can be maintained without experiencing high levels of change. (Ecological footprint)

The Ecological Footprint

MEASURES

how fast we consume resources and generate waste

Energy | Settlement | Timber & paper | Food & fibre | Seafood

COMPARED TO

how fast nature can absorb our waste and generate new resources.

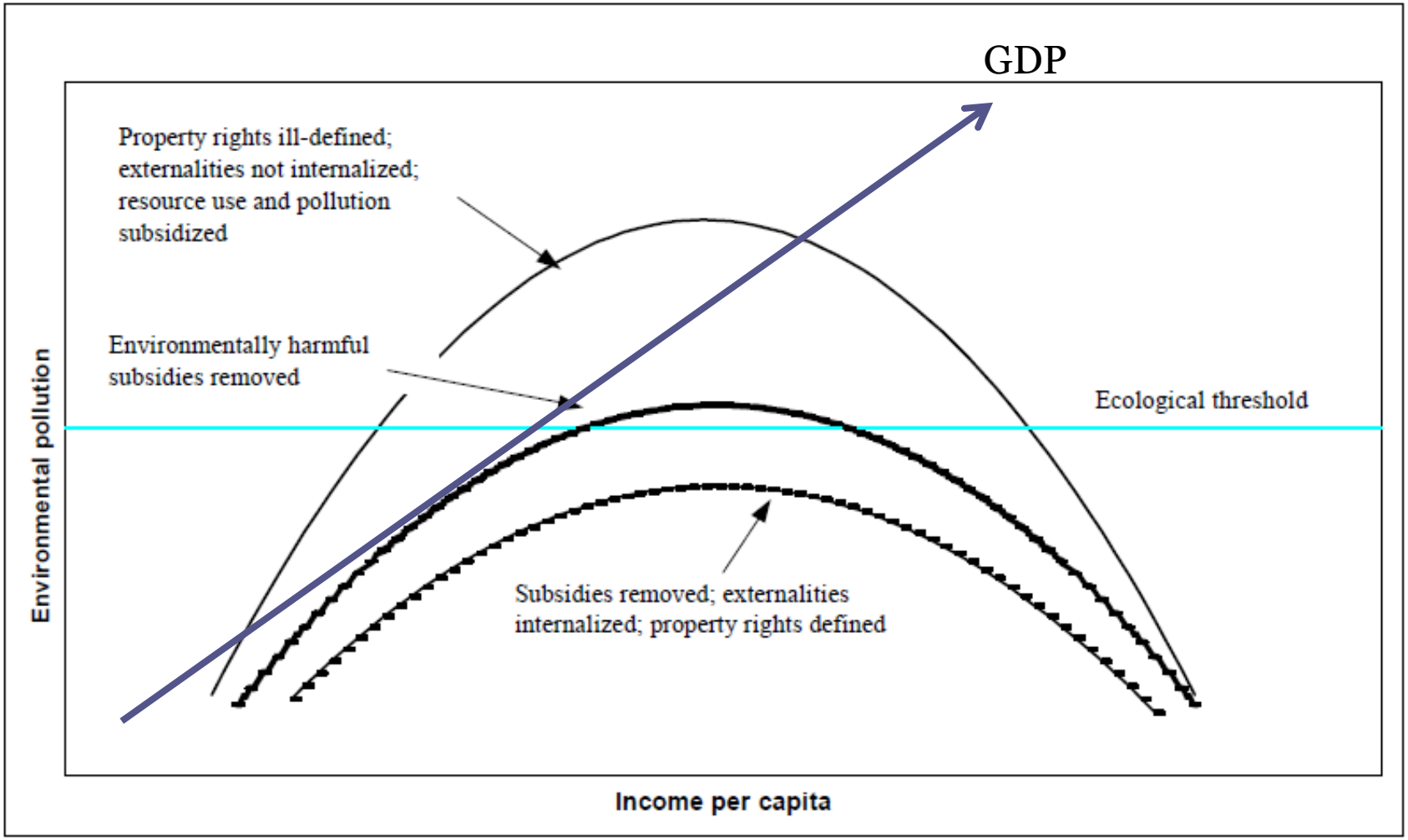
Carbon Footprint | Built-up land | Forest | Cropland & pasture | Fisheries

Kuznets curve

The **standard of living** in a region can help to alter an area's carrying capacity. Areas with a higher standard of living tend to have a reduced carrying capacity compared to areas with a lower standard of living due to the access to and demand for more resources.

The effect this has on an ecosystem is called an "**ecological footprint," which can be used to measure and manage the use of resources** throughout an economy.

The Curve


GDP
Property rights ill-defined; externalities not internalized; resource use and pollution subsidized
Environmentally harmful subsidies removed
Ecological threshold
Subsidies removed; externalities internalized; property rights defined
Environmental pollution
Income per capita

Sustainable development

Our Common Future (1987), defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs," which has become the accepted standard definition.

The three component:

- economic growth,
- environmental protection,
- and social equity.

Sustainable system and connections

Sustainable econ linking the economy

Since sustainable development goes well beyond economic issues, **linking the economy**, environment, and society, no comprehensive economic theory related to sustainable development exists.

However, progress toward sustainable development is often measured by a **variety of indicators**, which can be used at the local, regional, national or international level.

Indicators

Economic indicators:

Gross domestic products
Trade balance
Intensity of energy use

Social indicators:

Poverty rate
Life expectancy
Literacy rate

Environmental indicators:

Greenhouse gas emission
Percent of forested land
Water quality

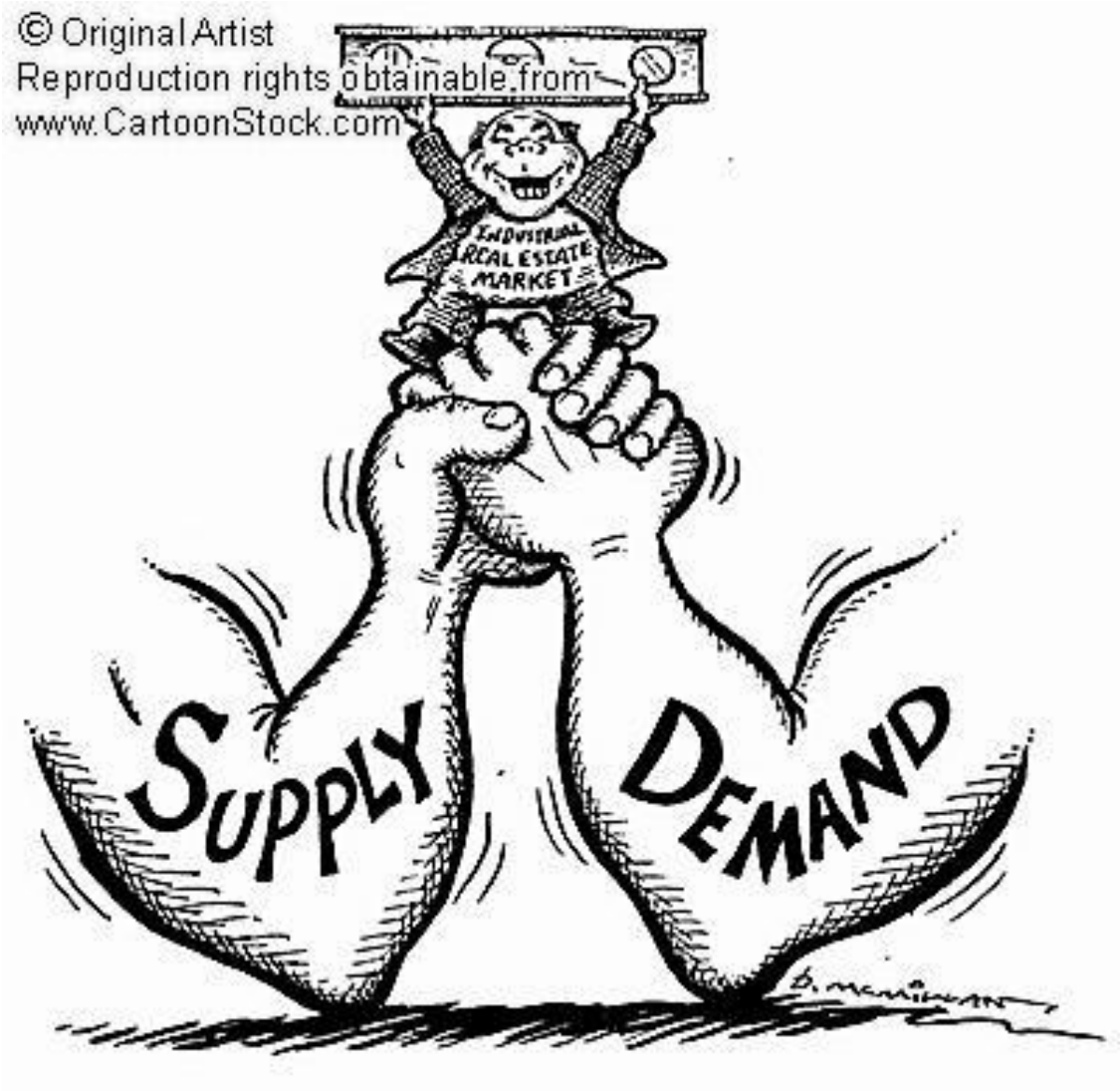
Institutional:

R&D expenditures
International cooperation
Disaster preparedness

How markets work

The market is the way in which an economic activity is organized between buyers and sellers through their behavior and interaction with one another.

Buyers, as a group, determine the overall demand for a particular product at various prices while sellers, as a group, determine the supply of a particular product at various prices.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www.CartoonStock.com
INDUSTRIAL
REAL ESTATE
MARKET
SUPPLY
DEMAND

Supply and demand

Two basic terms that are used most often by economists are ***supply and demand.*** How much of something that is available - the supply - and how much of something people want - the demand - are what makes a working market. **Markets have existed since early in history** when people bartered and made exchanges for food, trinkets, and other goods.

The price

A key function of the market is to find the **equilibrium price when supply and demand are in balance**. At this price, the goods supplied are equal to what is being demanded thereby bringing about the most efficient allocation of the goods.

An efficient allocation of goods in a market is one in which no one can be made better off unless someone else is made worse off.

Know Your Market: The Supply and Demand Factor

Variable influences

Variables that Influence Buyers (Demand)	Variables that Influence Sellers (Supply)
• Price • Income • Prices of related goods • Tastes • Expectations • Number of Buyers	• Price • Input prices • Technology • Expectations • Number of sellers

Market based economy ≠ Global capitalism

EXTERNALITIES

Market equilibrium

Most economic analyses focus on finding the market equilibrium, there exist a **number of other market forms.**

When it comes to the utilization of natural resources or other environmental quality amenities, it is often difficult to find the equilibrium through mere market pricing since they are not true market goods.

Externalities

Efficiency would require maximizing current costs and benefits of using or extracting natural resources while also taking into consideration future costs and benefits, as well as the intrinsic and existence value of the resources. When the market fails to allocate the resources efficiently, market failure can occur.

One example of this is the creation of **externalities.**

What causes externalities

Often, this occurs when clear property rights are absent, as with air and some water resources. Sometimes the government intervenes in an attempt to promote efficiency and bring the market back into equilibrium.

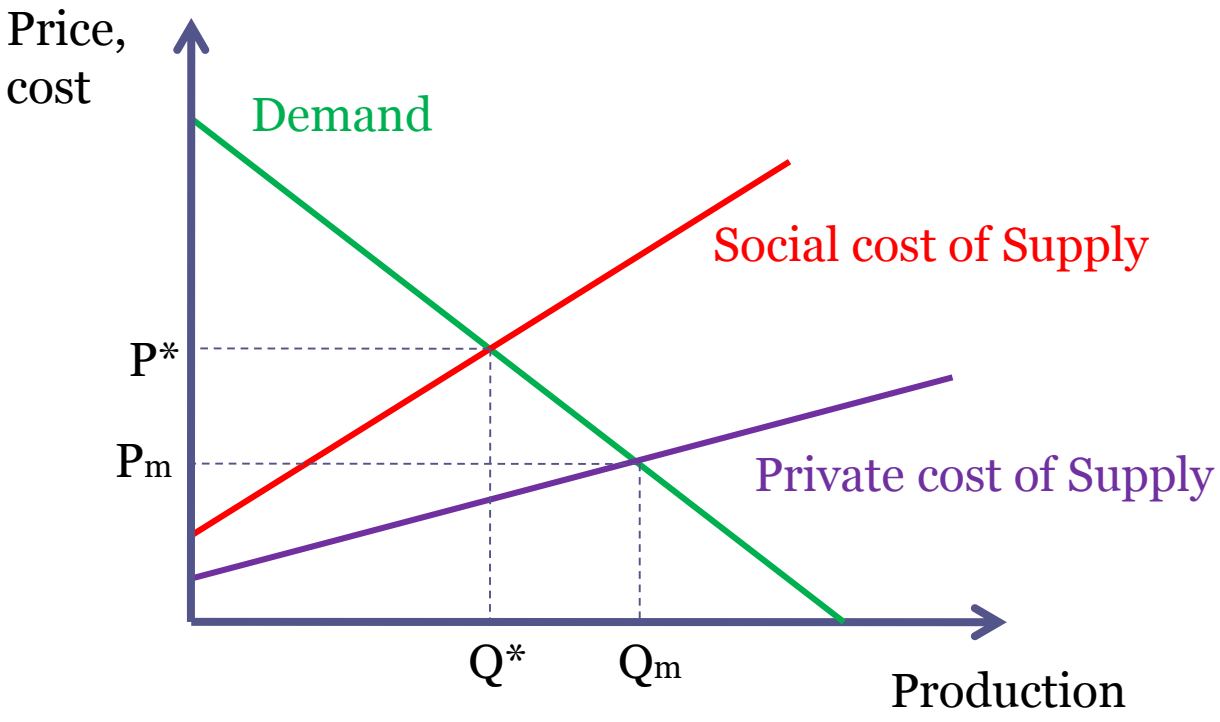
Market options can include economic incentives and disincentives, or the establishment of property rights.

Negative externalities

Externalities are unintentional side effects of an activity affecting people other than those directly involved in the activity.

A **negative externality** is one that creates side effects that could be harmful to either the general public directly or through the environment. An example would be a factory that pollutes as a result of its production process.

Market situation in the case of negtive externalities

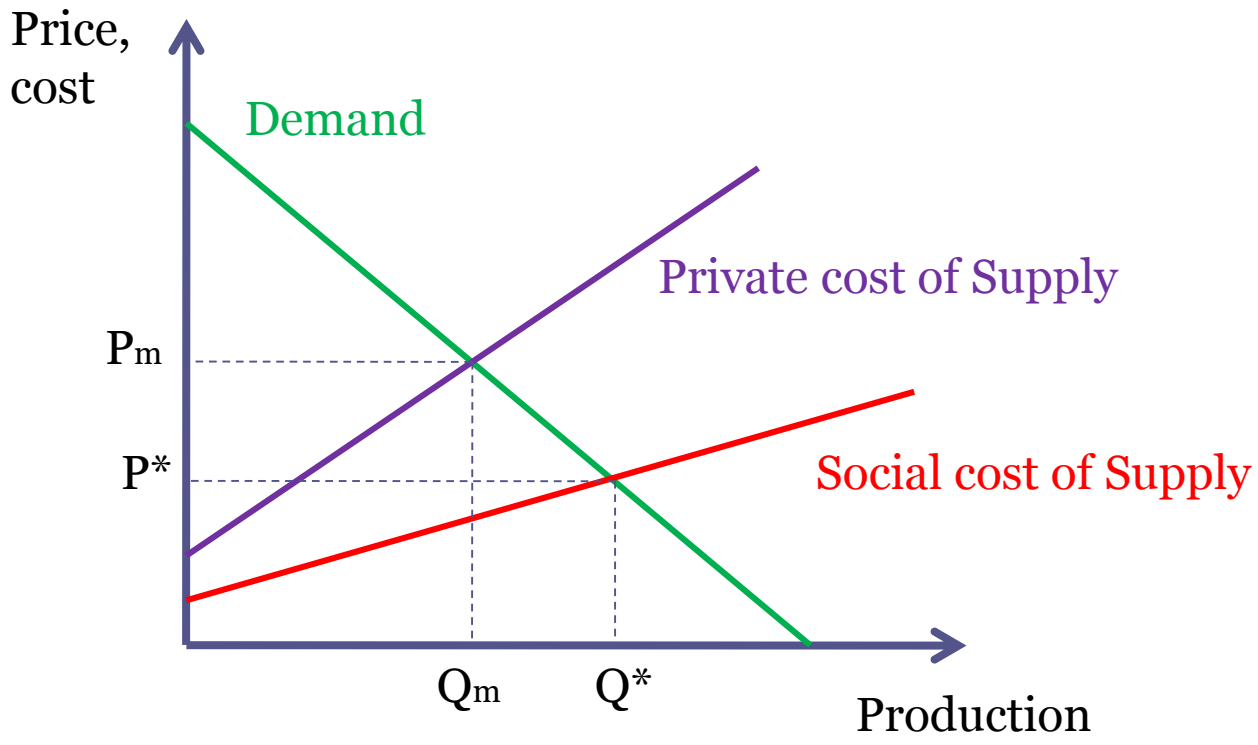


Positive externalities

A positive externality is **an unpaid benefit that extends beyond those directly initiating the activity**. One example would be a neighborhood resident who creates a private garden, the aesthetic beauty of which benefits other people in the community.

Also, when a group voluntarily chooses **to create a benefit, such as a community park,** others may benefit <u>without contributing to the project</u>. Any individuals or groups that gain additional benefits without contributing are known as "**free riders".**

Market situation in the case of positive externalities



Internaliasation of the externalities by the goverment

Traditionally, both negative and positive externalities are considered to be forms of market failure - when a free market does not allocate resources efficiently.

Arthur Pigou, a British economist best known for his work in welfare economics, argued that the existence of externalities justified government intervention through legislation or regulation.

Pigou supported taxes to discourage activities that created harmful effects and subsidies for those creating benefits to further encourage those activities. These are now known as **Pigovian taxes and subsidies.**

Internalisation of the externalities by the market

Economist **Ronald Coase** showed that taxes and subsidies were typically not necessary as long as the parties involved could strike a voluntary bargain.

According to **Coase's theorem, it does not matter who has ownership, so long as property rights exist** and free trade is possible.

The options for dealing with externalities - positive or negative - are numerous, and often depend on the **type of externality**.

Second Part

Short term and longer-term analyses

Economists focus much of their analyses on a marketplace where supply and demand are **based on the perceptions of present value and scarcity.**

However, when going beyond the **simplicity of the short-term**, particularly when costs and benefits occur at different points in time, it is important to utilize **discounting to** undertake **longer-term analyses.**

Discounting adjusts costs and benefits to a common point in time. This approach can be useful in helping to determine <u>how best to utilize many of our **non-renewable** natural resources</u>.

Net Present Value definition

Net present value (NPV) is a calculation used to estimate the value – or net benefit – over the lifetime of a particular project, often longer-term investments, such as building a new town hall or installing energy efficient appliances.

NPV allows decision makers **to compare various alternatives on a similar time scale** by converting all options to current dollar figures. A project is deemed acceptable if the net present value is positive over the expected lifetime of the project.

The NPV formula

$$\mathrm{NPV} = \sum_{t=0}^{N} \frac{C_t}{(1+i)^t}$$

The formula for NPV requires knowing the likely amount of time (*t, usually in* years) that cash will be invested in the project, the total length of time of the project (*N, in the same unit of time as t), the interest rate (i), and the cash flow at* that specific point in time (cash inflow – cash outflow, *C)*.

Tradicional bulb changing

For example, take a business that is considering changing their lighting from t**raditional incandescent bulbs to fluorescents.** The initial investment to change the lights themselves would be **EUR 40,000.**

After the initial investment, it is expected to cost **EUR 2,000** to operate the lighting system but will also yield **EUR15,000** in savings each year; thus, there is a yearly cash flow of **EUR 13,000** every year after the initial investment.

For simplicity, assume a discount rate of **10%** and an assumption that the lighting system will be utilized over a **5 year** time period.

NPV calculations of the scenario

- t = 0 NPV = (-40,000)/(1 + .10) 0 = -40,000.00
- t = 1 NPV = (13,000)/(1.10) 1 = 11,818.18
- t = 2 NPV = (13,000)/(1.10) 2 = 10,743.80
- t = 3 NPV = (13,000)/(1.10) 3 = 9,767.09
- t = 4 NPV = (13,000)/(1.10) 4 = 8,879.17
- t = 5 NPV = (13,000)/(1.10) 5 = 8,071.98

Based on the information above, the total net present value over the lifetime of the project would be **EUR 9,280.22**.

NPV > 0

Once the net present value is calculated, various alternatives can be compared and/or choices can be made.

Any proposal with a **NPV < 0** should be dismissed because it means that a project will likely lose money or not create enough benefit.

The clear choice is a project whose **NPV > 0** or, if there are several alternatives with **positive NPVs**, the choice would be the alternative with the higher NPV. With most societal choices, the **opportunity costs are also** considered when making decisions.

Net present value provides one way to minimize **foregone opportunities and identify the best possible options.**

Account for depreciation

Net present value calculations can also help account for **depreciation. Over time** most assets depreciate, or **lose value**. Companies or individuals must be able to calculate a rate that includes depreciation for account balancing and tax purposes, as well to help predict replacement times for the asset in question.

NPV and depreciation calculations are extremely valuable in the world of economics; they tell us what projects and businesses are better investments and what outcomes we may expect in the future.

NPV and natural resources

However, while depreciation rates can be reliably estimated for most physical items, such as **computer equipment or buildings**, their application to natural resources and other environmental issues is more uncertain.

Natural resources do not necessarily lose value over time. Thus, in most cases natural resources should not be depreciated when calculating resource NPVs.

NPV vs Ecosystem valuation

Despite how helpful calculating NPV can be, using it to assess projects related to the environment will continue to be controversial. **Ecosystem valuation is a** complex process that does not always result in the assignment of accurate values to natural resources.

And, while the use of **discounting may make sense for money** – being not as valuable in the future as it is today – it may be more difficult to use in assessing natural resources.

Since many natural resources often increase in value, <u>this type of evaluation method would need to recognize increased future resource values</u> and/or that of other environmental services.

Evaluating options

Valuation can be a useful tool that aids in **evaluating different options that a natural resource manager might face.** Because our ecological resources and services are so varied in their composition, it is often difficult to examine them on the same level. However, after they are assigned a value, an environmental resource or service can then be compared to any other item with a respective value.

Ecosystem valuation is the process by which policymakers assign a value – monetary or otherwise – to environmental resources or to the outputs and/or services provided by those resources.

Multiple value options

Environmental resources and/or services are particularly hard to quantify due to their intangible benefits and **multiple value options**. It is almost impossible to attach a specific value to some of the experiences we have in nature, such as viewing a beautiful sunset.

Problems also exist when a resource can be used for multiple purposes, such as a tree – the wood is valued differently if it is used for **flood control** versus if it is used for **building a house**.

Quantity of the resources

The **quantity of a resource** must also be taken into consideration because value can change depending how much of a resource is available.

An example of this might be in preventing the **first "unit" of pollution** if we have a pristine air environment. Preventing the first unit of pollution is **not valued** very highly because the environment can easily recover.

However, if the **pollution continues** until the air is becoming toxic to its surroundings; the value of preserving clean air by preventing additional pollution is going to be increasingly valued.

Willingness to pay

There are typically two ways to assign value to environmental resources and services – **use and non-use – and there are approaches to measuring** environmental benefits based on these defined values.

When environmental resources or services are being used, it is easier to observe the price consumers are **willing to pay** for the conservation or preservation of those resources.

Opportunity cost

Market or **opportunity cost pricing can be used when there are tangible** products to measure, such as the amount of fish caught in a lake.

Replacement cost can also be used, calculated based on any expenses incurred to reverse environmental damage.

Cost-benefit analysis

A **cost-benefit analysis requires the quantification of possible impacts of a** proposed project. The impacts could be physical or monetary, but both must be calculated and included since a financial analysis that requires assigning dollar values to every resource evaluated is also performed.

The process of environmental resource or service valuation provides a way to compare alternative proposals, but it is not without problems.

All valuation techniques encompass a great deal of uncertainty: mistakes can exist in the methods of assigning value accurately due to a wide number of variables and it is difficult to compartmentalize and measure environmental and natural resources and/or services within an ecosystem that functions as an interconnected web.

PART III.

About the ecosystem valuatios

In summary, **ecosystem valuation is a complex process by which economists** attempt to assign a value to natural resources or to the ecological outputs and/or services provided by those resources.

Although challenging, it allows policymakers to make decisions based on specific comparisons, typically monetary, rather than some other arbitrary basis. <u>In recent years, the government has placed increasing emphasis on cost-effective laws and projects.</u>

Therefore, establishing a common measure by which to evaluate alternatives is essential.

Trade-off

As we make everyday choices – how much time to spend working or studying, what to spend our money on – we are experiencing what in economics are called **trade-offs and opportunity costs.**

A trade-off is when we choose one option in favor of another and the opportunity cost is what is sacrificed in order to get something.

Whether we realize it or not, <u>we are constantly evaluating the costs and benefits of each decision</u> we make; therefore, it can also be said that we are performing our own **cost-benefit analysis each time we make a choice.**

Service fee of natural resources

The economy and the environment are inextricably linked. Whether one is looking at daily life or natural resources and other environmental issues, because resources are scarce, choices have to be made about how to use them.

The basic fact is that resources used to meet one choice or alternative cannot be used to meet another. Just like how we value regular goods, the **valuation of natural** resources and the environment is based on how we value their services and, for services that are consumed directly, that value is based on our utility and willingness to pay for a certain amount of the services.

Direct cost and external cost

The decision about how to allocate resources relating to the environment has an impact on all sectors of our economy, primarily because of the complex relationship between utilizing natural resources and economic output.

Many times, the cost of utilizing these resources and/or services include **direct costs as** well as **opportunity costs and external costs, which are not traded in markets** or assessed directly in monetary terms.

For example

For example, when trees are cut for such uses as housing and furniture, some of the **direct costs** will include the cost of machinery and labor during cutting, processing, and manufacturing.

The **opportunity costs** relating to this use would be the opportunities foregone by the machinery and labor that could not be used elsewhere, since it was occupied cutting trees.

The **external costs** are the loss of environmental benefits that are no longer realized which may include a loss in watershed management services, species protection, and CO_2 reduction.

Actual supply and demand

Many agree that in most cases the market is the best way to determine the allocation of resources.

The demand for various products and the availability of natural resources – along with a number of other factors, including preferences, the number of buyers and sellers, pricing, alternative choices, etc – is expected to lead to an efficient result of actual supply and demand.

However, markets can fail to account for the full cost of a natural resource and/or services, which will prevent it from achieving an efficient allocation of the resource, leading to **externalities.**

Reduce the market failures

To **reduce the potential for market failures and their resulting externalities,** planners and policymakers attempt to identify a course of action that generates the greatest societal benefits.

Much of this is done by using a **mix of policy and strategies, including regulation, taxes, permits, access restrictions,** etc.

It is finding the appropriate balance between utilizing our natural resources and meeting the demands of society that will allow us to continue to expand our economy while sustaining our natural resources and the environment.

Marginal cost and benefits

Marginal costs and benefits are essential information for economists, businesses, and consumers.

Even if we do not realize it, we all make decisions based on our marginal evaluations of the alternatives. In other words, “what does it cost to produce one more unit?” or “what will be the benefit of acquiring one more unit?”

Marginal cost measures

Marginal cost measures the change in cost over the change in quantity. For example, if a company is producing 10 units at $100 total cost, and steps up production to 11 units at $120 total cost, the marginal cost is $20 since only the last unit of production is measured in order to calculate marginal cost.

Mathematically speaking, it is the **derivative of the total cost. Marginal cost is** an important measurement because it accounts for increasing or decreasing costs of production, which allows a company to evaluate how much they actually pay to 'produce' one more unit.

Marginal cost and externalities

Marginal cost will normally initially decrease through a short range, but increase as more is produced. Therefore the marginal cost curve is typically thought of as upward sloping. **The marginal cost curve can represent a wide range of activities that can reduce the effects of environmental externalities, like pollution.**

The **key point** is that most environmental improvements are not free; resources must be expended in order for improvement to occur.

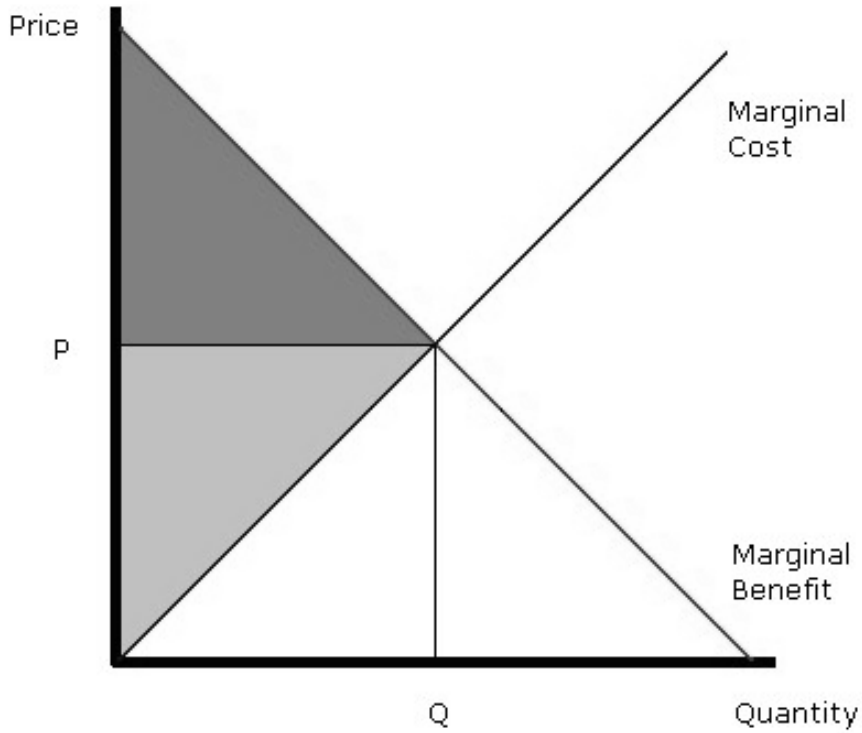
For example, take an environment that has been polluted – while the initial *unit of cleanup* may be cheap, it becomes more and more expensive as additional cleanup is done. If cleanup is undertaken to point "Q", the total cost of the cleanup is P*Q the white and light gray areas on the graph below.

Marginal benefit

Marginal benefit is similar to marginal cost in that it is a measurement of the change in benefits over the change in quantity. While marginal cost is measured on the producer's end, marginal benefit is looked at from the consumer's perspective – in this sense it can be thought of as the demand curve for environmental improvement.

The **marginal benefit curve represents** the trade-off between environmental improvement and other things we could do with the resources needed to gain the improvement.

Marginal cost and benefit curve



The total consumer benefit that is represented as the dark grey area, the net benefit is greatest when the quantity – "Q" – reaches the marginal benefit curve. We could increase total benefit by adding pollution controls beyond Q, but only with marginal costs (MC) greater than marginal benefits (MB), so it is no longer efficient to further increase the benefits.

Certain level of production and consumption

Marginal costs and benefits are a vital part of economics because they help to provide the relevant measurement of costs and benefits at a certain level of production and consumption. If measured marginal costs and benefits are provided, it is much easier to calculate the ideal price and quantity.

It is where the two intersect that will always be the most economically efficient point of production and consumption.

Cost benefit analisys (CBA)

Cost-benefit analysis (CBA) is an analytical way for society to make decisions about complicated issues such as education, health care, transportation, or the environment.

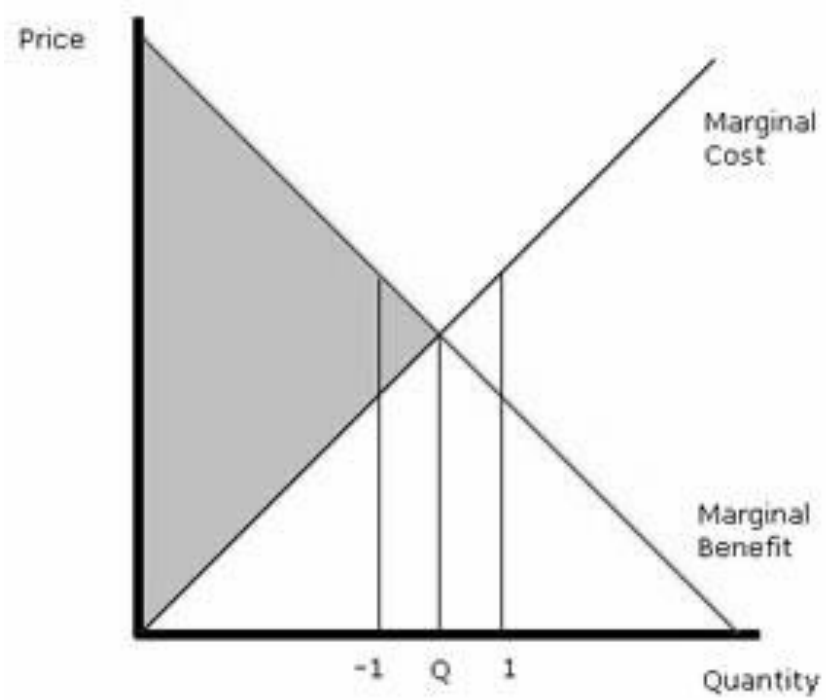
Like most personal decisions, it involves a comparison of the costs of an action compared with considerations of the benefits of that action. However, for public policy it is formalized and quantitative. For instance, a public policy can be evaluated by calculating and weighing the benefits against the costs, once all factors have been given a common unit of measurement.

Cost effective policy

When policymakers have to choose among various alternatives, they require a tool that will allow them to distinguish between the options. Decision makers can then choose the policy with the **largest surplus**, or overall net benefits.

In recent years, for example, the U.S. government is increasingly seeking more cost-effective policies in order to balance the budgets. While the overall concept of CBA is simple, the steps taken to evaluate each benefit and cost can become quite complicated.

CBA – MC and MB



A final result of a CBA should be where **marginal benefits and marginal costs** of a proposed project are equal. In the graph above, this is at **point Q.** The surplus is illustrated by the shaded area in the graph. At the equilibrium, the surplus is greatest, making it the best possible solution. If the quantity were to increase to point 1, the marginal costs would exceed the marginal benefits, meaning it would not economically efficient.

Critics to CBA

Critics argue that cost-benefits analysis does not include equity considerations. Ecological valuation and discounting are other controversial aspects of CBA because there are many different values that certain natural resources could assume, and the discount rate chosen will have significant implications for the resulting analysis.

These arguments are perhaps the best illustration of why CBA can best be used when **combined with other forms of analysis.**

To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation…

~ National Environmental Policy Act (1969)

The Third part

Environmental Impact and Regulation

An **environmental impact analysis is typically conducted to assess the** potential impact a proposed development project will have on the natural and social environment.

This may include an assessment of both the **short- and longterm effects** on the physical environment, such as air, water and/or noise pollution; as well as effects on local services, living and health standards, and aesthetics.

Environmental Impact Statement

One provision of the law requires that an **Environmental Impact Statement** (EIS) be written for major federal actions and made available to all, including to the general public.

An EIS must include: the environmental impacts of a proposed action; unavoidable adverse environmental impacts; alternatives – including no action;

Short term and long term

The relationship between short-term uses of the environment and maintenance of long-term ecological productivity; irreversible and irretrievable commitments of resources; and secondary/cumulative effects of implementing the proposed action.

Now, most state and local governments also require that **environmental impact analyses** be conducted prior to any major development projects.

Problems with the EIS

Environmental impact analyses are often challenging because they call for making projections with **incomplete information**. Methods of assessing the impacts typically include both **objective and subjective information** making it difficult to quantify.

Therefore, the methods are frequently seen as complex and oftentimes **controversial.** Despite being a requirement for many development projects, the function of an environmental impact statement is merely procedural.

Gives complex answers

Although **environmental impact analysis often raises more questions than it** answers as it examines the various **links between social, economic, technological, and ecological factors** involved in a potential development project, it also provides a practical and interesting approach to the understanding and appreciation of the many complexities and uncertainties involved with these interrelationships.

Command and control

Environmental regulation in the United States has traditionally relied on **command-and-control policies in which regulators – typically the government** – set standards or limits and apply them uniformly to a broad category of sources.

There are three types of command-and-control mechanisms that regulators can choose to implement: **ambient, emissions, or technology standards.**

Ambient-emission standard

An **ambient standard sets the amount of a pollutant that can be present within a** specific environment. An example of this would be when a regulator sets a limit on ground level ozone allowable within a city's limits.

Emissions standards are much more common as they seek to limit the amount of emissions released by a firm, industry, or area. It differs from an ambient standard because its use does not determine the ambient level of a pollutant in the environment; rather, it attempts to reduce the overall amount of a pollutant released on a firm-by-firm basis.

Economic insentives

Taxes or fees charge the polluter a certain amount per unit of pollution, the value of which is determined by the regulator.

Marketable permits allow companies to pollute at a level that is marginally cost-effective. It allows them to buy additional permits as needed if they fail to meet their targets internally, and to sell excess permits if they exceed their internal pollution reduction targets.

Liability involves establishing a precautionary level that allows for the greatest benefit to society, and holding firms to that standard if a problem arises.

Command-and-control vs market mechanism

However, while **command-and-control regulation is still common, more and more legislation is beginning to use market mechanisms, or a combination of command-and-control along with** market mechanisms, in order to best meet the demands of the environmental issues at hand.

Reference:

Environmental Economics Volume 1: The Essentials
Environmental Literacy Council, - environliteracy.org

THANK YOU FOR YOUR COOPERATION!

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