Sustainability (2)

- A region has an underground aquifer.
- Two possible policies:
  - **Option A – Intensive extraction**
    - High water use for agriculture today
    - High current profits
    - Aquifer depleted in 20 years
    - Future generations face severe water scarcity
  - **Option B – Sustainable extraction**
    - Moderate water use
    - Slightly lower profits today
    - Aquifer remains stable over time
    - Future generations maintain access to water

Sustainability (3)

- **Comparison**
  - Option A may maximize **short-term welfare,**
  - But it violates the **constraint on future well-being.**

- Option A is efficient and optimal in the short run,
- but it is **not sustainable.**

- **Efficiency** alone is not enough.
- Optimality must include **intergenerational constraints.**
- **Sustainability = optimality with a future well-being constraint.**

Environmental economics – Neoclassical economics (1)

- Value determined by the exchange of goods and services in the market
  - demand preferences and production costs

- "…By pursuing his own interest, he (the entrepreneur) frequently promotes that of society more effectively than when he really intends to promote it" (Smith, 1776)

- In early models absence of land or natural resources.

Environmental economics – Neoclassical economics (2)

- **Scenario**: there is a competitive market for timber.
  - Firms cut trees and sell wood.
  - Consumers demand wood for furniture and construction.
  - Price is determined by **supply and demand**.
- **Classical / Neoclassical Interpretation**
  - If demand for wood increases → price rises.
  - Higher price → firms cut more trees.
  - Market reaches equilibrium.
  - Resources are allocated efficiently through prices.
    - By pursuing profit, firms increase supply.
    - By pursuing utility, consumers signal preferences.
    - The market outcome maximizes total surplus = profits + utility of consumers.
- This reflects **Adam Smith's idea**: Self-interest promotes social welfare!

Environmental economics – Neoclassical economics (3)

- **Nature Is "Missing"**
  - In early models:
  - Forest is treated as a **free input**
  - No explicit value assigned to:
    - Biodiversity
    - Carbon storage
    - Ecosystem services
  - Only **marketed timber** has value!

Environmental economics – Neoclassical economics (4)

- **The Limitation of this theoretical approach**
  - Suppose logging causes:
    - Flooding
    - Habitat loss
    - CO_2 emissions

- If these damages are **not priced**, they are ignored in market exchange.
  - Market outcome may be efficient **privately**
  - But not necessarily efficient **socially!**

- Environmental economics later emerged to correct this omission.

Welfare economics (1)

- Normative judgments made about alternative configurations of
  - economic activities
  - allocation of resources
- Social welfare function
- Externalities
  - Marshall (1890)
  - Pigou (1920)

Welfare economics (2)

- **Normative Judgments and Social Welfare**
- **Practical Example**
- **The Scenario: A Coal Power Plant**
  - A government must decide whether to:
  - Allow a **coal power plant**
  - Restrict it and switch to cleaner energy

Welfare economics (3)

- **Step 1 – Market Outcome (Positive Analysis)**
- The **coal plant:**
  - Produces cheap electricity
  - Makes profits
  - Creates jobs
- Market **price reflects:**
  - Production costs
  - Consumer demand
- But…the coal plant also **causes:**
  - Air pollution
  - Health problems
  - Environmental damage
- These costs are **not included in the market price.**

Welfare economics (4)

- **Marshall** (1890) – Externalities
  - Alfred Marshall introduced the idea that some economic activities create external effects on others.
  - Here:
    - Pollution affects third parties
    - These are external costs

- **Pigou** (1920) – Correcting Externalities
  - Arthur Pigou argued that government should correct externalities.
  - Solution:
    - Impose a pollution tax equal to the external damage(“Pigouvian tax”)
    - This forces firms to internalize social costs.

Welfare economics (5)

- **Step 2 – Normative Judgment**
- Now **society** must decide:
- Should we:
  - Maximize **profits** and cheap electricity?
  - Or maximize overall **social welfare** (including health and environment)?
  - This requires a **value judgment**.

Welfare economics (6)

- **Social Welfare Function**
  - A social welfare function combines:
    - Firm profits
    - Consumer benefits
    - Environmental damages
    - Public health
- Suppose:
  - Electricity **benefits** = €100 million
  - Production **costs** = €60 million
  - Pollution **damage** = €50 million

- Market outcome looks **positive privately** (+€40m)
- But **socially**:100 – 60 – 50 = –€10 million
- **Social welfare decreases.**

Welfare economics (7)

- Choosing the allocation that maximizes **social welfare** involves **normative judgment**.
- Externalities create a divergence between **private** and **social** outcomes.
- **Marshall** identified the problem.
- **Pigou** proposed corrective taxation.

Ecological economics

- The economic system is part of a more extensive system
- Economic and environmental systems are interdependent
- Kenneth Boulding (1910 – 1993)
  - The economics of the coming space earth (1966)
  - Read the paper and describe the main differences between the “cowboy economy” and the “spaceman economy”

Modern economics

- Under **proper conditions**, markets bring efficiency to resources allocation
- The problem deals with **property rights** of natural resources:
  - they do not exist or are not clearly defined.
- **Price fails to signal** the social cost and benefits of using natural resources.
- The government should intervene in the market
  - When and how should the government intervene?
  - How to deal with global problems?

Monetary valuation of natural resources

- Environmental policies can only be implemented if a **monetary valuation** of **natural resources** is available.

- There are many valuation techniques for unpriced environmental services, however
  - there is **no unanimous consensus** on which is **preferable**
  - on the **robustness** of the values obtained
  - on the fact that environmental **policies** should be based **on the monetary values** of environmental resources.

Time dimension of economic decisions

- Flow resources:
  - the level of use today does not have implications for availability tomorrow
    - solar radiation, the power of wind, of tides, and of flowing water
- Stock resources:
  - today's use has implications for tomorrow's availability
    - mineral deposits, oil fields

- Renewable resources
  - biotic, plant, and animal populations, they have the capacity to grow in size over time through biological reproduction
- Non-renewable resources
  - abiotic, stocks of minerals, and do not have that capacity to grow over time

Substitutability and irreversibility

- If the depletion of a resource stock is irreversible,
- and there is no close substitute for the services that it provides,
- then the rate at which the resource is depleted has major implications for its sustainability,
- that is to preserve the possibility of consuming the services that it provides in the future.
- Two problems:
  - define the extent to which **one natural resource can be replaced by another** (e.g., solar power substitute for fossil fuels on a large scale?)
  - define the degree to which an environmental resource can be **replaced** by other inputs, especially the **human-made capital** resulting from saving and investment.

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- Perman, R., Ma, Y., McGilvray, J., Common, M. Natural resource and environmental economics, Pearson Education. 3 ed. - Chapter 1

- Hanley, N., Shogren, J., White, B. Introduction to Environmental Economics, Oxford, 3 ed. - Chapter 1

Open-ended questions

- Define the concepts of efficiency, optimality, and sustainability. Provide examples and explain how these concepts are related.
- According to Boulding, what are the main differences between the Cowboy and Spaceman economies?
- Describe why the time dimension is important in natural resource management.