

SD  
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# OBJECTIVES

The traditional method of **ENRE (Economics of Natural Resources and the Environment)** focuses on analyzing the challenges of managing natural resources from various perspectives and goals.

To determine and fundament the criteria for the optimal exploitation of the resources.

To establish the optimal referential; compare the concrete situations; identify deviations subject of corrective intervention of public nature.

To explain the **agents behaviour** facing the production and use of the resources in different market structures. To establish typologies of representative behaviour in different institutional framework.

To identify the policies; motivating the agents to develop the efficient management **REGULATION**

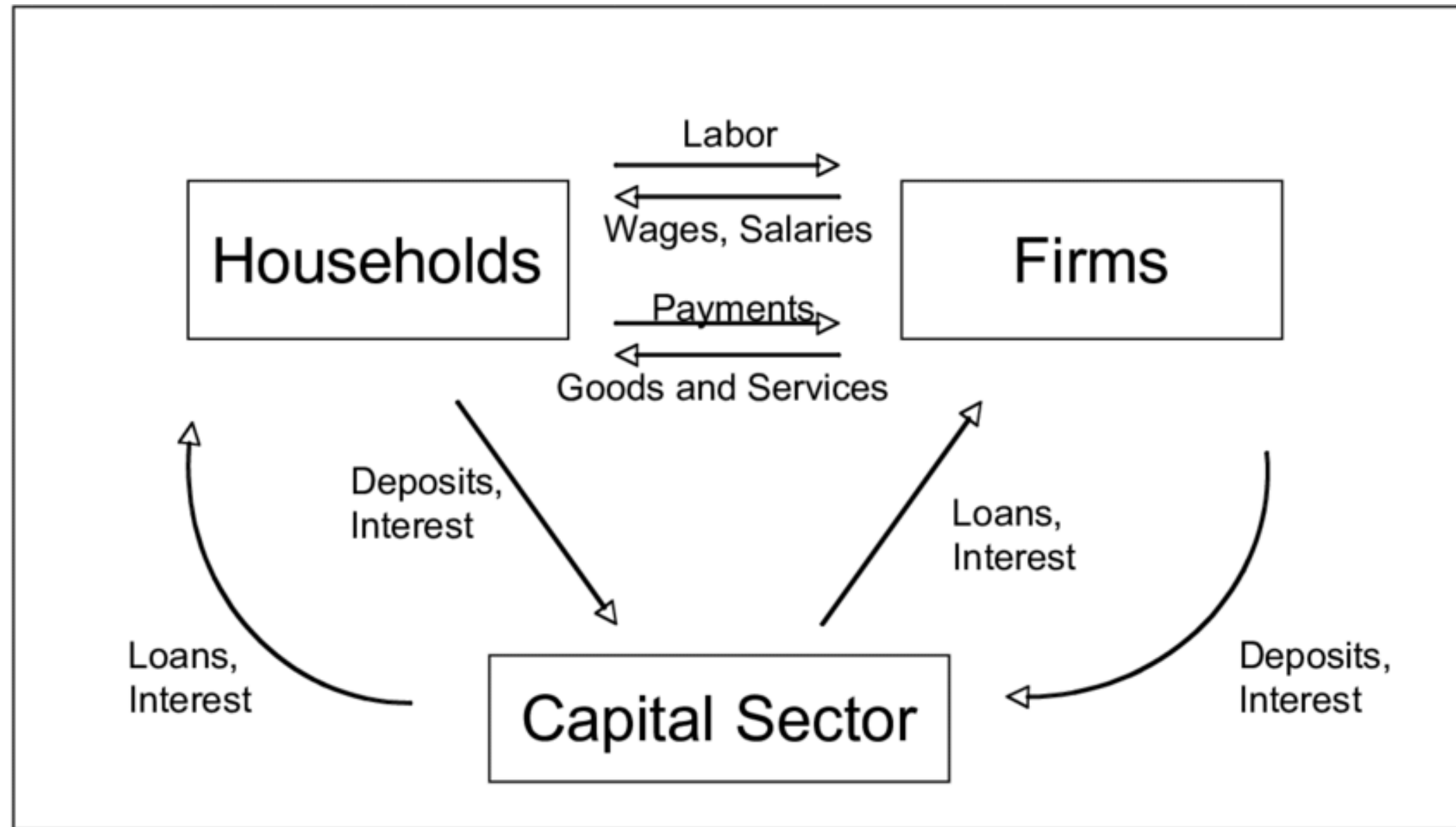
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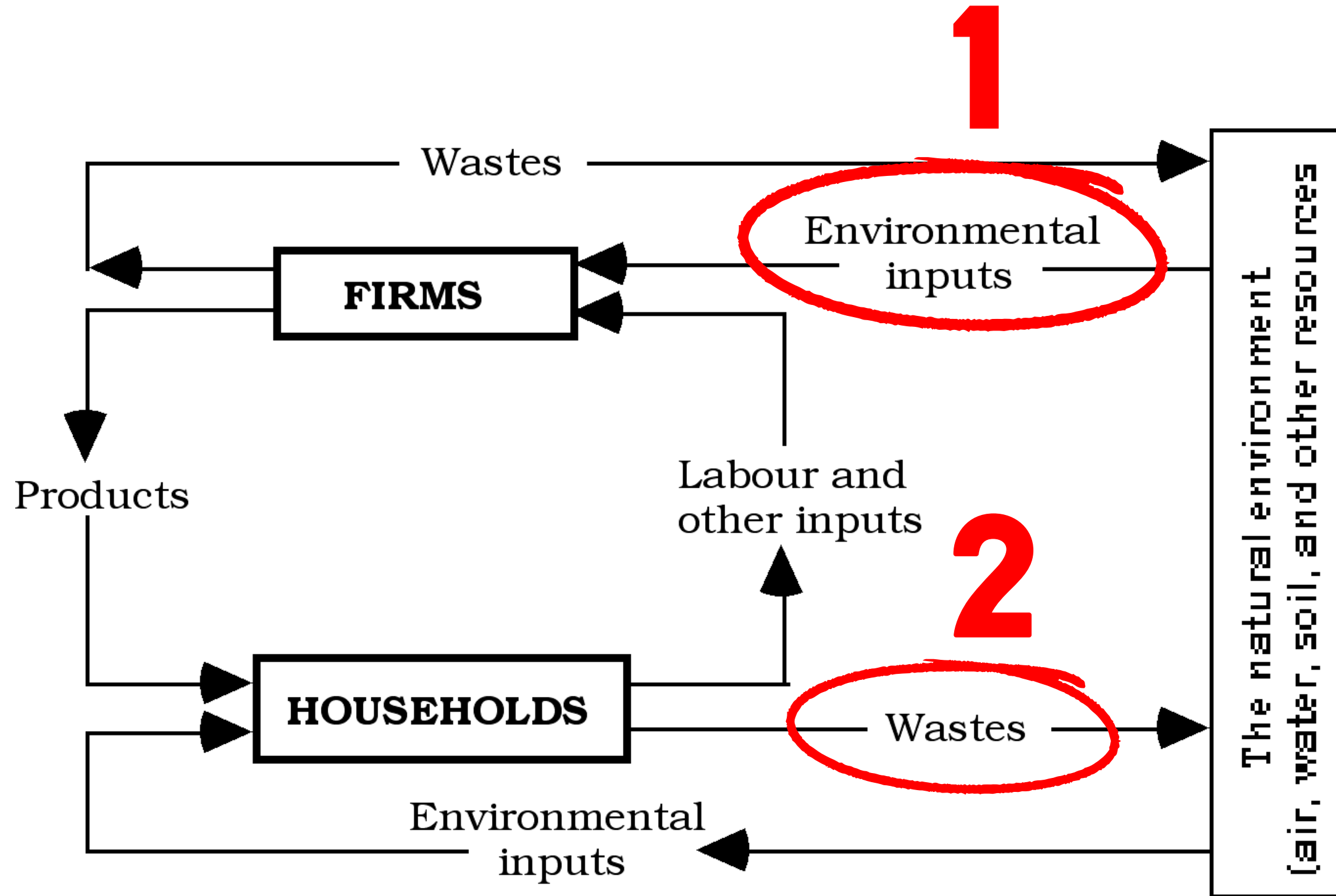
# TRADITIONAL ECONOMY MODEL



what is missing here?

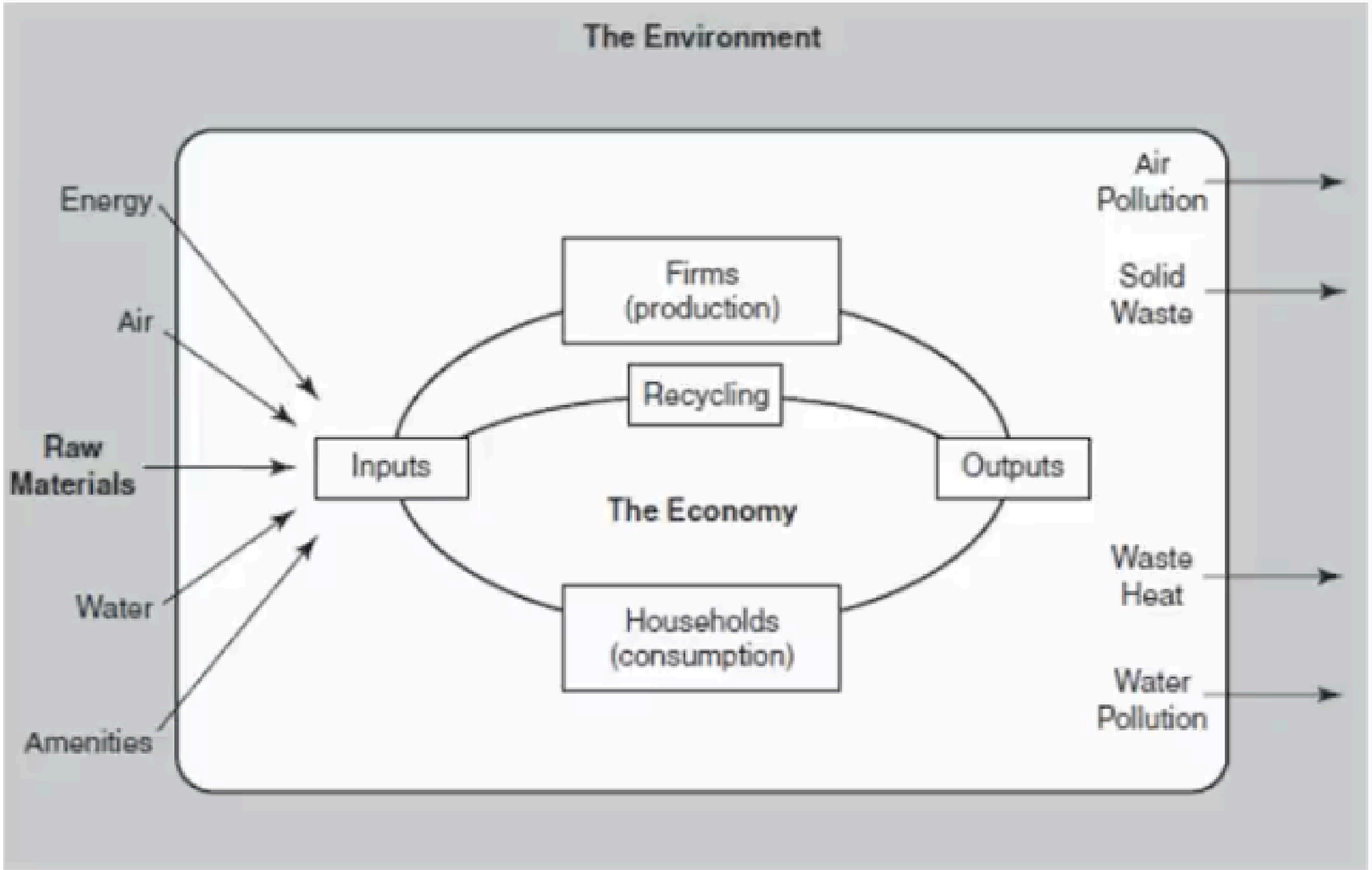
Basic Circular Flow Model of the Economy, with Capital Accumulation (modified from Heilbroner and Thorow 1982).

# THE ENVIRONMENT



Source: Thampapillai 1991, p. 3.

# CLOSED SYSTEM



**To understand sustainability, we must understand  
how the economy manages natural capital.**

# OVERVIEW - ISSUES Delimitation

## CONCEPTUAL AND METHODOLOGICAL FRAMEWORK OF ENRE

The conceptual framework of ENRE (Economics of Natural Resources and the Environment) provides a foundation for understanding the intricate relationship between **economic activities** and the **natural environment**.

At its core, ENRE seeks to address **how societies allocate, use, and value natural resources**, and the subsequent impacts on environmental sustainability.

How can we use natural resources efficiently without destroying them? Since we need natural resources for everything!

# ENVIRONMENTAL ECONOMICS

The field has made significant contributions to understanding market failures, designing policy responses, and integrating environmental considerations into economic paradigms.

## Core Concepts:

- **Market Failures:** Understanding how markets fail to account for environmental costs and benefits.
- **Policy Instruments:** Development of tools such as environmental taxes, emissions trading, and subsidies to address environmental issues.
- **Interdisciplinary Approaches:** Incorporation of ecological, social, and economic factors to address complex environmental problems.
- **Externalities:** Environmental economics often deals with externalities, which are costs or benefits of economic activities not reflected in market prices.

# ENVIRONMENTAL ECONOMICS

## Key Principles of Environmental Economics

### **1. Ecological Sustainability**

- Ensuring that economic activities do not compromise the ability of future generations to meet their needs by maintaining the health of ecosystems and natural resources.

### **2. Polluter Pays Principle**

- Assigning the cost of pollution to those who cause it, thereby internalizing environmental costs into market prices and encouraging pollution reduction.

### **3. Precautionary Principle**

- Taking preventive action in the face of uncertainty to avoid potential environmental harm, even if some cause-and-effect relationships are not fully established scientifically.

### **4. Equity**

- Addressing the fair distribution of environmental benefits and burdens across different social groups and generations

# **NATURAL RESOURCES:**

**What are the special  
characteristics and  
typology?**

The **NATURAL RESOURCES** have *special characteristics*:

- **Public Good:** They often exhibit the characteristics, which means they cannot be excluded from use (No-Exclusion) and one person's use does not reduce its availability for others (No-Rivalry).
- There can be external effects (externalities) during their production or consumption.

*The field of Natural Resources encompasses a wide range of disciplines due to the unique characteristics of each resource. While there is a vast diversity in approaches and subjects, ENRE (Economics of Natural Resources and the Environment) provides a cohesive conceptual and methodological framework that brings consistency to the field. As environmental challenges arise, there's an increasing need to define criteria for the sustainable and efficient use of resources over time.*

# EXAMPLES OF PUBLIC GOODS:

1. **Clean Air:** *Clean air is a good that everyone enjoys, and one person's use of it does not prevent another from doing so. Additionally, it's challenging to exclude someone from breathing clean air.*
2. **Sunlight:** *Sunlight is accessible to all and is not diminished by one person's use. One person sunbathing in a park doesn't prevent another from doing the same.*
3. **Open Oceans and Seas:** *While specific parts of the oceans might be regulated or claimed by countries, the oceans in general are accessible to all and are not "used up" or diminished by use.*
4. **Biodiversity:** *The variety of life on Earth, in all its forms and interactions, is something everyone can value and appreciate, and one person's mere appreciation doesn't reduce another's ability to do the same.*
5. **Ozone Layer:** *It protects the Earth from harmful ultraviolet rays. All living beings benefit from its protection, and one individual benefiting from it doesn't diminish it for others.*

## (MICROECONOMICS) APPROACH OF ENRE/EE

**Microeconomics:** This branch of economics focuses on the **behavior of individual agents**, such as consumers, producers, and firms, and how they make decisions about the **allocation of limited resources**. It examines supply, demand, pricing, elasticity, and other concepts that explain individual and firm-level behaviors in markets.

The "Microeconomics Approach of ENRE" uses the tools and principles of microeconomics to understand and address issues related to the environment and natural resources at the level of individual decision-makers and firms. It offers insights into how individual behaviors contribute to larger environmental issues and how policy interventions can influence these individual choices for better environmental outcomes.

## (MICROECONOMICS) APPROACH OF ENRE

To determine and to fundament the criteria underlying **the optimal exploitation** of the resources.

Normative Discipline: **establish the optimal referential to compare** with the concrete situations and identify eventual distortions subject of corrective intervention of public policy.

To explain the **agents behavior** facing the production and use of the resources in different market structures; To establish typologies of representative behavior in different institutional framework.

To identify the **policies that allow to motivate the agents** to develop the efficient management of the resources >>>>REGULATION.

# NATURAL RESOURCES AND CAPITAL THEORY

NATURAL CAPITAL - The concept behind natural capital is to **recognize nature's role in delivering economic value**. Just as with other forms of capital (like human capital, social capital, or manufactured capital), **natural capital can be invested in, depleted, and can yield dividends in terms of ecosystem services**.

## A TYPOLOGY OF NATURAL RESOURCES:

*“Natural resources could refer to all the living and nonliving endowment of the Earth”*,  
HOWE (1979)

- 1. Renewable Natural Capital:** These are elements of nature that can replenish or regenerate over time if managed sustainably, such as forests, fish stocks, and clean water.
- 2. Non-renewable Natural Capital:** These are elements that are finite and cannot be replaced once they are extracted or consumed, such as fossil fuels or mineral deposits.

# Natural Regeneration capacity x Exploitation rate

Over-exploiting a resource faster than it can regenerate can lead to its depletion, affecting both ecosystems and human livelihoods.

Balancing Act:

- **Sustainability Equilibrium:** For a resource to be used sustainably, the water entering the tub (regeneration) should, on average, match the water leaving the tub (exploitation). If they balance, we achieve sustainability.
- **Over-exploitation:** If the drain lets out water faster than the tap fills it, the tub (or resource) will eventually run dry. This represents resource depletion due to over-exploitation.
- **Under-exploitation:** Conversely, if the tap fills the tub faster than the water is drained, the tub will overflow. While this rarely poses a problem with natural resources, in some cases, under-utilization can lead to other challenges, such as overgrowth or imbalances in ecosystems.

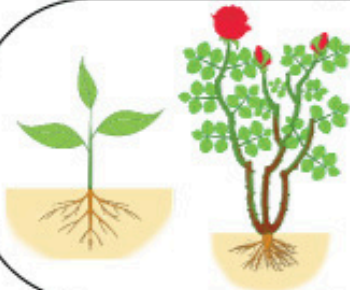
# Types of Natural Resources

## Renewable Resources

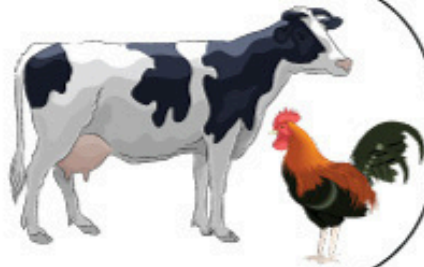
Sun



Plants



Animals

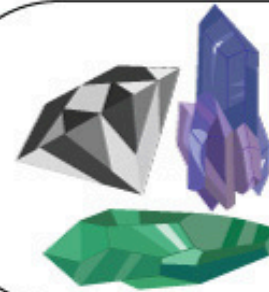


Water



## Non-renewable Resources

Minerals



Soil



Coal



Natural gas



Every renewable resource must be used at or below the rate at which it can regenerate itself.

Every non-renewable resource must be used at or below the rate at which a renewable substitute can be developed.

# BASIC MODEL OF A RENEWABLE NATURAL RESOURCE MANAGEMENT

Example: Forests or Fisheries

## ISSUES:

What reasons explain the excessive exploitation of the resources? Is it an inevitability?

What specific characteristics of the market operation do justify the situation?

The “Invisible Hand” doesn't work? What reasons explain that the market, in conditions of free competition, does not reach a socially efficient solution?

Which is the influence of the decision and property regime?

Which is the optimal level of resource use along the time?

Should the State regulate the market? How? Advantages/disadvantages of the regulation alternatives?

# EXTERNALITIES

## Definition - BAUMOL and OATES (1975)

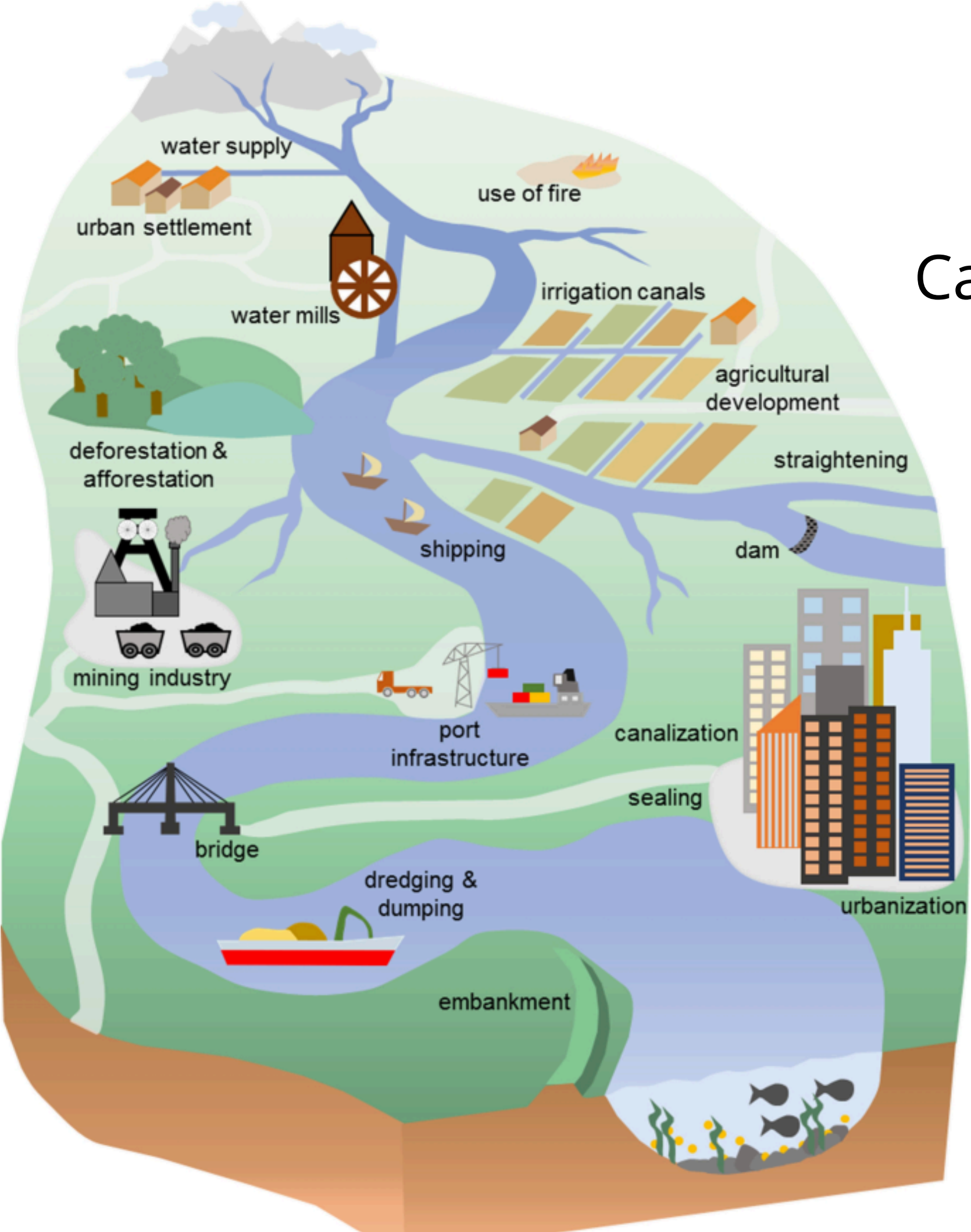
An externality is present whenever some individual's utility or production relationships include real variables, whose values are chosen by others (persons, corporations, government) **without particular attention to the effects on his welfare.**

The decision maker, whose activity affects others' utility levels or enters their production functions, **does not receive (pay) in compensation for this activity** an amount equal in value to the resulting (marginal) benefits or costs to others.

# EXTERNALITIES : TYPOLOGIES

- **Positive Externalities** (External Benefits): Occur when the actions of an individual or firm benefit others without providing compensation for them. For example, a beekeeper who maintains hives for honey production ends up benefiting a neighboring farmer whose apple trees are pollinated by the bees. This process increases the orchard's productivity at no cost to the farmer.
- **Negative Externalities** (External Costs): Occur when the actions of an individual or firm impose costs on others without compensating them. A classic example is a factory emitting pollution, negatively affecting the health of nearby residents.





Can you identify the Externalities?



Now, think globally!

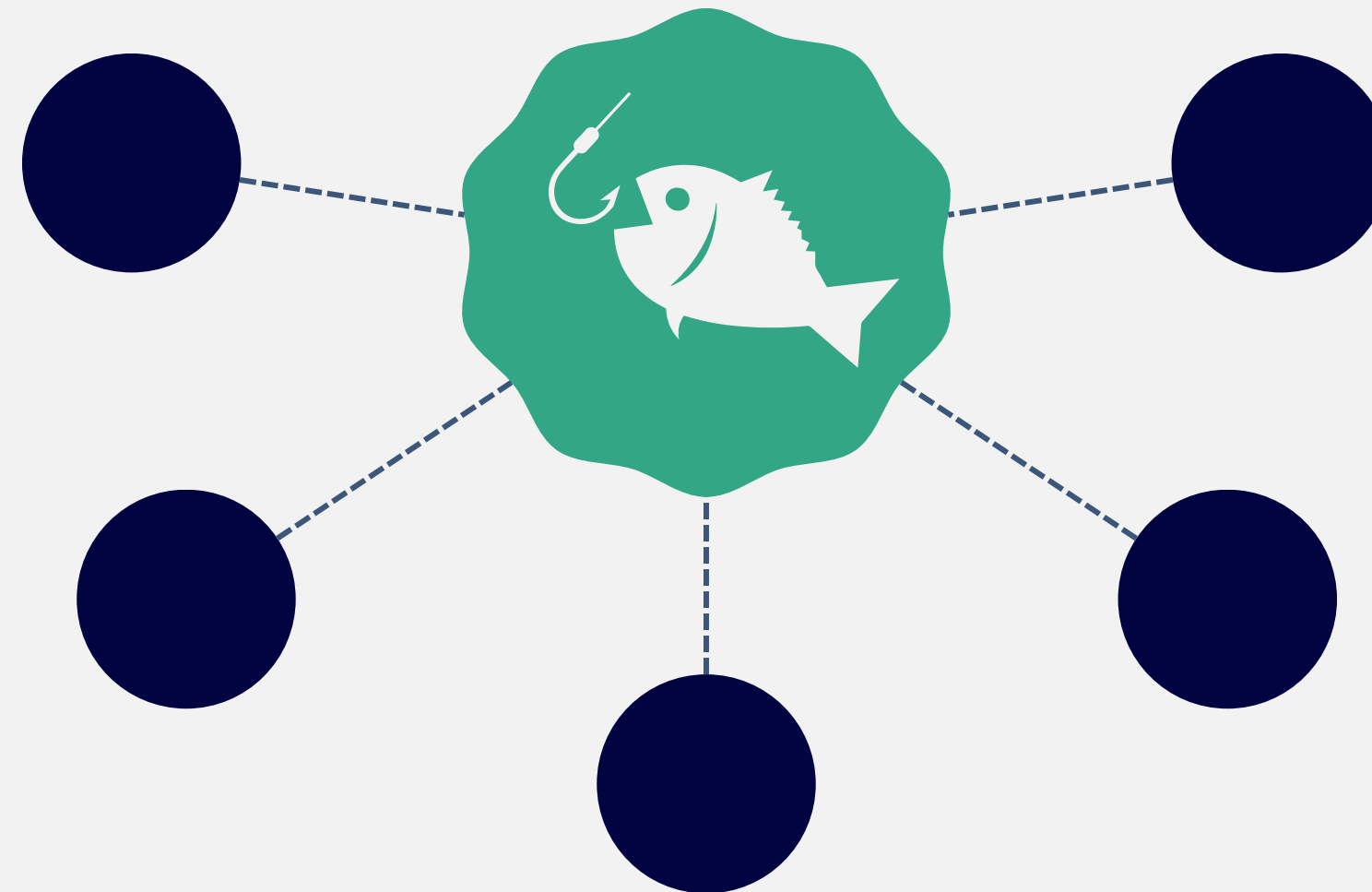
# CASE: FISHERIES

## Interdependence (in the MEADE sense)

stakeholders should **coordinate their economic policies** to account for these international spillover effects, ensuring global economic stability.

## Stock Externalities

When a fisher overexploits a shared fish stock, it **reduces the future population and potential catch for all** other fishers, leading to long-term resource depletion and reduced profitability for the entire fishing community.



## Crowding externalities

The presence of numerous fishers in a confined space can also **increase operational costs, conflicts, and risks, diminishing the overall efficiency** and profitability of the fishing activity.

## “Ownership Externalities” (BATOR) - Not-paid Factor

the **absence of well-defined property rights** or the inability to enforce them leads to inefficiencies in the market.

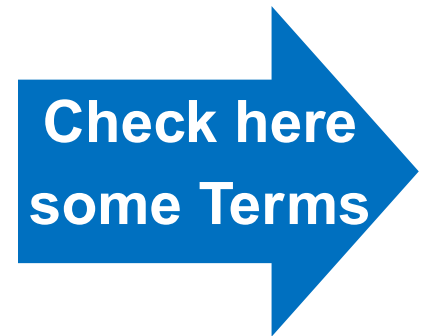
## net Externalities

net-size externalities in fisheries refer to the external impacts arising from the choice of net size used by fishers. **The size of the net in fishing determines the size and age of fish that are caught.**

# EXTERNALITIES (negative) in FISHERIES

Two consequences:

Divergence between private marginal cost and social marginal cost >>>> Market equilibrium is not Pareto-optimal - **the market doesn't lead to the most efficient allocation of the resources.**



Each firm convinced that the others, in the aim of larger captures, do not adopt any conservation measures, has **no** motive to develop a sustainable management of the resource.

**“Prisoner Dilemma”**: The dilemma describes a situation where two individuals, acting in their own self-interest, fail to produce the optimal outcome for both, illustrating the conflict between individual and collective rationality.

**TRAGEDY OF THE COMMONS** (Hardin, 1968) : illustrate the potential negative outcomes when individuals act solely based on their self-interest without considering the broader community or environment.

## Step 1

- Private marginal cost (PMC) → what it personally costs a company or person to produce one more unit of something (e.g., one more car, one more burger).
- Social marginal cost (SMC) → what it **really costs society** as a whole to produce that same unit — including hidden side effects like pollution, health impacts, or traffic.

## Example

Imagine a car factory:

- The factory pays for materials, workers, and electricity. **That's its private cost.**
- But it also pollutes the air, causing health problems and climate damage. Those are **extra costs paid by society** — not by the factory.
- So the social cost is higher than the private cost.

## Step 2 – Why this matters?

If the factory ignores pollution (because it doesn't pay for it), it will produce more cars than what's best for society.

That's because, for the factory, it seems profitable to make more — but from society's point of view, each extra car causes more harm than benefit.

## Step 3 – The “market equilibrium” part

In a free market, prices and production levels are determined by **private costs and private benefits** — not by social ones.

So, when private and social costs diverge, the market equilibrium (where supply meets demand) is not socially efficient.

## Step 4 – What “not Pareto-optimal” means

“Pareto-optimal” just means that you can't make anyone better off without making someone else worse off.

But here, if the government or someone made the polluter pay for the damage (for example, a pollution tax), society would be better off without hurting anyone unfairly — meaning the current situation is not Pareto-optimal.

**How can we solve this  
problem?**

WITH PROPERTY RIGHTS

# COMMON PROPERTY

**Free Access** - Property rights/Rights of use of the resources non-exclusive and non-transferable; rights possessed in common but free access for all; “property of anybody”; res-nullius.

**State Property** - Ownership and management control of the State; res-publica.

**Communal Property** - Use rights controlled by an identifiable group; Cooperative policies; System of resources management of community basis; “true” common property; res-communes. BROMLEY (1991)

COASE (1960) <<<<<<Property Rights Theory >>> COASE versus PIGOU

**ELINOR OSTROM** >>> THE “DRAMA” of the Commons?

“Co-management”

# Class Activity: “Oil, Growth, and the Amazon – What’s the Real Cost?”

Apply the key concepts from Economics of Natural Resources and the Environment to a real-world case: Brazil’s decision to allow oil exploration off the Amazon coast. Evaluate the **trade-offs** between **economic development** and **environmental protection**, using theory to justify their reasoning.

**Externalities:** Identify potential externalities (positive & negative). Who bears the costs and who benefits?

**Resource Typology:** Is oil a renewable or non-renewable resource? What are the implications for intergenerational equity?

**Property Rights:** Who “owns” the environmental risk? Are property rights clear enough to internalize externalities?

**Finally:**

- Identify **Pros** of the project;
- Identify **Cons** of the project;

# PILLARS OF ECONOMIC THEORIES

Some common pillars that form the foundation of major economic theories

<b>The Law of Supply and Demand</b>	The law of supply and demand is a fundamental pillar of economic theory, as it explains how the prices of goods and services are determined in the market based on the interaction between supply and demand.
<b>Utility Principle</b>	Utility refers to the satisfaction or well-being that people derive from consuming goods and services. Economic theory assumes that individuals seek to maximize their utility given budget constraints.
<b>Incentives</b>	Incentives refer to the rewards and punishments that people receive for their actions and choices, which can influence human behavior and economic decisions.
<b>Opportunity Cost</b>	Opportunity cost refers to the cost of forgoing one alternative in favor of another.
<b>Scarcity</b>	The principle of scarcity indicates that resources are insufficient to produce all the goods and services that meet people's needs, and prices are used as a tool to facilitate transactions.

# PILLARS OF ECONOMIC THEORIES CONNECTED TO SUSTAINABILITY

## Incentives

They refer to the rewards and punishments that people receive for their actions and choices, and they can influence human behavior and economic decisions.



**Incentives** can be connected to sustainability by using economic tools to reward sustainable behavior and **penalize unsustainable** practices. Examples include taxes, subsidies, permits, green bonds, and certification programs.



The principle of scarcity indicates that **resources are insufficient** to produce all the goods and services needed to satisfy people's needs, and prices are used as a tool to facilitate transactions.

## Scarcity

**Resource scarcity** necessitates sustainable use, as overuse or depletion of resources leads to scarcity and negative externalities, such as pollution or ecosystem degradation.


**ADDRESSING SUSTAINABILITY CHALLENGES REQUIRES  
MORE THAN JUST ECONOMIC TOOLS.**

**—IT ALSO DEMANDS A DEEPER UNDERSTANDING OF HOW WE  
PERCEIVE AND MANAGE NATURAL AND ECONOMIC CAPITAL.**

# CONCEPTS OF SUSTAINABILITY

## Weak sustainability


This concept is based on the idea that **natural capital** (resources provided by nature) can be replaced by **man-made capital** (human-made resources and technologies). Proponents of weak sustainability, often mainstream neoclassical economists, argue that as long as the total capital stock (natural + man-made) is maintained, sustainability is achieved



it may lead to the degradation of irreplaceable natural resources and ecosystems. It tends to favor short-term economic gains over long-term ecological health.

- **Replaceability:** Weak sustainability relies on the idea that natural resources can be substituted by human-made capital. For example, if a forest is cut down, the economic value derived from the timber can be used to invest in other forms of capital, such as infrastructure or technology, which can provide similar benefits.
- **Total Capital Maintenance:** The focus is on maintaining or increasing the total stock of capital (natural and human-made) over time. This means that as long as the overall capital stock does not decrease, the depletion of natural resources is considered acceptable.
- **Economic Efficiency:** Weak sustainability often aligns with economic efficiency, where market forces determine the optimal allocation of resources. This approach assumes that technological advancements and human ingenuity can compensate for the depletion of natural resources.

- **Substitutability:** Argues that certain natural resources and ecosystem services are irreplaceable and must be preserved. This approach emphasizes the non-substitutability of critical natural capital and the need to maintain ecological integrity.
- **Total Capital Maintenance:** Imposes strict limits on the use of natural resources to prevent irreversible damage and ensure the resilience of ecosystems. It emphasizes the preservation of natural capital and often involves setting safe minimum standards for resource use.
- **Economic Efficiency:** Policies focus on conservation and sustainable use of natural resources, often incorporating ecological thresholds and resilience thinking. This approach may use multi-criteria analysis (MCA) to account for ecological and social factors in decision-making.



This approach is seen as more robust in addressing the ecological limits and ensuring the resilience of natural systems. It is considered essential for protecting biodiversity and mitigating climate change

### Strong Sustainability

In contrast, strong sustainability posits that natural capital **provides essential services** that cannot be replaced by man-made capital. It emphasizes the need to **maintain certain physical aspects of ecological systems intact**, recognizing the **limits to substitution** and the importance of preserving natural capital for future generations

## Key Differences:

Aspect	Weak Sustainability	Strong Sustainability
<b>Substitutability</b>	High substitutability between natural and man-made capital	Low or no substitutability; natural capital is irreplaceable
<b>Focus</b>	<u>Economic growth and technological solutions</u>	Ecological preservation and resilience
<b>Approach</b>	Market-based, individualistic solutions	<u>Collective, community-based approaches</u>
<b>Examples</b>	Using technology to replace natural functions (e.g. water purification systems)	Protecting natural ecosystems to maintain their functions (e.g. wetlands for water purification)
<b>Policy Implications</b>	Supports policies that promote economic development and technological innovation	<u>Advocates for policies that protect and restore natural ecosystems and biodiversity</u>

## **THESE DIFFERENCES HAVE IMPLICATIONS:**

- **FOR ENVIRONMENTAL IMPACT ASSESSMENT AND**
- **ECONOMIC DECISION-MAKING**

**PARTICULARLY IN THE CONTEXT OF ADDRESSING ENVIRONMENTAL DEGRADATION AND ENABLING ORGANIZATIONS FOR ENVIRONMENTAL SUSTAINABILITY.**

## CONCEPTUAL FRAMEWORK OF ENRE (RESUME):

1. **Sustainability:** Ensuring resource use today doesn't compromise future generations' ability to meet their needs.
2. **Externalities:** Costs or benefits of an economic activity that affect third parties not directly involved in the transaction.
3. **Public Goods:** Goods that are non-excludable and non-rivalrous.
4. **Common Property Resources:** Resources accessible to all members of a society, leading to potential overuse (e.g., open fisheries, common grazing lands).
5. **Property Rights:** The rights individuals or groups have to use and benefit from resources.
6. **Marginal Cost and Benefit:** Evaluating the additional costs and benefits of consuming or producing one more unit.
7. **Discounting:** The method of comparing the value of future costs and benefits to present values.