



EE475 Natural Resource Economics

Economic Frameworks and Natural
Resource Problems (1):

Public Goods and the Commons

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Outline

- ▶ Problems of Public Goods
- ▶ Problems of Common-pool resources: Tragedy of the Commons

Typology of Goods and Services in Economics

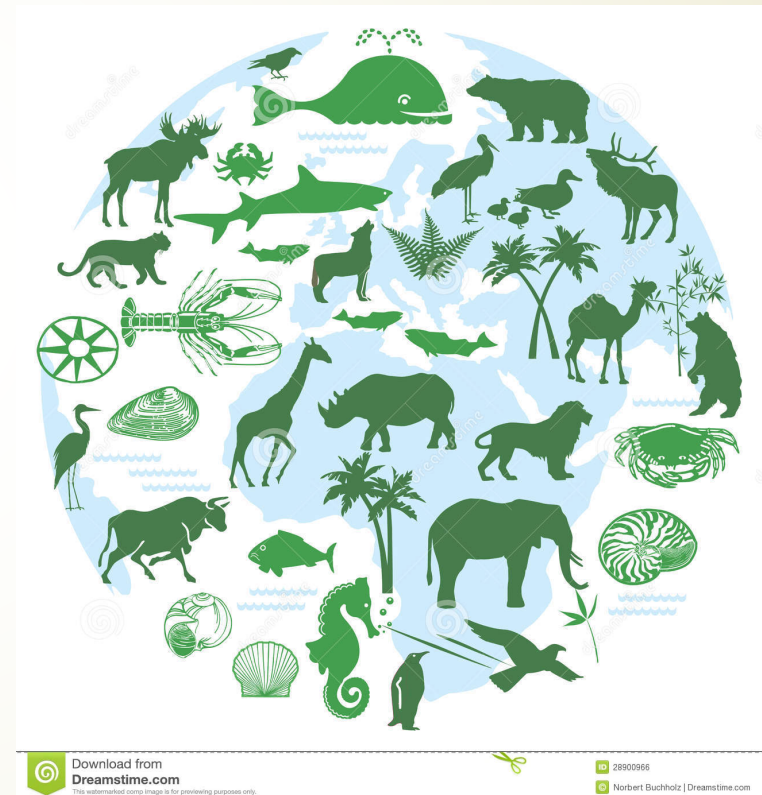
Excludability		Non-Excludability (or difficult to exclude)
Rivalry (Subtractability)	Private Goods	Common-pool resources
Non-rivalry (Non-subtractability)	Club goods (Toll goods)	Public goods

Market failure: Public Goods

- ▶ Public Goods are goods and services with the following characteristics:
 - ▶ *Non-excludability* refers to a circumstance in which the resource is provided, even those who fail to pay for it cannot be excluded from enjoying the benefits it confers.
 - ▶ *Non-rivalry* (non-divisibility/non-subtractable) refers to a circumstance when one person's consumption of a good does not diminish the amount available for others.

Market failure: Public Goods

- ▶ Example:
- ▶ Biological Diversity
 - ▶ The amount of genetic variability among individuals within a single species (**Genetic Diversity**)
 - ▶ The number of species within a community of organisms. (**Biological Diversity**)



Market failure: Public Goods

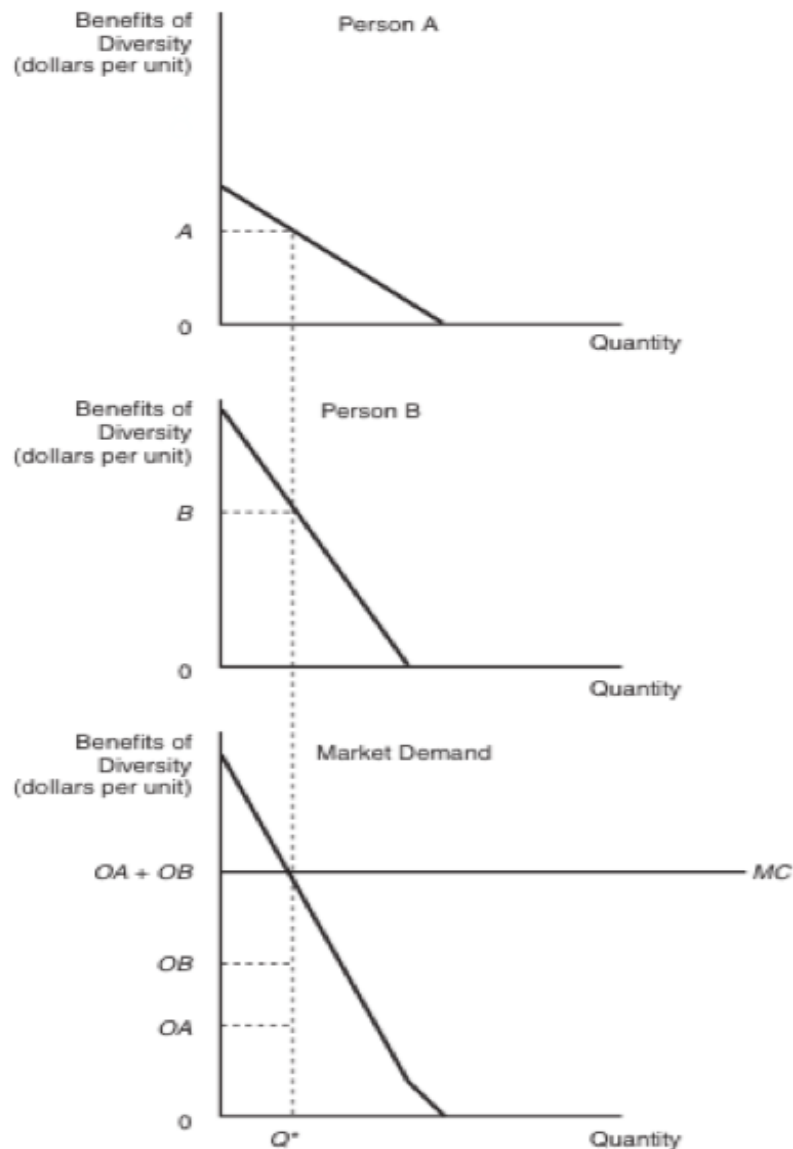


See "How wolves change rivers"
<https://www.youtube.com/watch?v=ysa5OBhXz-Q>

- Genetic Diversity
 - Critical to species survival in the natural world
 - Important in the development of new crops and livestock
- Diversity of species within a community of organisms
 - Contribute to balance and stability to their ecological communities by providing food sources or holding the population of the species in check
 - Provide new sources of food, energy, industrial chemicals, raw materials, and medicines.

Can we rely on the private sector to produce the efficient amount of public goods, such as biological diversity?

FIGURE 2.7 Efficient Provision of Public Goods



Efficient Provision of Public Goods

- ▶ How are the demands for public goods combined into a market demand ?
- ▶ Where is the efficient level of biodiversity diversity provision ?
- ▶ How should the biodiversity be priced?

Source: Tietenberg & Lewis (2012) p. 32

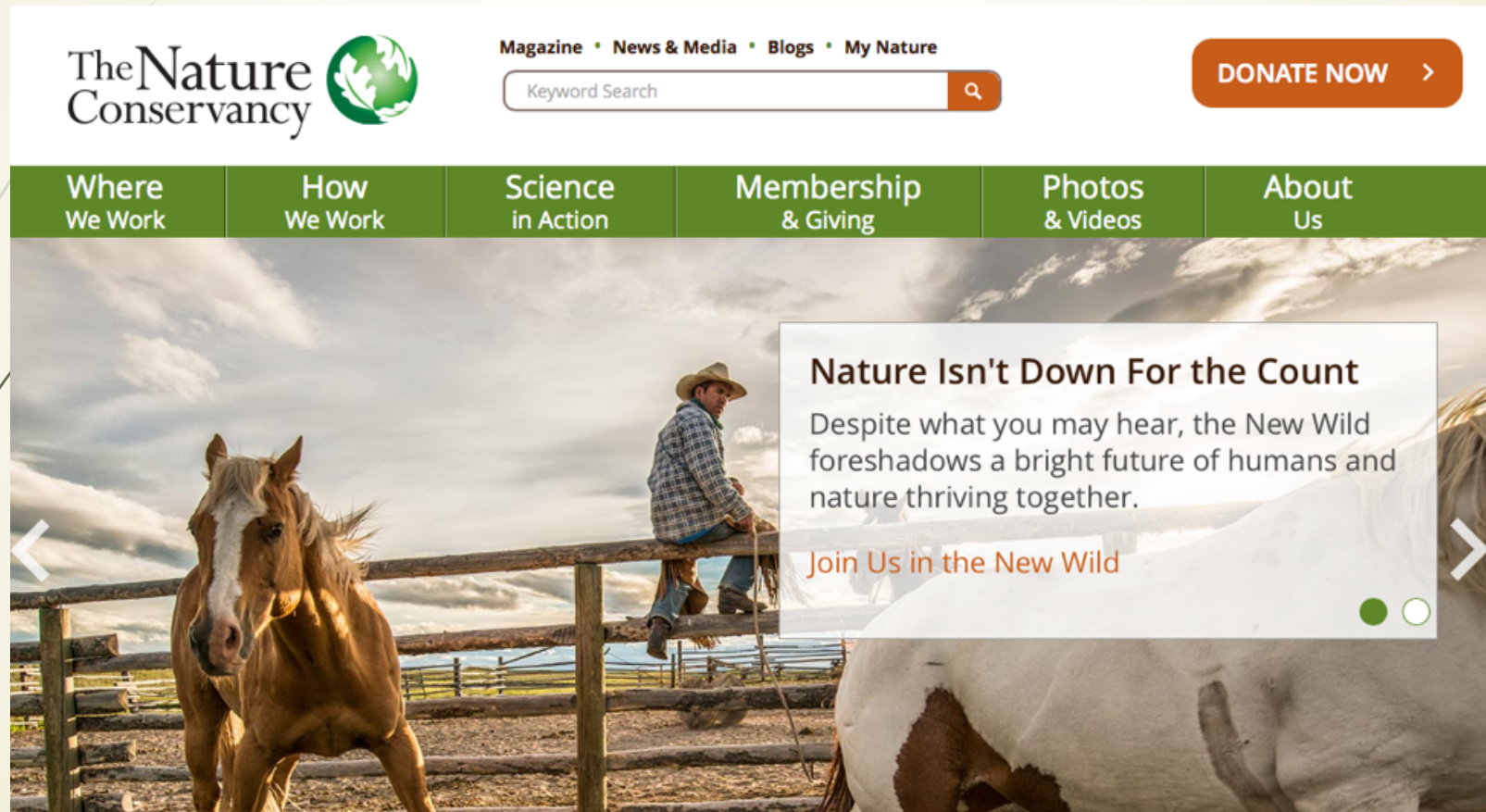
Market failure: Public Goods

➤ Public Goods problems

- **Difficulty in pricing:** because the consumers get very different marginal willingness to pay from the efficient level of provision, the efficient pricing system would require charging a different price to each consumer.
- **Understate the strength of consumers' preference:** All consumers have an incentive to understate the strength of their preferences to try to shift more of the cost burden to the other consumers.
- **Free Rider:** Someone who derives the value from a commodity without paying an efficient amount for its supply. Because of the characteristics of public goods, consumers receive the value of any of the goods purchased by other people.

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Example: public goods provided by private sector



Example: public goods provided by private sector

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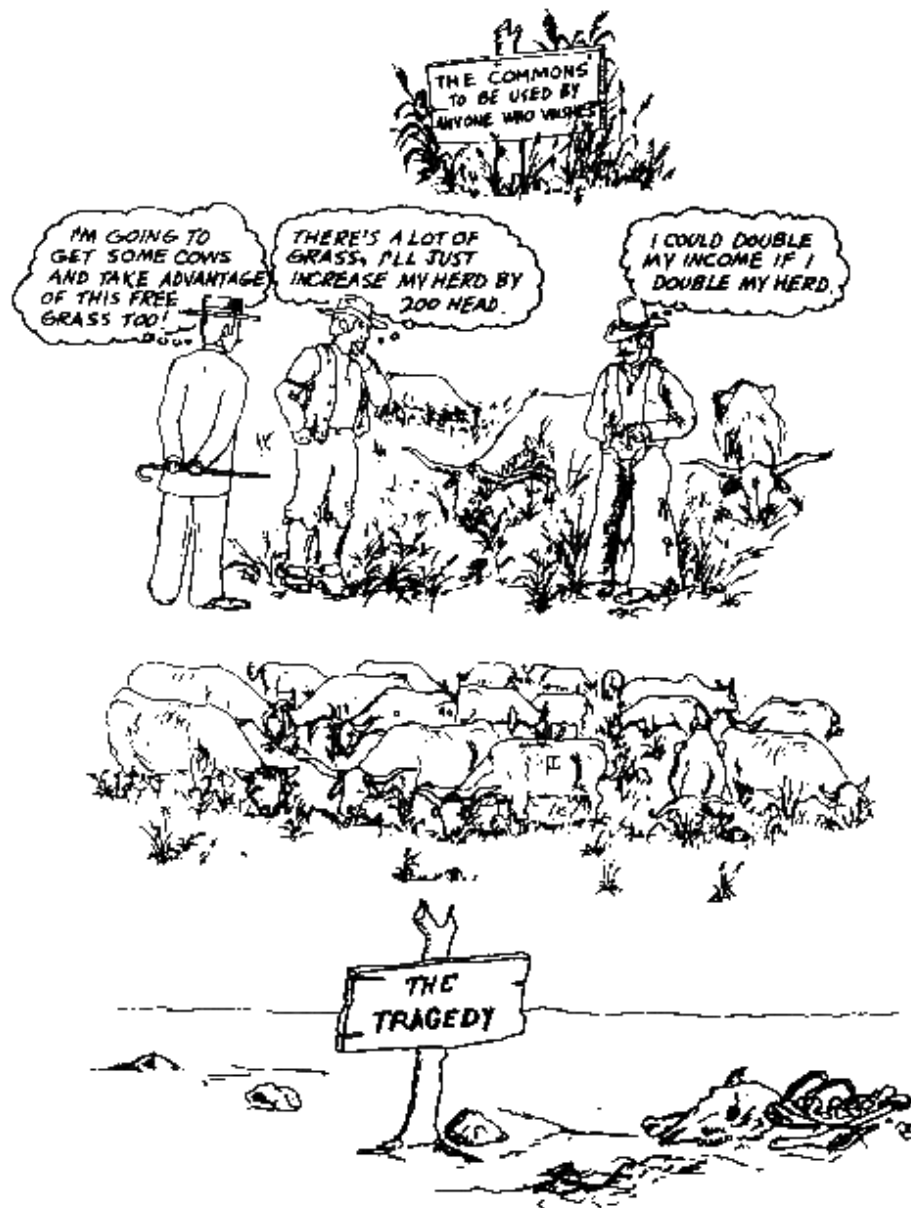


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Source:
<http://www.nature.org>

Typology of Goods and Services in Economics

Excludability		Non-Excludability (or difficult to exclude)
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Traditional Belief on Natural Resource Conservation

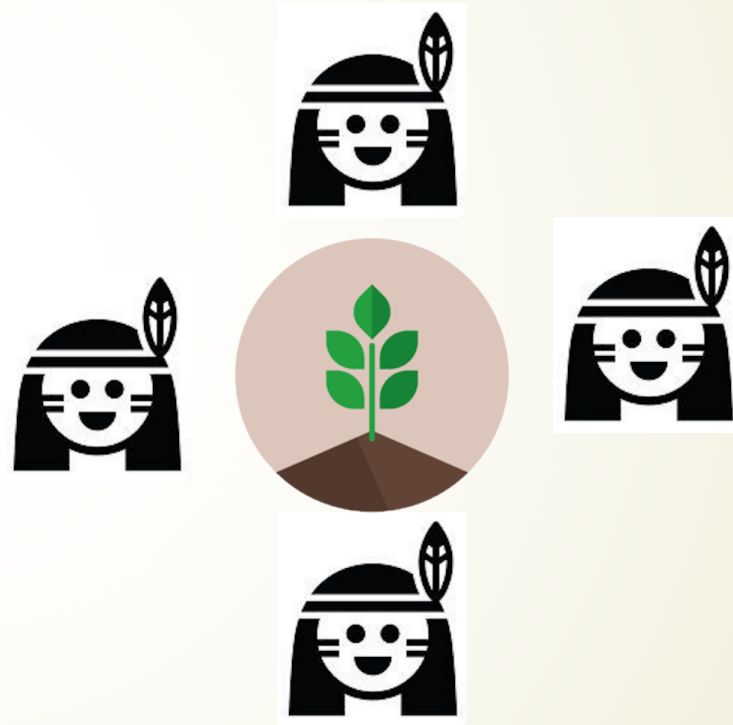
- **The Tragedy of The Commons**
 - If resource users are allowed to appropriate/harvest the resources freely, natural resources would be depleted.

Hardin, G. J. (1968). The Tragedy of the Commons. *Science* (Vol. 162).

Traditional Belief on Natural Resource Conservation

Indigineous and local people can no longer use the natural resources on which their lives depend.

NO ENTRY



Traditional Belief on Natural Resource Conservation



- **National park/Wildlife sanctuary** – Put the resources under state property rights, prevent people from entering and using the resources.

- **Solutions?**

- **Private Concession** – Put private property rights over the resources and let private sector take care and benefit from the resources



What do you think?

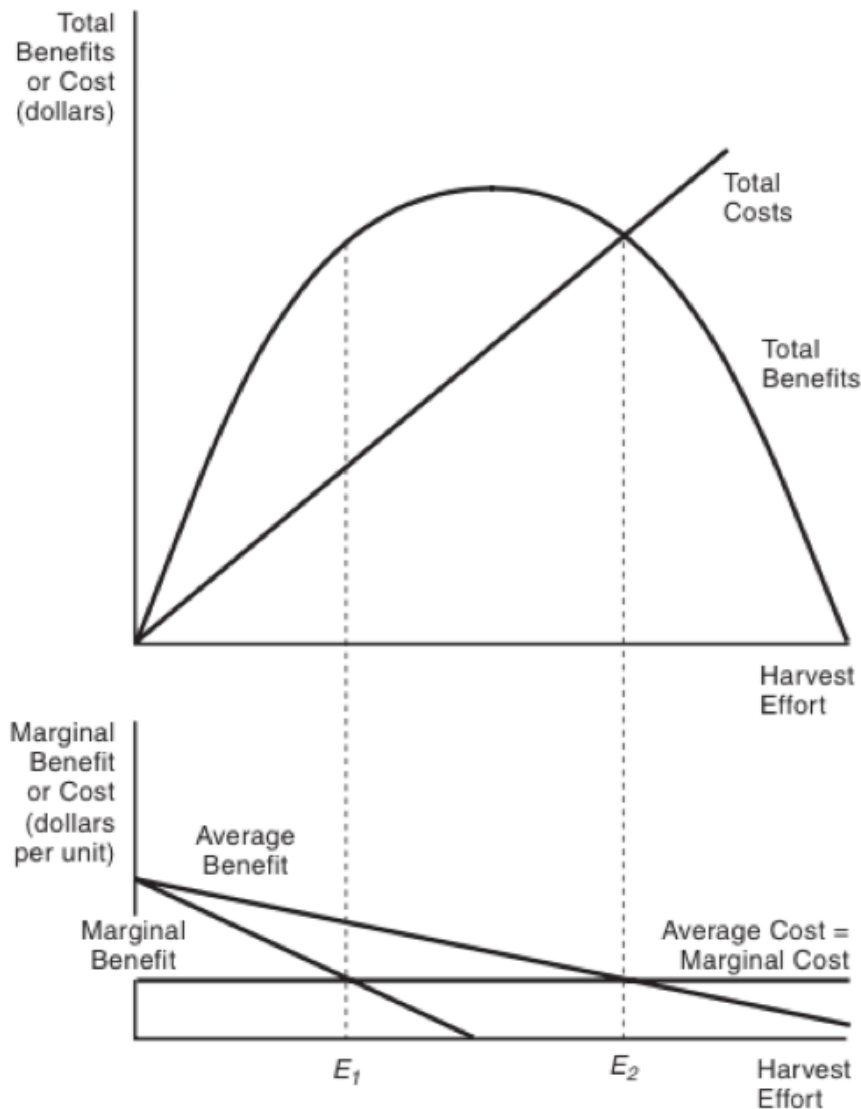
- ▶ Do you agree with “The Tragedy of The Commons”?
- ▶ Do you think that the commons will always be depleted if resource users are allowed to use the resource without control from the government or without ‘private property rights’?
- ▶ How can we explain this phenomenon? .

Tragedy of the commons in the case of Bison in the North America :



- ▶ Comparing effects of private property and open-access regime

FIGURE 2.6 Bison Harvesting



Tragedy of the commons in the case of Bison in the North America :

- Assumption
 - Price of Bison is constant.
 - Marginal Cost is constant.
- **The marginal revenue (benefit)** curve is downward sloping (despite the constant price) because as the amount of hunting effort increases, the resulting bison population size decreases. Smaller populations support smaller harvests per unit of effort expended.

Analysis of the Tragedy of the Commons using Prisoner's dilemma game

- ▶ Hardin's model is formalized as a prisoner's dilemma game (Dawes 1973, 1975)

The Game

- ▶ This is a **2-person game**.
- ▶ Players are herders using a common grazing meadow.
- ▶ There is an upper limit to the number of animal that can graze on the meadow for a season and be well fed at the end of the season. (**Carrying capacity of the meadow**) = L

Analysis of the Tragedy of the Commons using Prisoner's dilemma game

- ▶ “Cooperate” strategy: grazing $L/2$ animal for each herder.
- ▶ “Defect” strategy: grazing as many animals as he thinks he can sell at a profit, given his private costs, and assuming that this number is greater than $L/2$

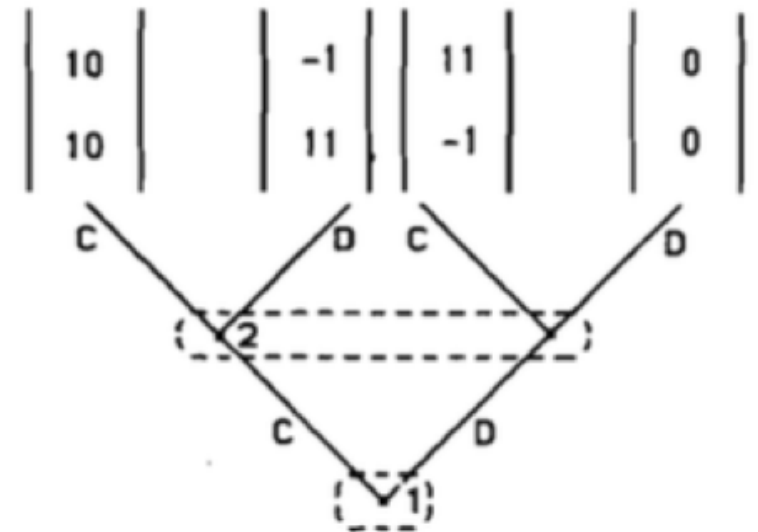


Figure 1.1. Game 1: The Hardin herder game.

Source: Ostrom (1990), p.4

Analysis of the Tragedy of the Commons using Prisoner's dilemma game

➤ *Noncooperative game*

- All players possess complete information.
- Communication among the players is forbidden or impossible or simply irrelevant.
- If communication is possible, verbal agreements among players are presumed to be nonbinding unless the possibility of binding agreements is explicitly incorporated in the game structure.

Analysis of the Tragedy of the Commons using Prisoner's dilemma game

- ▶ *"Dominant Strategy"* - to defect
 - ▶ What is dominant strategy?
 - ▶ Why is it defect the dominant strategy?
- ▶ Which branch of the game tree would be the result of this game?
- ▶ Which branch of the game tree is preferable the most?

Analysis of the Tragedy of the Commons using Prisoner's dilemma game

- ▶ Paradox: "Individually rational strategies lead to collectively irrational outcomes."

"Quite simply, these paradoxes cast in doubt our understanding of rationality and, in the case of the Prisoner's Dilemma suggest that it is impossible for rational creatures to cooperate. Thus, they bear directly on fundamental issues in ethics and political philosophy and threaten the foundations of the social sciences. It is the scope of these consequences that explains why these paradoxes have drawn so much attention and why they command a central place in philosophical discussion"

Richmond Cambell (1985) p.3

Paradoxes of Rationality and Cooperation

Source: Ostrom (1990), p.5

Nobel Prize in Economics



"for her analysis of economic governance, especially the commons"

- Ostrom proposed that resource users can cooperate, manage, and use natural resources sustainably, under certain conditions.
- Her work is supported by several case studies of long-lasting community-based natural resource management (CBNRM) around the world.
- The tragedy of the commons is falsified. CBNRM is supported.

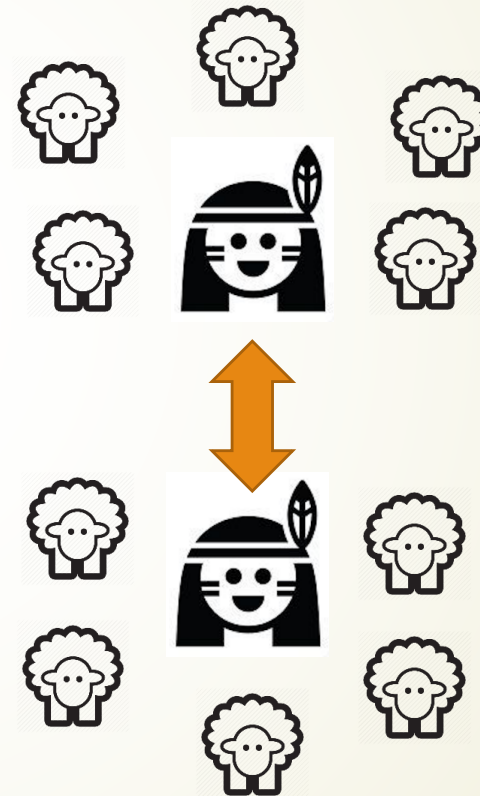
Ostrom's Explanation

- The Tragedy of the Commons is based on assumptions of **the Prisoner's Dilemma Game**.
- Basically, 2 prisoners are interrogated in 2 different rooms and cannot communicate.
- The best choice is to not confess. **But both of them is not sure if the other would do the same.** If the other confess and he does not, he would be jailed for a long time.
- So both of them would **decide to confess** and be jailed for a shorter period of time, which is the second-best outcome.



Ostrom's Explanation

- The Tragedy of the Commons hypothesis uses the same assumption as the Prisoner's Dilemma – The resource users cannot communicate and thus not cooperate.
- **However, in several areas of the world, resource users live in community and everyone knows and related to each other in some ways.** Therefore, the assumption is not applied.
- There are cases that prove that resource users can cooperate and formulate a set of rules to manage natural resources.



The Design Principle



A "**design principle**" is common characteristics found in rule-in-use of several cases of long-standing community-based natural resource managements. The users may be concious or unconscious about the principle.

The Design Principles

1) Clear Boundaries – in terms of resources and beneficiaries

2) Congruence with local conditions – both social and ecological conditions

3) Collective-Choice Arrangement – all stakeholders are involved in rule drafting and changing process.

4) Monitoring – users' behavior and resource conditions are monitored.

5) Graduated Sanction – First-time violation is not punished or punished mildly. Sanction severity will increase once the violation is repeated.

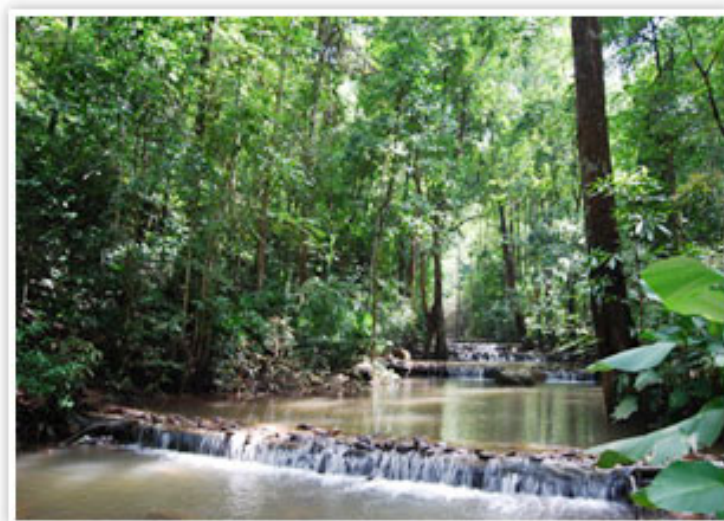
6) Conflict resolution mechanism – the mechanism is accessible, efficient and affordable.

7) Minimal recognition of rights by the state

8) Nested enterprises – local governance is connected with broader systems.

Example: Traditional irrigation ditch (ระบบเหมืองฝาย)

- Traditional irrigation ditch systems have been used in the North of Thailand for more than (300) years.
- Communities cooperate to take care of waterway and negotiate the distribution of water for agriculture between communities along the waterway.
- The system was replaced by state irrigation system and changed back to the traditional system in some areas because it is more efficient.



Example: Community Forest (ป่าชุมชน)



- Community forests are widespread in Thailand in the North, Northeast, and South.
- Rules-in-use is different from community to community, and integrated with local culture and traditions.
- The community takes care of the forest because they benefit from non-timber forest products such as mushroom, honey,

Example: Coastal Resources Management

- In Thailand, community-based coastal resource management is quite advance. Hundreds of communities along the coast of Andaman sea and Thai gulf have formed a network protecting coastal resources from exploitative commercial fishing fleets.
- They also manage other coastal resources such as mangrove forest, dolphins and dugon dugong.

