AE 503

THE "TRAGEDY OF THE COMMONS"

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THE PROBLEM

- **If property rights are ill-defined, it can result in market inefficiencies**

- **A well-known example of such a problem is the so-called "tragedy of the commons"**

- **This problem arises where the law on property rights is either ambiguous or non-existent:**

  - ☞ **excessive fishing in international waters**

  - ☞ **extinction of species such as whales due to over-hunting**

  - ☞ **over-grazing of common land**

- **Imagine a body of water that derives its value from the marine life it sustains, in particular the fish it contains are non-migratory in nature**

- **Nobody actually owns the fishing ground, it is in open sea in *international waters* - everyone has an equal right to fish in the area - *open access***

- **The fish population is *self-renewable* if the population is large enough - if it gets below a *threshold* level, the chances of a species surviving are diminished**

- **The *rate of catch* is crucial in determining whether a species is *endangered***

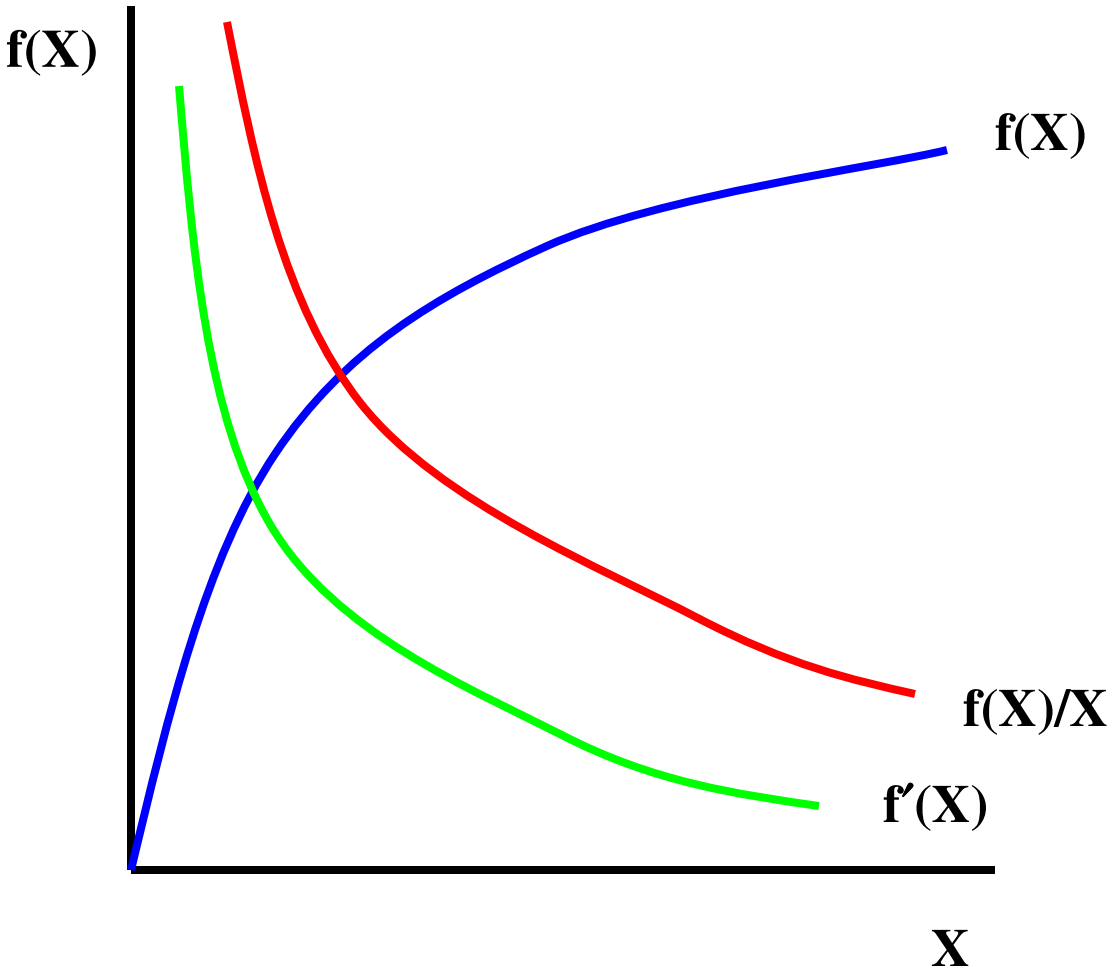
- **To understand the problem, need to compare what happens if fishing ground has open access vs. private ownership**

- **Suppose fishing is treated as a production activity where the variable input is fishing vessels, X, so the total catch Y from a fishing ground of size S is:**

$$Y = f(X, S)$$

- **The total catch Y exhibits diminishing marginal returns as number of vessels X increases**

- **This reflects fact that the fishing ground is fixed in size - as the number of vessels increases, there is an overcrowding effect**



f(X) = total product

f(X)/X = average product

f′(X) = marginal product

X	f(X)	f(X)/X	f′(X)
1	100	100	100
2	180	90	80
3	240	80	60
4	280	70	40
5	300	60	20

Rental cost per vessel is $60

Price of fish is $1/fish

- **Suppose that it costs p dollars to rent a fishing vessel**

- **The amount of fish a vessel can catch depends on how many other vessels are at the fishing ground**

- **For simplicity, assume that the price of fish = 1 so f(X) is the *total value of the catch* from the fishing ground (total revenue)**

- **Hence, if there are X vessels in the sea, the *value of the catch per vessel* is just average product f(X)/X (average revenue)**

- **Suppose the fishery were in *private ownership*, i.e. there is one person who owns the area of sea, so they can decide on how many vessels to allow in**

- **The owner will want to maximize profits:**

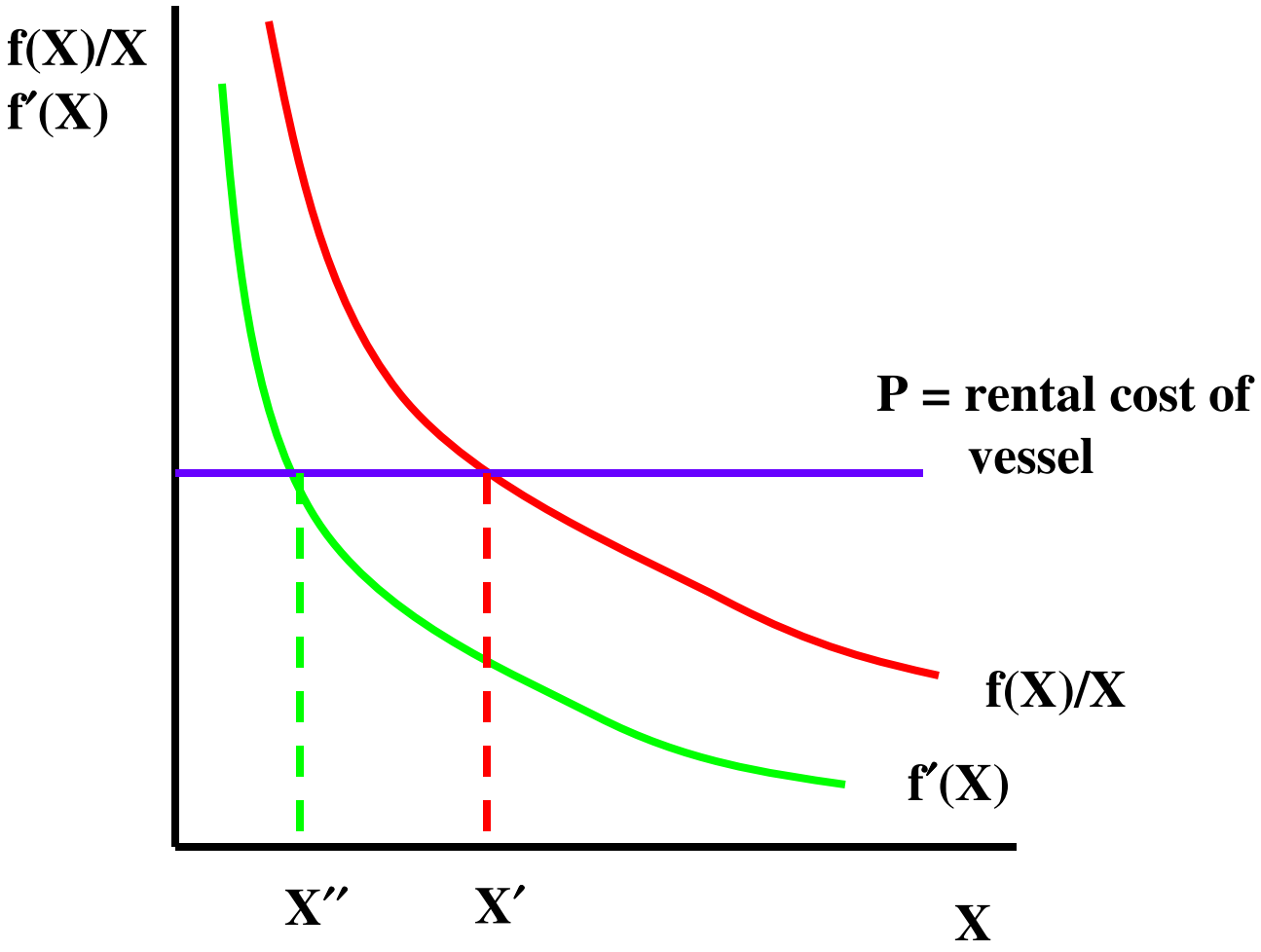
  max f(X) - pX

  i.e. the owner would want to maximize the difference between the value of the fish caught f(X), and the total cost of renting vessels pX:

  f′(X) = p

  when marginal revenue product is equal to marginal cost

- **The owner would rent just enough vessels to maximize their profits at X″ (See figure)**



X′ = equilibrium number of vessels

X″ = efficient number of vessels

X′ - X″ = amount of over-fishing

- **Suppose there is *open access* to the fishing ground - a person will only rent a vessel if it is privately profitable to do so, but they do not account for the impact their vessel has on the output of vessels already in the fishing ground**

- **If current value of output per vessel is f(X)/X, if a new vessel is added, the new value of output per vessel is f(X+1)/(X+1)**

- **As long as the value of output per vessel exceeds the cost of renting the vessel, vessels will enter:**

  $$f(X+1)/(X+1) > p$$

- **Vessels enter until the value of output per vessel is just equal to the rental cost:**

  $$f(X^*)/X^* = p$$

  i.e. at point X′ **(See figure)**

- **Given that average product is diminishing, it must be the case that the marginal product of vessels lies everywhere below average product**

- **This means that the number of vessels in the common fishing ground will always exceed that in a private fishing ground**

- **In the absence of a mechanism for restricting entry of vessels, fishing ground is over fished by X′ - X″**

- **The externality here is that common fishery ground gets over-fished as access cannot be controlled**

- **Ultimately, results in reduction in fish stocks, given assumptions about non-migratory nature of fish species and population growth**

POLICY OPTIONS

- **In principle, if this were an inland fishing ground such as the Great Lakes, possible to restrict access**

- **In the case of international waters, extremely difficult to assign and enforce property rights**

- **Even in a country's defined territorial waters, there is often international conflict over rights to fish e.g. the so-called "Cod War" between Iceland and the UK, and the U.S./Canadian salmon treaty dispute**

- **Commonly governments have attempted to agree on quota systems to prevent over fishing of international waters - fix either number of vessels X, or catch per vessel**

- **Such systems are difficult to police - International Whaling Commission established in 1946 to protect whale species by setting maximum catch limits - Commission has no authority to enforce rules**