EE475 Natural Resource Economics

Fishery Resource

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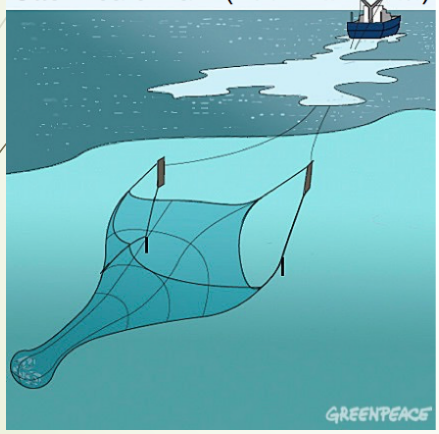
Outline

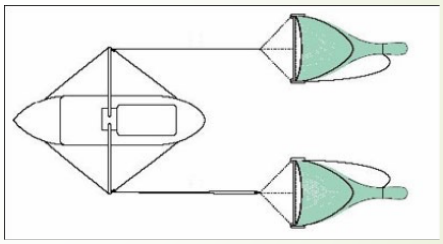
- Type of fishing gears
- Biological Aspects of Fishery Resource
- Concept of Sustainable Yield
- Maximum vs Efficient Sustainable Yield
- Property rights and the use of fishery resource
- Government policies and their effects
  - Raising real cost: prohibiting destructive gear, limiting fishing time
  - Taxation
  - Individual Transferable Quota (ITQ)

Types of Fishing Gears

Otter Board Trawl (อวนลากแผ่นตะเฆ่)



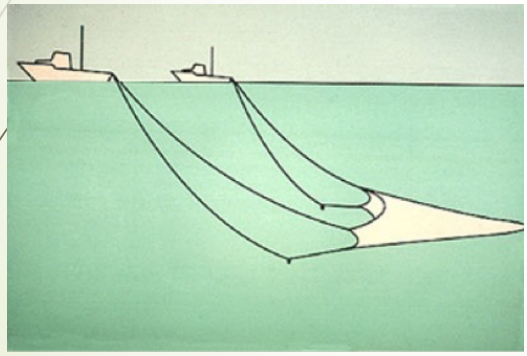
- Commercial Fishing Gears



Beam trawl (อวนลากคานถ่าง)

Types of Fishing Gears

- Commercial Fishing Gears



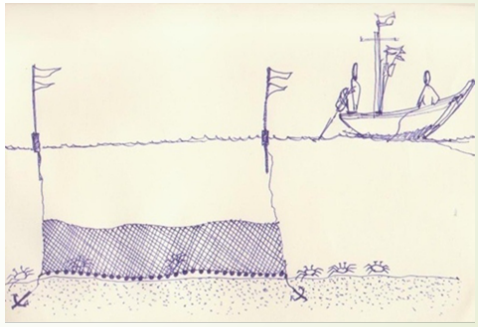
Pair trawl (อวนลากคู่)

Push Net (อวนรุน)

Types of Fishing Gears

- Artisanal Fishing Gears

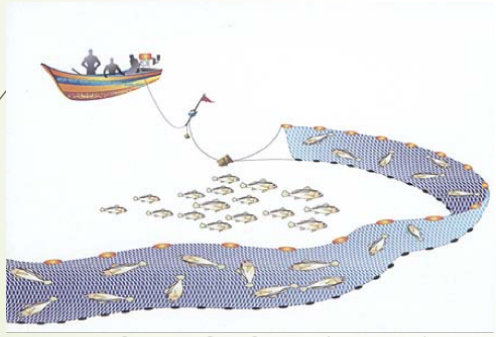
Dredge (คราด)



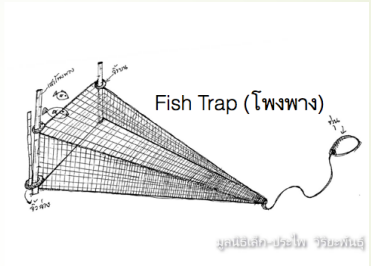
Trammel Net (อวนจม)

Types of Fishing Gears

- Artisanal Fishing Gears



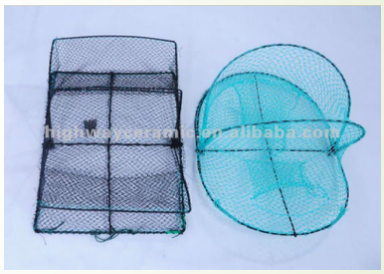
Floating Seine, Gill Seine (อวนลอย)



Types of Fishing Gears

- Artisanal Fishing Gears

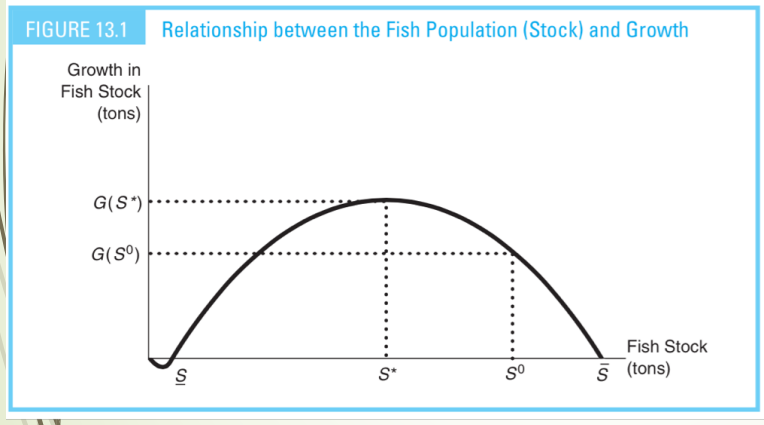
Crap Trap (ลอบดักปู)



Introduction to Economics of Fishery

- Fishery is an 'Interactive Resources'
  - Size of the resource stock (population) is determined jointly by biological characteristics as well as by actions taken by society.
- Maximum Sustainable Yield - Biology
- Efficient Sustainable Yield - Economics
- Whether efficiency is a sufficiently strong criterion to avoid extinction?
- Will efficient harvests always result in sustainable outcome?

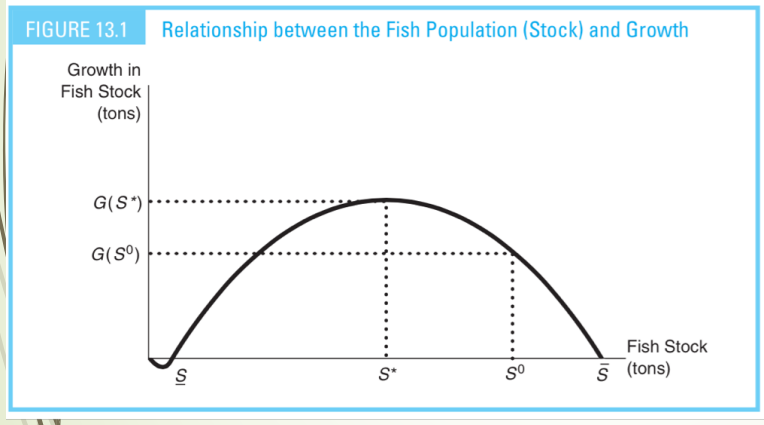
Biological Aspect



Source: Tietenberg & Lewis (2012) p.322

- The Schaefer model: depicting relationship between "Growth in Fish Stock" and "Size of Fish Stock"
- The growth in fish stock increases from the fish stock S_ to S*.
- Subsequently, the growth declines from S* to S̄.

Biological Aspect

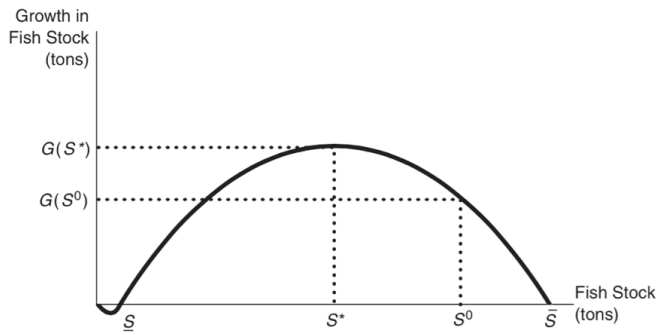


Source: Tietenberg & Lewis (2012) p.322

- S bar is a natural equilibrium.
- It is natural equilibrium because it would persist in the absence of outside influences
- The reduction of the fish stock would be exactly offset by increase in the stock.

Biological Aspect

FIGURE 13.1 Relationship between the Fish Population (Stock) and Growth



Source: Tietenberg & Lewis (2012) p.322

- S bar is also a stable equilibrium.
- When moving away from the equilibrium, the conditions around it would force the population to return to S bar.
- The fish stock is limited at S bar could be because of the carrying capacity of its habitat.

Biological Aspect

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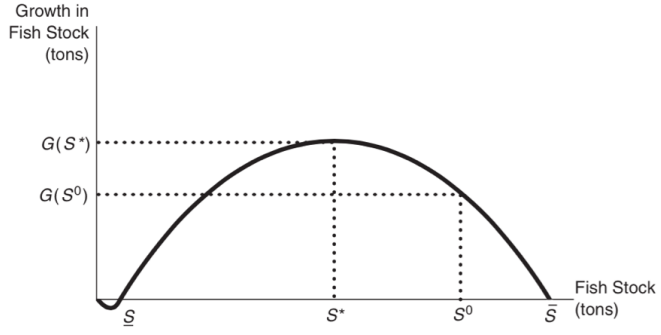
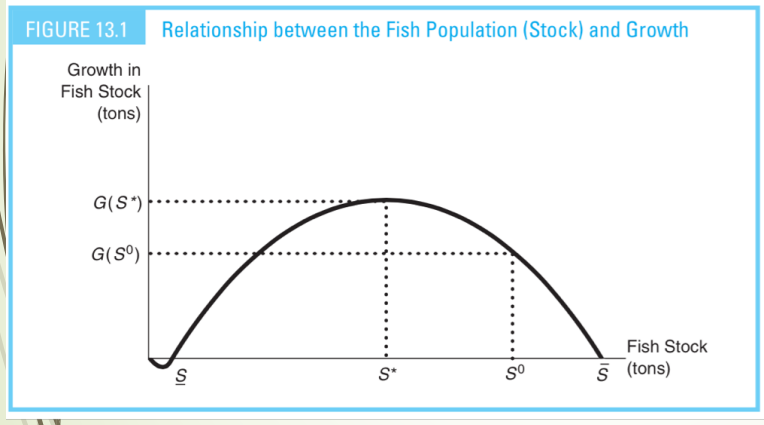


Source: Tietenberg & Lewis (2012) p.322

- S_ is the "minimum viable population".
- below this point, the growth in population is negative (deaths and out-migration exceed births and in-migration).
- S_ is an unstable equilibrium.
- Can you see why?

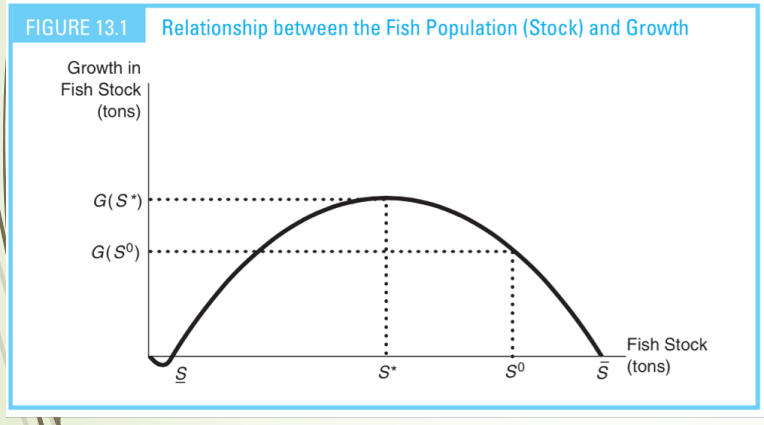
Biological Aspect



Source: Tietenberg & Lewis (2012) p.322

- Sustainable Yield
- A Catch Level = Growth Rate of the Population
- Maximum Sustainable Yield
- Can you see where the Maximum Sustainable Yield is?

Biological Aspect



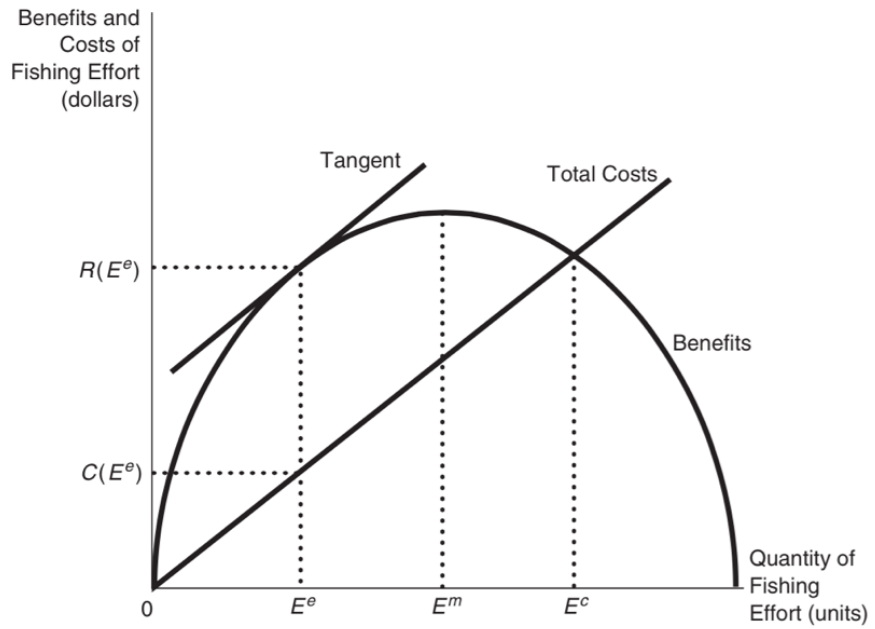
Source: Tietenberg & Lewis (2012) p.322

- Q: What happen to the fish stock if the catch is more than sustainable yield?
- Q: Can you see where the extinction could be?

Static Efficient Sustainable Yield

- Is the Maximum Sustainable Yield synonymous with efficiency?
- Recollection:
  - What do we mean by "Efficiency"?
  - What is it associated with?

FIGURE 13.2 Efficient Sustainable Yield for a Fishery



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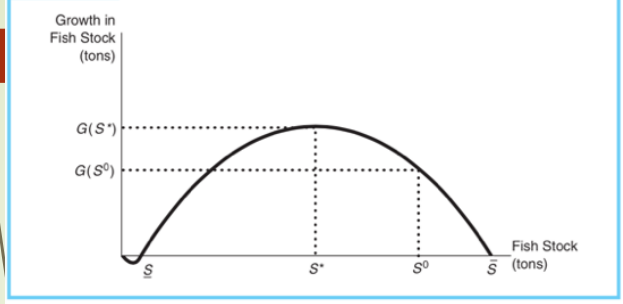
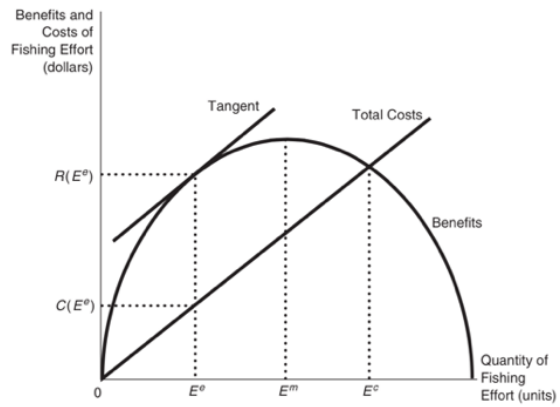


In the fish stock and growth graph on the left, horizontal axis is **Fish Stock**. The movement from smaller to bigger size of the stock is represented by the movement from left to right on the axis.

FIGURE 13.2 Efficient Sustainable Yield for a Fishery



In the efficient sustainable yield graph (on the right), horizontal axis is not fish stock but **quantity of fishing efforts** (e.g. hours of fishing, vessel years). Therefore, the movement from smaller to bigger size of the fish stock is represented by the movement from right to left on the horizontal axis.

Static Efficient Sustainable Yield

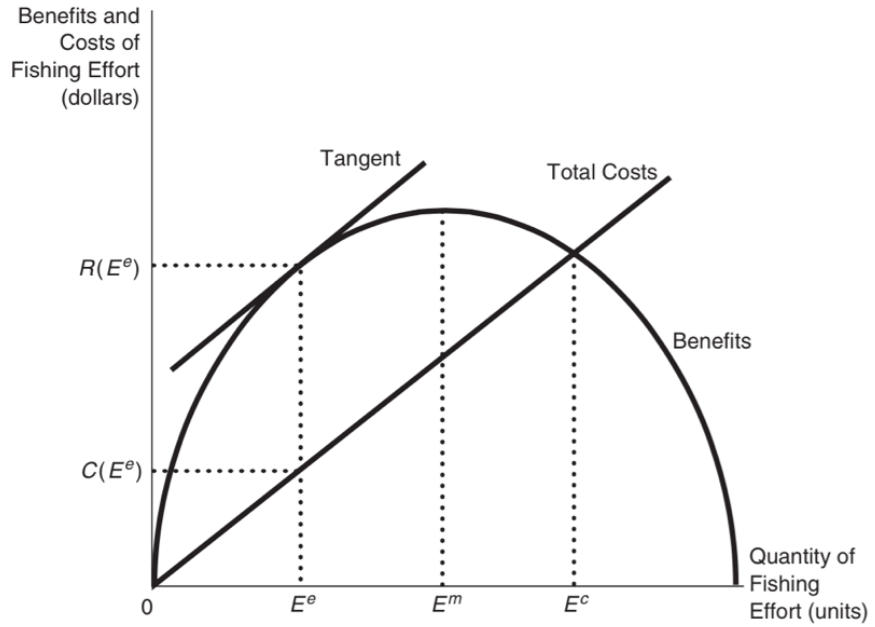
- In any sustainable yield, annual catches, population, effort levels, and net benefits remain constant over time.
- The static efficient sustainable yield allocation maximizes the constant annual net benefit.

Static Efficient Sustainable Yield

- Three assumptions

- The price of fish is constant and does not depend on the amount sold; —> shape of the revenue (benefit) function is dictated by the shape of the biological function.
- The marginal cost of a unit of fishing effort is constant;
- The amount of fish caught per unit of effort expended is proportional to the size of fish population (smaller population, the fewer fish caught per unit of effort).

FIGURE 13.2 Efficient Sustainable Yield for a Fishery



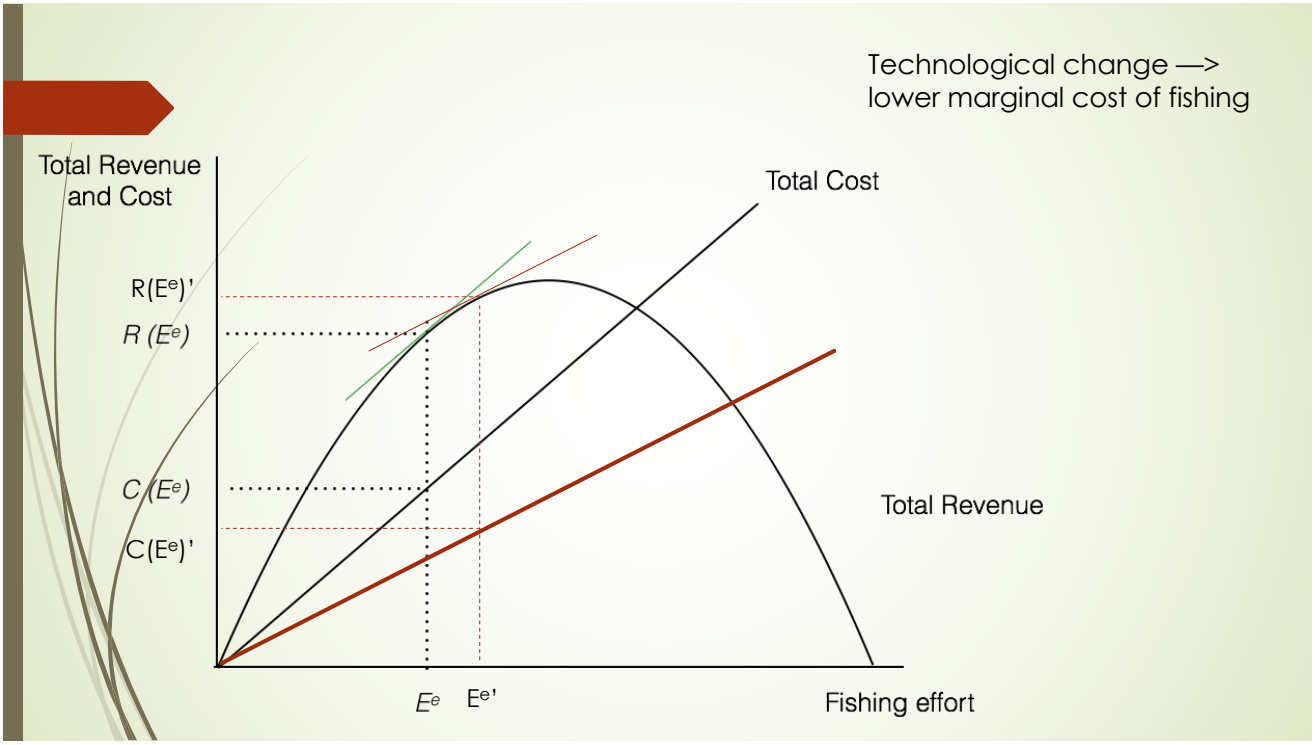
Static Efficient Sustainable Yield

- Beyond E^m, sustainable catch and revenue declines. (E^m corresponds to the maximum sustainable yield).
- E^e is the efficient level of effort. Can you see why?
- Back to the question: Is the Maximum Sustainable Yield synonymous with efficiency?

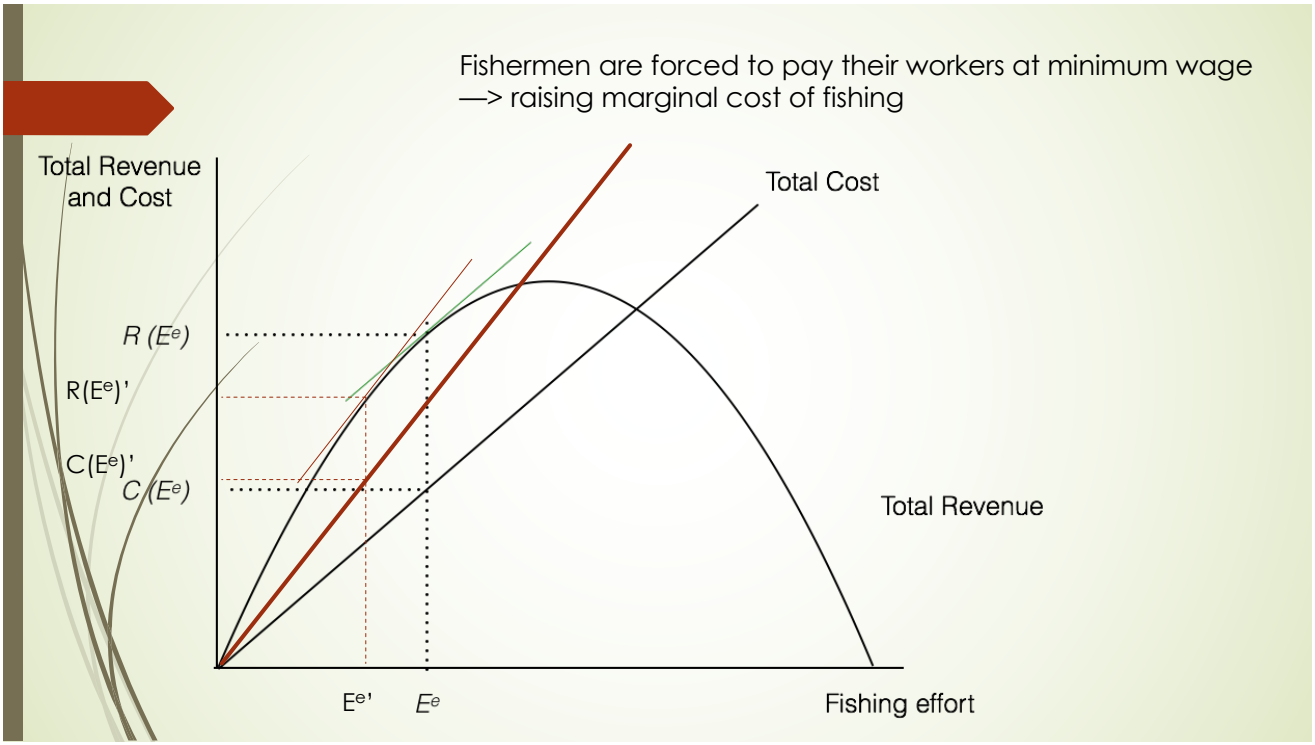
Static Efficient Sustainable Yield

- What would happen to the graph if the following situations happen?
  - Technological change —> lower marginal cost of fishing
  - Fishermen are forced to pay their workers at minimum wage —> raising marginal cost of fishing
  - Marginal cost is zero.

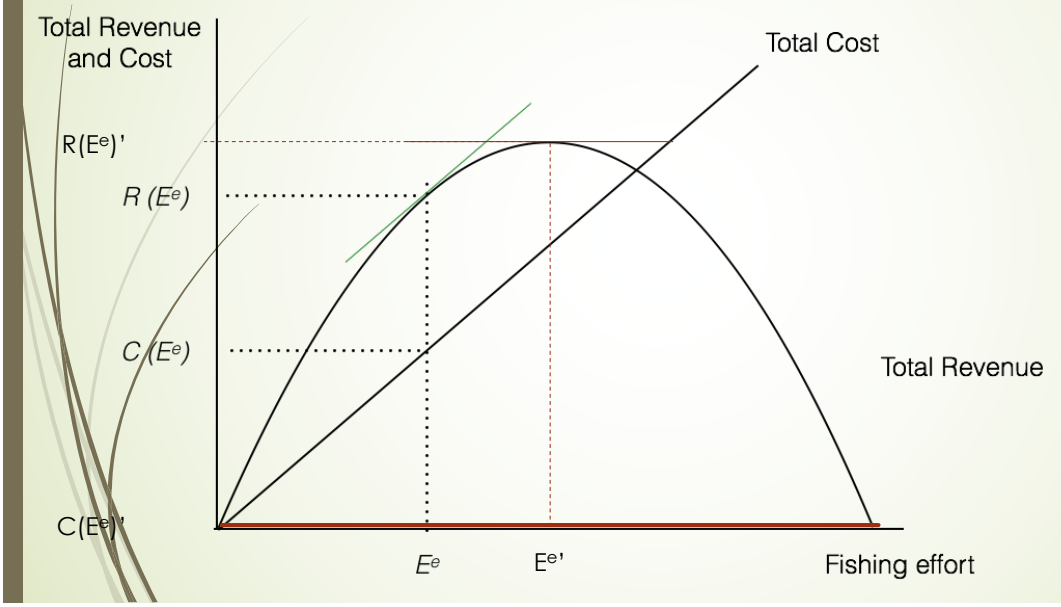
Technological change —>
lower marginal cost of fishing

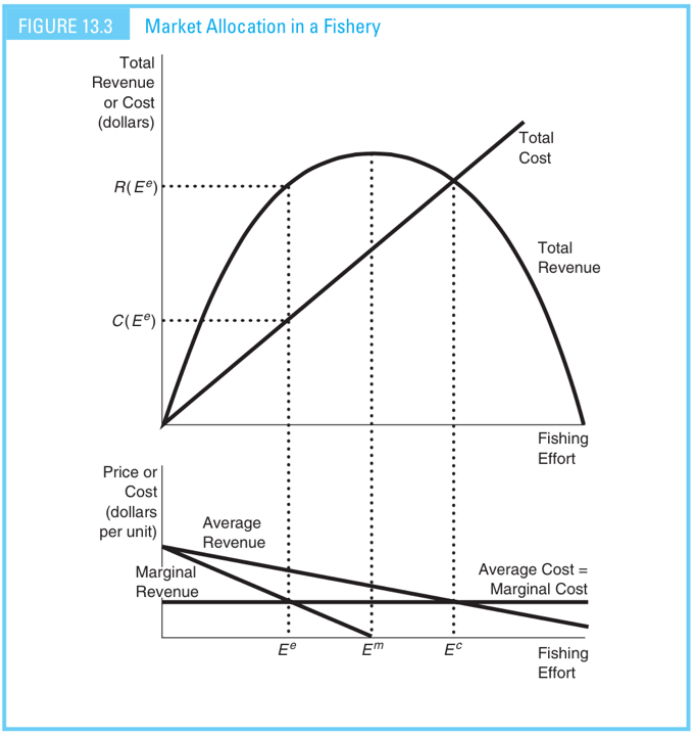


Fishermen are forced to pay their workers at minimum wage
—> raising marginal cost of fishing



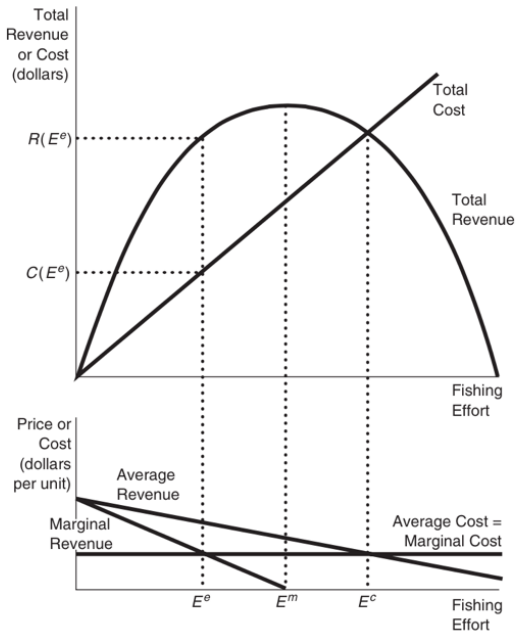
Marginal cost is zero.





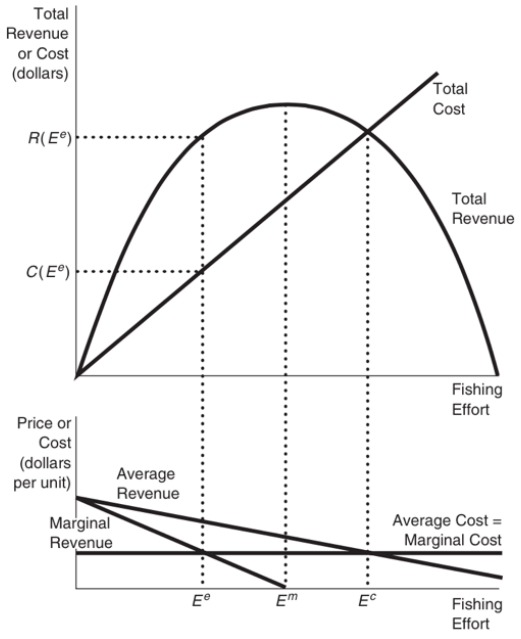
- If **private property rights** over an area of the ocean is possible, which level would the fishing effort be?
- In reality, open-access is more likely. Which level would the fishing effort be in the case of **open-access property regime**?

FIGURE 13.3 Market Allocation in a Fishery



- The open-access property rights in the case of fishery resource create two kinds of external cost
- Contemporaneous external cost:
  - Too much effort is being expended to catch too few fish, and the cost is substantially higher than it would be in an efficient allocation
- Intergenerational external cost
- In the first period, overexploitation would result in higher catch. As a result the population is reduced, as well as the growth rate, causing future profits to be lower.

FIGURE 13.3 Market Allocation in a Fishery



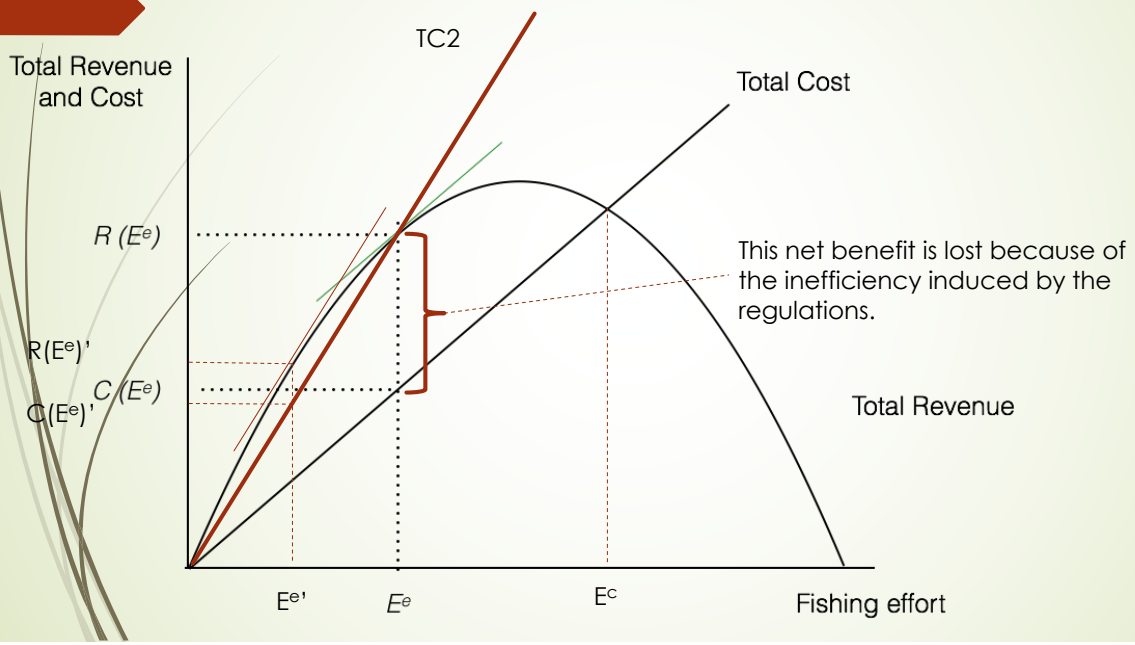
- Is it always the case that open-access property rights would lead to a stock lower than (S*)?
- Does open-access fishing always pose the treat of species extinction? From the theory, what are the conditions determining the species extinction?

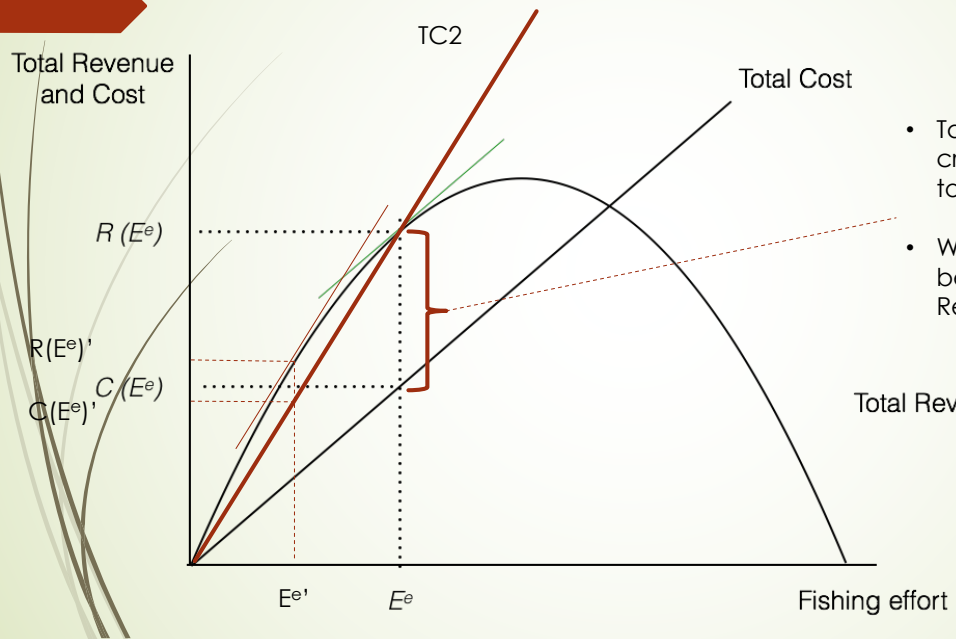
Government policies

- Several government policies were proposed and enforced the fishing industry
  - Prohibit the use of destructive gear
  - Limit fishing time
- These policies raise "real cost of fishing".
- These policies are good for the ecosystem and the natural resources.

- But are they 'efficient' policies?

Raising Real Cost of Fishing … Efficient ?





Taxation

- Taxes on effort would create the same effect to the TC curve.
- What is the difference between Taxes and the Regulations?

Government policies: Taxation

- Distinguish between *transfer costs* and *real-resource costs*
  - Real-resource costs: Costs which involve utilization of resources
  - Transfer costs: Costs to that part of society (in this case fishermen) bearing them, but are exactly offset by the gain received by the recipients
- The 'net benefit' of the fishermen from taxes are not wasted, but transferred to other parts of society through government.

Individual Transferable Quotas (ITQ)

- 3 Characteristics of an efficient quota system
- (1) The quotas entitle the holder to catch a specified share of the total authorised catch of a specified type of fish.
- (2) The catch authorised by the quotas held by all fishermen should be equal to the efficient catch for the fishery.
- (3) The quota should be freely transferable among fishermen and market should send appropriate price signals about the value of the fishery.

TABLE 13.1 Countries with Individual Transferable Quota Systems

Country	Number of Species Covered
Argentina	1
Australia	26
Canada	52
Chile	9
Denmark	1
Estonia	2
Falkland Islands	4
Greenland	1
Iceland	25
Italy	1
Morocco	1*
Mozambique	4
Namibia	10
The Netherlands	7
New Zealand	97
Portugal	1*
South Africa	1*
United States	6

*Complete species list unavailable

Source: Adapted from Cindy Chu. "Thirty Years Later: The Global Growth of ITQs and their Influence on Stock Status in Marine Fisheries," *Fish and Fisheries* Vol. 10 (2009): 217–230.

Individual Transferable Quotas (ITQ)

- Established in New Zealand in 1986
- 18 countries adopting it
- Species-based

Individual Transferable Quotas (ITQ)

- Considering transferability of the ITQ
  - The entitlement to fish flows to those gaining the most benefit from it because their costs are lower.
  - Encouraging technological progress

Individual Transferable Quotas (ITQ)

- The distribution of the rent : Possibilities and Outcomes
- 1) Auction : The outcome would be very similar to the tax system. why?
- 2) Give quotas to the fishermen in proportion to their historical catch. Then, let them trade through market.
  - New entrants have to purchase quotas from existing fishermen.
  - Competition among the potential purchasers would drive up the price of the quotas until it reflected the market (present) value of future rents