

# Economic Instruments for Environmental Protection

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# Overview of Environmental Regulation

- Direct Regulations
  - Uniform Standards (most common)
  - Fine-tuned Standards
- Economic Instruments
  - Tax (Laguna de Bay)
  - Subsidy
  - Tradable Permits (Lake Dillion)

# Criteria for Comparing Regulations

- Efficiency
  - Are they cost-effective?
- Equity
  - Are they fair? Are they politically acceptable?
- Effectiveness
  - Do they achieve their goals?
- There is usually a conflict among these criteria for any given policy.

# Illustrative Example: “Lake Yunnan”

- Assume there is a lake in southwest China called “Lake Yunnan” suffering from severe eutrophication caused by excess phosphorus discharge from two industries:
  - Fertilizer Factory (10 tons P per year)
  - Paper Mill (10 tons P per year)
- Through research, the government has decided that the total amount of phosphorus entering the lake must not exceed 10 tons per year.
- How can the required load reduction (10 tons per year) best be achieved?

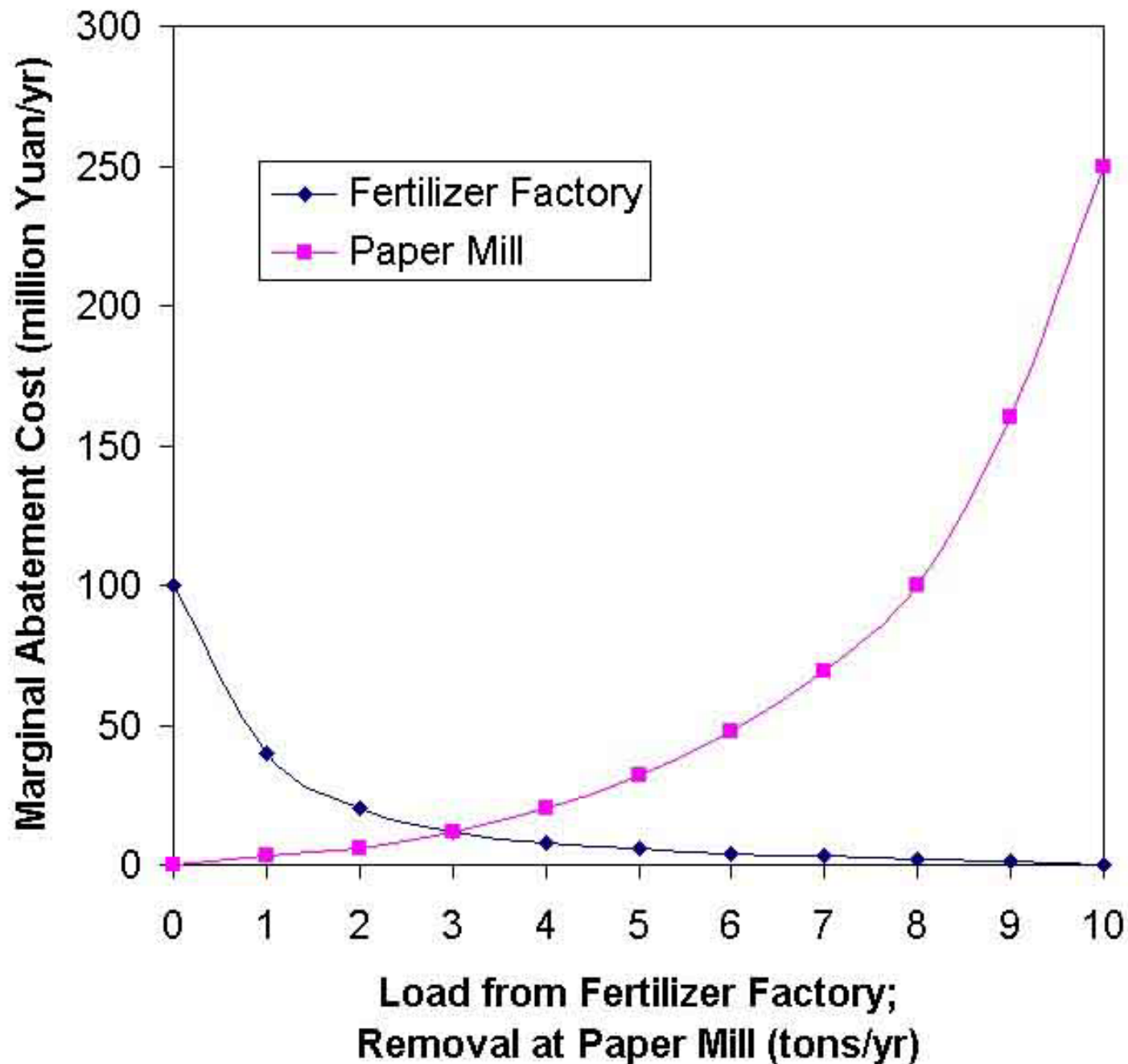
# Abatement Costs

**Table 1. Hypothetical Abatement Costs for Two Dischargers into Lake Yunnan**

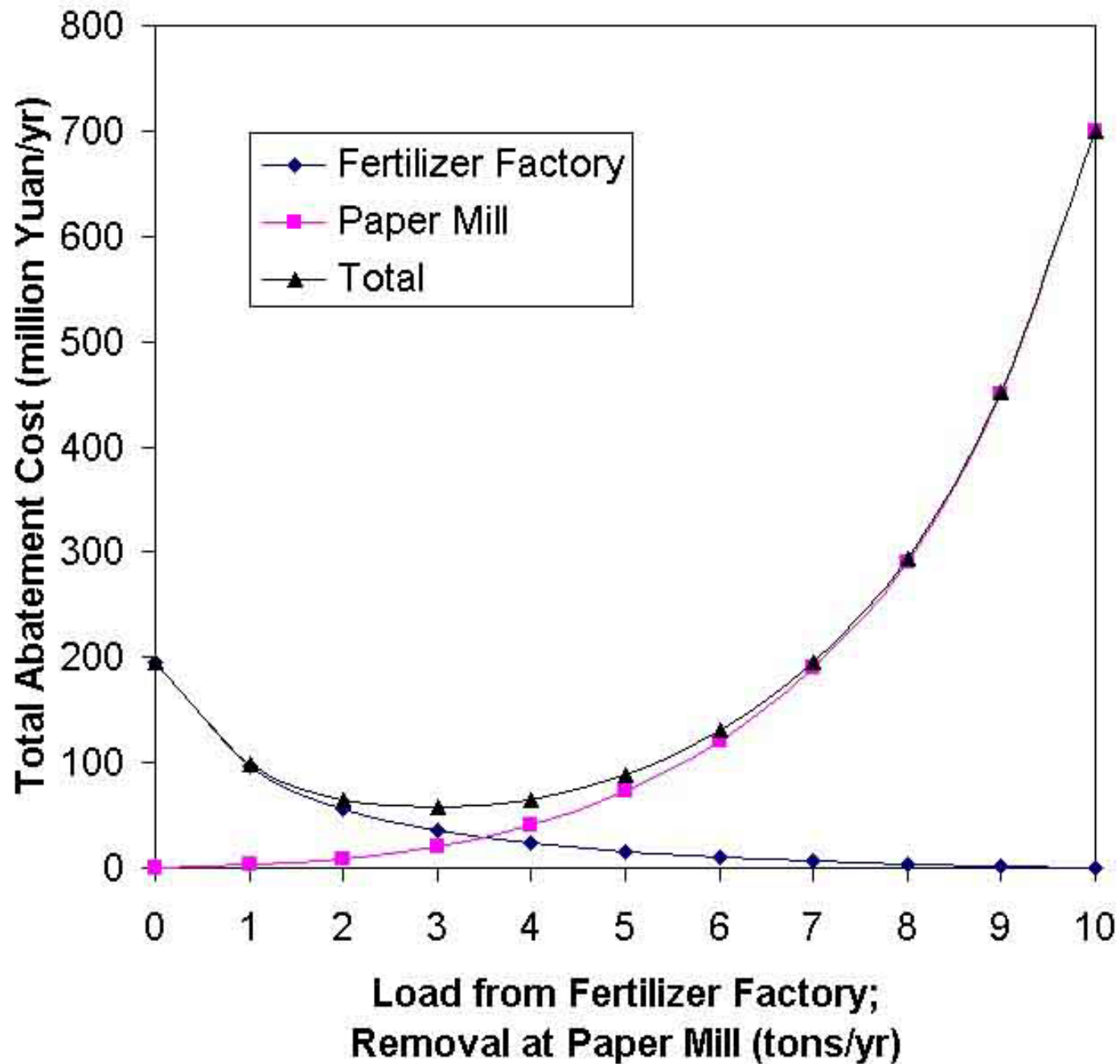
Discharge (ton P/year)	Marginal Abatement Costs (10 <sup>6</sup> Yuan/year)		Total Abatement Costs (10 <sup>6</sup> Yuan/year)	
	Fertilizer Factory	Paper Mill	Fertilizer Factory	Paper Mill
10	0	0	0	0
9	1	3	1	3
8	2	6	3	9
7	3	12	6	21
6	4	20	10	41
5	6	32	16	73
4	8	48	24	121
3	12	69	36	190
2	20	100	56	290
1	40	160	96	450
0	100	250	196	700

- Hypothetical, but representative: different between polluters, rising MAC

# Marginal Abatement Costs



# Total Abatement Costs



# Uniform Standards

- Both the Fertilizer Factory and the Paper Mill must cut their loads by half, that is, to 5 ton P/yr.
- It will cost
  - Fertilizer Factory = 16 million Yuan/yr
  - Paper Mill = 73 million Yuan/yr
  - Total Social Cost = 89 million Yuan/yr



# Fine-tuned Standards

- The government recognizes that each industry has different MAC and implements fine-tuned standards.
- Fertilizer Factory must abate to 3 ton P/yr, costing 36 million Yuan/yr.
- Paper Mill must abate to 7 ton P/yr, costing 21 million Yuan/yr.
- Total Social Cost = 57 million Yuan/yr (lower than uniform standards).

# Tax (Levy)

- Instead of setting effluent standards, the government sets a tax on each ton of phosphorus discharged to Lake Yunnan.
- After analyzing the data in Table 1, the government sets the tax rate at 12 million Yuan/ton P.
- Fertilizer Factory cuts its load to 3 tons per year, paying 36 million Yuan/yr in abatement cost and 36 million Yuan/yr in tax.
- Paper Mill cuts its load to 7 tons/year, paying 21 million Yuan/yr in abatement cost and 84 million Yuan/yr in tax.

# Subsidy

- Instead of setting effluent standards, the government offers a subsidy for each ton of phosphorus not discharged to Lake Yunnan.
- After analyzing the data in Table 1, the government sets the subsidy rate at 12 million Yuan/ton P.
- Fertilizer Factory cuts its load to 3 tons per year, paying 36 million Yuan/yr in abatement cost and receiving 84 million Yuan/yr in subsidy.
- Paper Mill cuts its load to 7 tons/year, paying 21 million Yuan/yr in abatement cost and 36 million Yuan/yr in tax.

# Tradable Permits

- The government sets uniform standards (5 ton P/yr) for each industry but lets permits be traded.
- That is, each industry receives 5 permits to discharge 1 ton P/yr into Lake Yunnan.
- Fertilizer Factory has relatively inexpensive marginal abatement costs. It sells 2 permits to the Paper Mill for an unknown price (probably between 20 and 52 million Yuan).

# Comparison

**Table 2. Evaluation of Policies in Illustrative Example**

Policy	Discharge (ton P/yr)		Total Cost for each Industry (million Yuan/yr)		Total Social Cost (million Yuan/yr)	Efficiency	Equity and Political Acceptability
	Fertilizer Factory	Paper Mill	Fertilizer Factory	Paper Mill			
Uniform Standards	5	5	16	73	89	No	Mixed
Fine-tuned Standards	3	7	36	21	57	Yes	No
Tax	3	7	72	105	57	Yes	No
Subsidy	3	7	-48	-15	57	Yes	No
Tradable Permits	3	7	36 minus gain from trade	21 plus gain from trade	57	Yes	Yes

- Tradable permits appear to satisfy all criteria, but...

# Difficulties with Implementing Tradable Permits

- Transaction Costs
- Monitoring Costs
- Information Costs
- Existing Regulations / Voluntary Agreements
- Other Restrictions on Trading
  - Control Device Licensing