Demo 3 - Pollution from agriculture - teams approaches (& other new stuff)

- Purpose
  - demonstrate choice of nonpoint source regulation instruments in practice using OPIA
  - show alternate (new) ways of dealing with nonpoint source pollution
  - expand your thinking on regulatory choice

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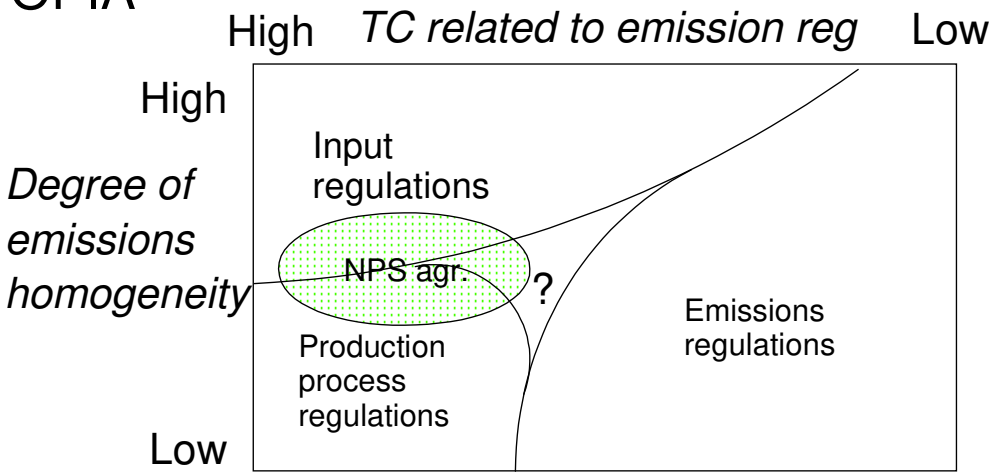
Outline

- Nonpoint source (NPS) pollution
- Agricultural pollution
  - point sources (manure storage, refill stations)
  - nonpoint sources (farm field leakages)
  - multiple kinds of pollutants: nutrients choliforme backteria, pesticide residues
  - mean emissions vs. variability
- Conventional NPS policies
- New NPS regulatory approaches
- Focus on the receptor - seeing agriculture in conjunction with other sectors

The NPS problem (1)

- Costly or technically difficult to measure runoffs (emissions) ⇒ reasonable high TC
  - search for policy instruments with desired impacts on environmental impacts that have lower costs
- OPIA



Agricultural pollution

- Point sources
  - manure storage
  - silage storage
  - refill stations for fertilizer, pesticides and fuel
    - ➡ most spills are acciedents
  - for most part fixed (not dealt with further)
- Nonpoint sources
  - nutrient runoffs
    - ➡ excessive fertilization or bad timing of fertilizer application
    - ➡ manure
  - erosion (mainly with arable land farming)
  - pesticide residues

... agricultural pollution (2)

- Nutrient runoffs
  - strongly stochastic
    - Extreme case 1: Bad growing season ⇒ much residual nutrients left in a soluable state in the soil, that will leach if fall or winter are warm and rainy.
    - Extreme case 2: Good growing season ⇒ plants utilize most of applied nutrients. Cold and dry fall/winter further immobilizes the few nutrients left
- Costly to measure nutrient runoffs from individual farm fields ⇒ look for other measures
  - tax on nitrogen fertilizers (input regulation)
  - catch crop in grains (process regulation)

... agricultural pollution (3)

- Tax on nitrogen fertilizers ⇒ fertilization rate ↓ ⇒ amount of residual nutrients ↓
  - \+ low TC, easy to administer, incentives for better utilization of manure
  - − remote from problem, reduces likelihood of getting "bumper crops"
- Catch crop in certain grains ⇒ residual nutrients immobilized
  - \+ can be differentiated (higher payments for catch crops in "high value areas"), reduces var(emissions)
  - − reduces yields somewhat as CC uses some of the nutrients in the growing season, requires more skills on behalf of grower

... agricultural pollution (4)

- Erosion and herbicide use
  - tillage (in particular fall ploughing) increase erosion risk
  - ... but tillage also important to control weeds in arable crop farming
  - ... tradeoff erosion risk - herbicide residue risk
- Erosion risk - soil type / steepness of field / tillage
- Herbicide leaching risk - water table / closeness to water ways / time of application (late fall problematic given low temperatures ⇒ reduced decomposition rate)

... agricultural pollution (5)

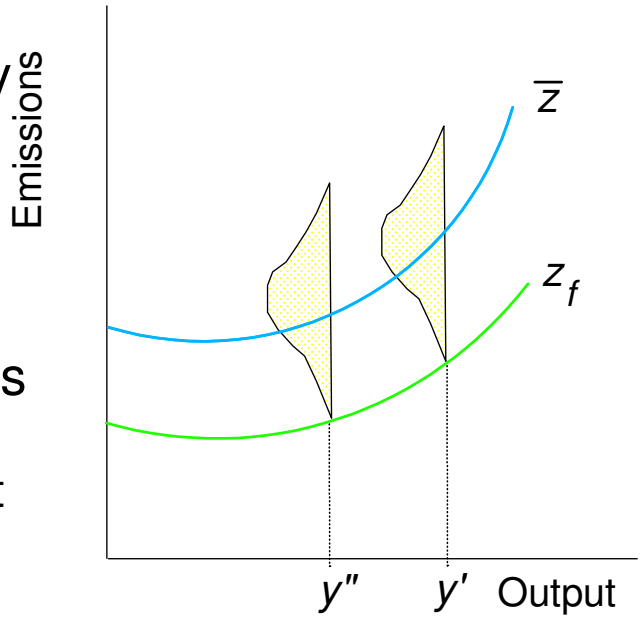
- Erosion policies - differentiation principle
  - tax fall ploughing (alternatively, pay for no fall ploughing) on areas with high erosion risk acreage
  - no tax/payment on low erosion risk areas
  - reduces overall need for herbicide treatment, and hence total herbicide loads
- Herbicide policies - difficult to make direct
  - high tax no option (black market/illegal imports)
  - indirect approach
    - ➡ limit time of application (cfr. decomposition time)
    - ➡ tax crops that are more pesticide intensive in areas where water table is high/close to water ways)

Conventional NPS policies

- A combination of input factor and process regulations
  - utilize that acreage cannot "move"
- Problems
  - no direct incentives to reduce emissions
  - do not reduce variability in emissions (exception - catch crops)
  - large variability in environmental performance among farmers (the managment factor?) who otherwise have similar conditions (climate, soil, type of production)
- Can we do better on the problem areas?

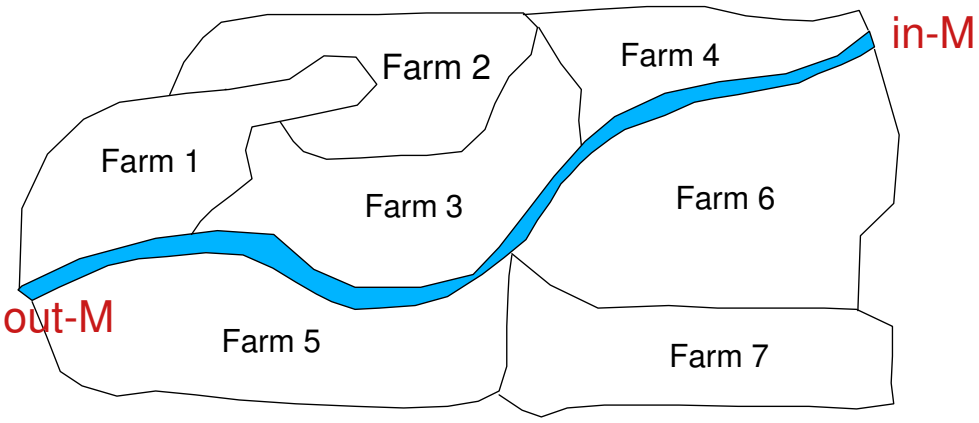
New approaches - emissions in NPS

- Input and process controls suggested by OPIA not without problems
- Large variability in environmental performance among farmers
  - making the environmentally least efficient farmers more efficent more promising than "correcting the mean"?



New approaches - teams (1)

- Main idea
  - measure ambient quality at the inflow and outflow points of a segment of a river
  - hold farmers jointly liable for difference in ambient standards at in- and outflow points



- Problem/challenge: making the team work

... new approaches - teams (2)

- Segerson (JEEM, 1988) seminal paper
  - ambient tax for the single farmer case where each polluter pays a charge depending on overall ambient levels
    - \+ correct marginal incentives
    - – unequal marginal incentives among polluters ⇒ informationally demanding
    - – high monitoring costs
    - – excessive collection of taxes
- Multiple works in the literature since have dealt with the "minus points", but not fully
  - Cabe & Herriges (JEEM1992), Horan et.al (JEEM, 1998), Hansen and Romstad (EE, 2007)

... new approaches - teams (3)

- Romstad (EE, 2003) pursues another approach of collectively making farmers responsible for changes in emissions/ambient quality
- Assumptions:
  - the principal (EPA) can monitor overall ambient quality, but it is too costly to monitor individual agents' (farmers') ambient performance
  - each agent has superior information vis-a-vis the principal on own emissions and the possible emissions of other agents (local commons, Seabright, JEP, 1993)
  - ... but inferior information regarding actual performance of the other agents (it is the principal who monitors)

... new approaches - teams (4)

- Regulatory "setup": The principal offers the agents to choose from the following:

1. Some std. regulatory NPS regime that reduces agents' profits vis-a-vis the unregulated case and the alternate regulation

2. A contract that is favorable to the team compared to (1) provided that the team meets the targeted ambient level, but unfavorable to the team (and individual agents) if the target is not met

... new approaches - teams (5)

The penalty scheme for the team:

$$B(Z - \bar{Z}) \qquad [2]$$

The penalty as seen by agent *n*:

$$B_n(\hat{z}_n + \hat{Z}_{-n} - \bar{Z}) \qquad [3]$$

The penalty as seen by agent *n* with self reporting (needed as accidents may occur):

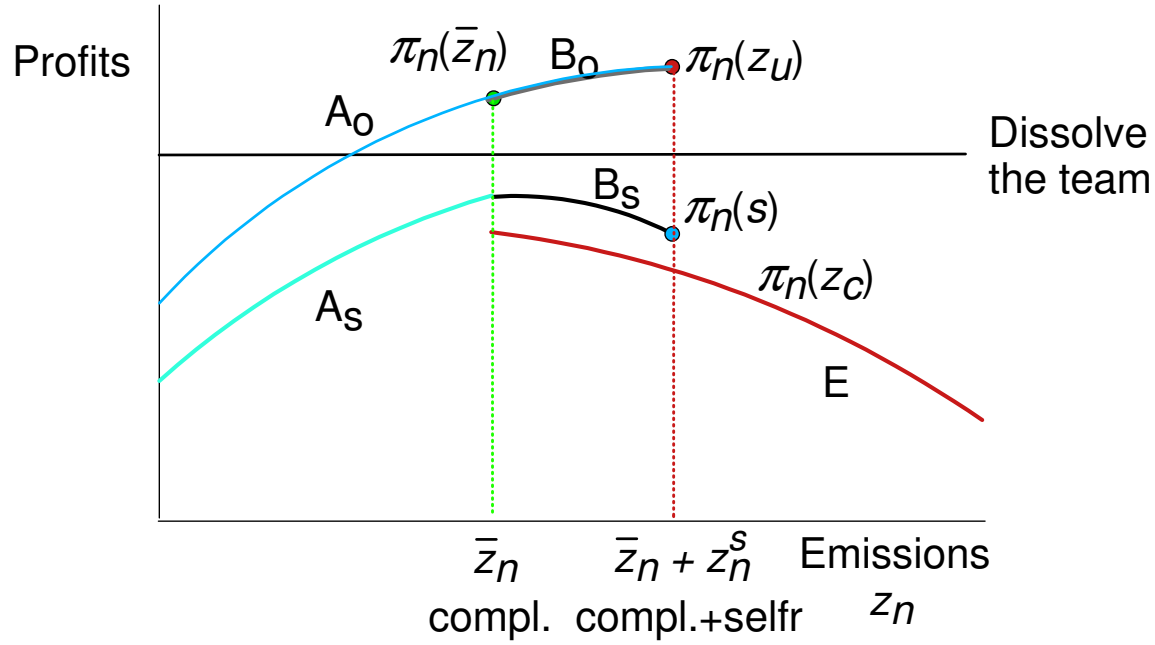
$$B_n^s\left[\hat{z}_n + (\hat{Z}_{-n} - \Sigma_{i\in\{N\setminus n\}} z_i^s) - \bar{Z}\right] \qquad [4]$$

... new approaches - teams (6)

- Problem (and virtue) with self reporting
  - agents may file "false" self reports to avoid the higher penalty of being caught in non-compliance
  - "exit option" (= leave the team) reduces the likelihood for this happening
    - ➡ an agent would not repeatedly take the blame for other agents' violations if
    - ➡ it is less costly for this agent to leave the team
  - "exit option" also provides incentives for "cheaters" not to cheat, as it is more profitable to be member of a compliant team than to face the std. regulation

... new approaches - teams (7)

Profitability of various options for agent *n*



... new approaches - teams (8)

- Main benefits of a teams approach
  - reduces monitoring costs for ambient/- emission based NPS approaches
  - incentives more consistent with purpose of regs.
  - opens for "trades" within the team on abatement obligations → equi marg. principle within the team)
- Disadvantage: increased monitoring costs vis-a-vis trad. NPS regulations
- Environmental damages vary across locations
  - expect to see ambient teams approaches and std. regulatory regimes "coexist"
- Teams - a small scale oriented scheme, but large watersheds consist of several small ones

New approaches - model assesm. (1)

- Basic idea: Use models to assess agents' individual pollution and issue taxes/- payments on this basis based on self reported input use/ choice of agronomic practices

- Features:
  - Contract approach with sign-on fee
  - Agents given access to models to enable them to test profit impacts of various actions
  - Agents self report planned input use/chosen agronomic practices
  - agriculture: weather ⇒ plans don't work out
    ⇒ additional reports on actual actions

... new appr. - model assesm. (2)

- Mechanism design difficulties:
- Model results challenged ⇒ costly litigation
  - "Solution": contract framework where agents waive their rights to sue
- Variability between years ⇒ variable profits
  - "Solution": non-forgiving - desirable that policies seek to reduce mean + "spread"
  - but NPS models also used to "wash" model emissions for clearly non-man made effects
- False self-reports (planned or actual)
  - "Solution": random monitoring of practices, penalty for false reports

... new appr. - model assesm. (3)

- WEB based versions of NPS models made available to farmers
  - enables testing of acceptance criteria
    - model reliability
    - size of contract sign-on fee
  - provides easy self-reporting on planned activities
    - difficulty: monitoring of actual actions
- Low cost experimental economics?
- A start regarding the use of models onto other "NPS" problems: ex. biodiversity

A receptor focus - other sectors

- Suppose that marginal abatement costs are lower in agriculture than other sectors (like dispersed rural housing)
- A potential for trades between agriculture and these other sectors
  - other sectors pays agriculture to
    - clean more
    - provide cleaning facilities (filter dams)
  - ... to reduce their own abatement obligations

Summary

- Conventional NPS regulations may capture the most important aspects of NPS regulations, but misses on
  - variability in emissions throughout/between years
  - variability in emissions among farmers who otherwise are reasonably equal
  - no incentives for equi-marginal principle
- Two alternate approaces
  - teams - high cost but desirable focus on emissions
  - model based - lower cost, but with some problems remaining
- Trades with other sectors (an opportunity when one sees beyond the single sector)