Is gypsum a promise of a better future?

- how to win the race for the Baltic Sea

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Two challenges for marine policy

- Agricultural nonpoint source pollution decreases too slowly
  - Nutrient policy has been ineffective all over the world
  - Long-term perspective is not strong enough, given that P loads depend on accumulated P reserves and can be reduced only gradually over time;

- Climate change impacts water quality
  - Increased precipitation and nutrient loading promotes eutrophication
  - Increase in water temperatures boosts eutrophication

- Double need
  1. More efficient P policy
  2. Increased efforts to mitigate climate change

- This presentation: *places gypsum in a broader policy context*
  - Suggestions of main policy features
  - Short run and long run policy aspects

Starting point for an efficient P policy

- Key requirements for reducing P loading
  - Reduce erosion to decrease particulate (PP) P loading
  - ”Mine” legacy phosphorus to reduce soluble (DRP) P loading
  - Prevent further accumulation of P in soil from manure

- A wise policy reflects these aspects…
  - Balances measures between these three aspects
  - Accounts for the trade-off between PP and DRP inherent in many practices
  - Accounts for different time spans of reducing P fractions

- … and follows good principles of policy
  - Cost-efficiency
  - Promotion of technological progress
  - Pigouvian principles (punish pollution, support abatement)

Policy outline for phosphorous loading

My suggestion reflecting about features of an efficient P policy design

- Use gypsum
  - Use gypsum to immediately reduce both PP and DRP loading
  - Use other amendments – preferable from recycled materials .. on soils to which gypsum does not apply
- Regulate P fertilization
  - Impose an upper limit on P fertilization for fields with high P reserves to run them down
- Improve manure policy
  - Prevent the increase in soil P reserves in areas with high livestock density
  - Promote nutrient separation and transportation
- Prevention erosion wisely
  - Continue employing current erosion prevention measures
  - But take into account the trade-off between PP and DRP e.g. when promoting no till or permanent vegetation

Gypsum as a short-term practice

- Fit on clay and coarse soils
- Application: 4 tons per ha;
- Effects: 50% reduction in PP and 25% reduction in DRP
- Duration: 5 years
- Total costs: 220 €/ha
- Cost of reduced P load (5 years, 3% discounting): **58€/P kg**

	P load	P reduction	Remaining load
PP	1,3	0,65	0,65
DRP	0,5	0,13	0,37
totP	**1,8**	**0,78**	**1,02**

- Reduction of P loads is immediate
- Reduction in total P loads depends on applicable land area and farmers' willingness to use gypsum
- **Finland:** the land area on 0,5 - 1 M ha & the reduction potential 400 – 600 t/totP; by adding gypsum on policy Finland would achieve its marine policy goals

Test: policy in action: 10 years time span

- Gypsum amendment: close to 50% annual reduction in P loading
  - Provides time for longer term solutions, that is, promoting reductions in soil P values
- P fertilization regulation: upper limit of 15 kg/ha
  - Focus on cereal crops with a yield of 4000-5000 kg/ha
  - The P limit and yields imply ”mining” of P reserves by 5 kg annually
  - Decreases gradually soil P reserves (t kg/yr.) and reduces DRP loading
- Manure regulation: to stop the increase in soil P reserves
  - Nutrient separation and efficient transport (helps with extra manure)
  - Upper limit per ha (prevents higher P intensity on close by areas)
- P load at the beginning: 1,8 kg/ha
  - Soil P value 15,9 mg/l
  - DRP = 0,5kg/ha and PP = 1,3 kg/ha
- What happens to P loading to waterways?

Impact: P loads/ha after 10 years

Loading under P fertilization regulation (no gypsum)

- Outcome: soil P value would decrease from 15.9 mg/l to 12.9 mg/l (19%) and DRP loading by 20%;
- Comments:
  - P loads after ten years 0,4 + 1,3 = 1,7 kg/ha (reduction 0,1 kg/ha)
  - Comments: the obtained reduction in DRP after ten years is roughly the same as obtained by gypsum immediately and annually

Loading under a tight P regulation with gypsum amendment

- Outcome: P loads 0,35 + 0.65 = 1,00 kg/ha (reduction 0,7 kg/ha)
- Comments
  - Gypsum brings short-run efficiency to phosphorus policy
  - Simulations for the Archipelago Sea suggest: a large scale gypsum amendment shows up in the improvement of coastal waters

Gypsum and the Baltic Sea

Countries of interest

- Clay soils dominant in Denmark, Finland and Sweden; also Poland (with more coarse soils) and Northern Estonia

Rough estimates

- Agricultural P loads from these countries is 8 000 tons
- Gypsum could reduce about 1500 - 2 000 tons of loads
- Contribution to implementation of the BSAP P targets: 20 %

Conclusions

- Gypsum fits well to current phosphorus policies and improved dramatically its efficiency (and cost-efficiency)
- Gypsum hits both forms of P loading: PP and DRP (this is exceptional)
- Gives time for running down legacy phosphorus
- If adopted widely, helps crucially to achieve the BSAP targets in the whole Baltic Sea area

Thus, adding gypsum in the policy package helps us to win the race for the Baltic Sea