The effectiveness of different mitigation measures for nitrogen pollution is altered by interactions between mitigation measures - considerations for implementation of measures in modelling and mitigation policies

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EGU2018 – April 10th 2018

STØTTET AF promilleafgiftsfonden for landbrug



The water framework directive calls for further reductions in nitrogen loading to costal waters!

How can reductions in nitrogen loading be achieved in a cost effective way?





Additive or multiplicative effects – stacking measures



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Additive or multiplicative effects – stacking measures





Additive or multiplicative effects – stacking measures



Measure	Effect on leaching (kg N ha ⁻¹)	Price (€ ha⁻¹)	Retention (ha)	Effect after retention (ton N ha ⁻¹)	Price (€ kg N ⁻¹)
Catch crop – outside wetland catchment	25	40	40%	15	2,7
Catch crop – wetland catchment	25	40	80%	5	8

Danish Agriculture & Food Council

Measures cannot be stacked additively!



Increasing catch crop area

Standard effect: 1 ha of catch crops reduces leaching 25 kg N pr. ha







Space for effective catch crops



The effect of catch crops declines because they have to be sown progressively later



On 40% of the winter wheat is followed by winter wheat! Winter sown crops blocks space for catch crops

Financial cost of making room for catch crops – substituting winter wheat with spring barley



Cost of reducing nitrogen application





Conclusions



- Nitrogen measures does not stack additively, as they can affect the effectiveness of each other
- As more measures are implemented in a catchment, effect decline and cost increases
- These considerations needs to be implemented in models, if reliable effect and cost effectiveness estimates are to be achieved



Disclaimer

- My conclusions are not necessarily valid for measures that improve the nutrient utilisation efficiency or other measure that yields a financial gain
- Each measure and it interaction with other measures needs to be considered individually





