EFFECT

Water Quality

EFFECT technical info-pack
Case Study#7

COLLECTIVE CONTRACT ARRANGEMENTS FOR SPATIAL COORDINATION OF WATER QUALITY ENHANCEMENT

Danish Targeted Nitrogen Regulation: Evolution, Evaluation and Future Paths

Nordsminde catchment

Credit: SEGES Innovation

Measure	Reduced N (ton)	%
Norm Reduction	91	0.7%
Catch Crops	434	3.3%
Pilar II	12,486	96.0%

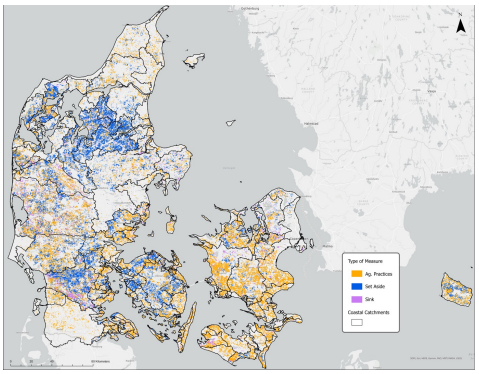
Distribution of measures in cost effective implementation

Eutrophication of fresh and marine waters started creating political conflicts over agricultural and environmental objectives in the mid-1980s. This conflict escalated until the 1993 agreement on the Action Plan for Sustainable Farming, which introduced a nitrogen application standard. Essentially, the standard is a non-tradable quota limiting nitrogen application at farm level. Over time, new policy instruments were added, and environmental targets recalibrated. Opposition to the standard grew as compliance costs rose, and the environmental achievements still fell short of achieving the EU Water Framework Directive (WFD). This led to a change in the 2015 Agricultural Accord, introducing a more targeted regulation allowing farmers to fertilize at the economic optimum, conditional on introducing catch crops in their crop management to retain excess nutrients. The current nitrogen regulation includes a voluntary and compensated catch crop scheme, offering flat-rate compensation for planting catch crops with the flexibility to choose alternative measures like norm reduction, catch crops, buffer zones, and land set-aside to achieve the required effect. Variation in the ecological status of water bodies and the hydrological properties of the catchments, and therefore the nitrogen retention capabilities, is taken into account when the area of catch crop requirement is calculated. In EFFECT, we conducted a comprehensive investigation of this agri-environmental policy problem, encompassing: 1) An evaluation of the cost-effectiveness of proposed measures using integrated modelling. 2) An assessment of the economic and environmental impact of the current scheme through ex-post impact evaluation. 3) An exploration of the implications of upgrading the current scheme into a collective arrangement through an ex-ante experimental approach.

The heterogeneity of hydrological linkages between the agricultural fields and the water bodies, the differences in required nutrient reductions and agricultural productivity means that spatial targeting is important for cost-effectiveness. In EFFECT, we have used a high spatial resolution cost-minimization catchment model, TargetEconN,

Catch crops from Odder municipality

Credit: Frank Bondgaard, SEGES Innovation



Spatial distribution of cost-effective measures to reach WFD targets

and applied to 108 individual catchments, to compare the cost-effectiveness of N-norm restrictions, catch crops, and the voluntary measures implemented as AES under pilar II to meet the WFD. We use TargetEconN to provide a baseline analysis of the cost effectiveness to meet of the required nutrient mitigation to achieve Good Ecological Status (GES) as required by WFD. We show that norm reduction contributes less than 1 % of the nutrient reductions, catch crops contribute less than 5 % to the reduction in nutrient load. The measures funded under the AES in pilar II (eg. wetland restoration; set aside; afforestation etc) therefore contribute over 90 % of the WFD load reductions. This implies that the policy aims to meet key water quality targets though the targeted catch-crop regulation does not appear justified on cost-effectiveness grounds.

Further, we conducted an ex-post impact evaluation of the current targeted nitrogen regulation in terms of its economic and environmental performance utilizing nine years of agricultural account statistics data. Our investigation specifically focused on the program's impact on farm level purchased nitrogen and crop revenue. Our results indicate that program participation has had a minimal impact on nitrogen purchases, but also a small but statistically significant reduction in farm crop revenues. However, we observed notable variations depending on farm types, and the outcomes proved to be sensitive to the inclusion of different program years in the analysis.

The current regulation faces limitations such as a lack of spatial coordination among farmers, high monitoring costs, and a significant implementation gap. Collective agri-environmental schemes, where incentives are tied to collective performance rather than individual actions, offer a potential solution to these challenges. In EFFECT, we evaluated experimentally the potential of a collective agri-environmental scheme to regulate nitrogen leaching. We also tested alternative collective schemes with internal enforcement mechanisms (peer rewards and sanctions). We designed a collective scheme with a shared responsibility among farmers and society to address the water pollution problem. We evaluated the proposed schemes in terms of environmental effectiveness, social welfare and equity. Our findings suggest a potential for collective agri-environmental approaches combining voluntary and mandatory elements. However, internal enforcement mechanisms can have adverse effects on environmental effectiveness, social welfare, and equity. A well-designed collective incentive blending voluntary and mandatory elements may be sufficient to achieve desired environmental and economic outcomes.

In conclusion, the case study shows that the development of Danish nitrogen regulation has been shaped over time by negative and positive feedbacks from different stakeholders, farmer unions, environmental interest groups and government agencies. A successful scheme is likely to require higher flexibility and measures, including more effective measures. Allocation of effort to the local public good may be improved using hybrids of top-down and bottom-up models. More ex-post evaluation of AES is necessary to evaluate whether AES goals actually live up to their intended goals. A mix of methods (experiments and modelling) can support development of new AES in collaboration with farmers, farm advisors and programme developers.

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