

Land use policy criteria for cost-effective improvement of coastal waters in Denmark

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In Denmark, eutrophication of coastal areas is one of the major challenges in meeting the requirements from the Water Framework Directive (WFD). This eutrophication is mainly a cause of excessive nitrogen (N) loads from agricultural production, which can be abated by implementing land use policy measures. The cost-effectiveness of a land use policy may vary depending on choice of location of implementation as well as choice of measure. Utilization of spatial heterogeneity can significantly reduce the cost of improving the coastal water quality. However, this means that farmers will face different requirements due to e.g. their existing crop choices and use of manure and due to different biophysical conditions on their land, such as soil type and nitrogen retention capacity. The differential treatment of farmers warrant careful consideration of the implementation of a spatially varied land use policy. To reduce administrative complexity and ensure legitimacy of the policy implementation, transparent criteria are needed to discriminate between farmers in the legislation. Furthermore, the chosen criteria should be based on the most cost-effective choices. We set out to compare different criteria for a non-uniform policy, evaluating the cost-effectiveness of different criteria against a least-cost solution. To that aim, we combine a number of data sources to set up a spatially specific optimization model for land use in the whole of Denmark. The model minimizes the costs of meeting N load reduction targets, defined to achieve the water quality specified in the WFD river basin plans for Danish water and finds the composition and spatial location of the optimal abatement effort. The solution serves as a reference point to guide the choice of potential criteria for a non-uniform land use policy.