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Ammonia abatement strategies in livestock production: A case study of a poultry installation

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Abstract

This study uses a linear programming approach to compare the potential effectiveness of uniform rules (under the Integrated Pollution Prevention and Control Directive) and a landscape-scale (a scale that includes different land-uses) based policy for reducing ammonia (NH_3) emissions and their related impacts from an operating case-study poultry installation. The model incorporates a variety of potential NH_3 abatement techniques. It also incorporates the first application of a spatial model of the diffusion of environmental impacts from NH_3 emissions. This models N deposition at a nearby nature reserve.

The model finds that the uniform rules proposed under the Integrated Pollution Prevention and Control Directive (IPPC) are likely to be ineffective in certain contexts and that a landscape-scale approach is more suitable for reducing N deposition from livestock production units in environmentally sensitive locations. However, the adjustments required are associated with large reductions in net margin. This reflects the limited range of cost-effective NH_3 abatement techniques available. An alternative cost-effective abatement technique could be to maintain a spatial buffer between livestock production and sensitive receptors.

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1. Introduction

Agricultural activities give rise to significant amounts of air pollutants (Brink et al., 2001). Particular concerns have centred on the emissions of ammonia (NH_3) and its environmental impacts (Hornung and Sutton, 1995; Asman et al., 1998) and accordingly, policies have been developed that aim to reduce NH_3 emissions. The policies implemented to date have resulted from international agreements with targets being defined at a national level. This is the case, for example with the commitments to bring NH_3 emissions within national ceilings under the Gothenburg Protocol (Gothenburg Protocol, 1999; National Emissions Ceilings Directive, 2001).

Assessments of the expected effectiveness of these targets set at a national level are being conducted using models at the UK scale with a 5 km resolution (e.g. NEGTAP, 2001). This, and recent work on the landscape-scale variability in NH_3 and other atmospheric N compounds (at a 25 m resolution) (Dragosits et al., 2002; Theobald et al., 2004), suggest that existing policies will not succeed in protecting many semi-natural ecosystems, such as forests, moorlands and grasslands.

A policy approach that places the responsibility for adjustment at the farm level and that could operate in a more spatially discriminating way at a local level may be possible under the 1996 Integrated Pollution Prevention and Control (IPPC) Directive, but the approach taken so far for agriculture has focused on developing a modest set of Standard Farm Installation (SFI) rules that should be implemented irrespective of farm location.

There is a need to consider the effectiveness and costs of policies being developed and implemented in regulating site-specific N loads. To this end a Linear Programming (LP) model was developed and used in order to compare the potential costs and effectiveness of uniform rules (as currently being implemented under the IPPC Directive) and an alternative approach that could reflect local circumstances at the landscape-scale for a case-study poultry installation.

The model used incorporates the first application of the Simple Calculation of Ammonia Impact Limits (SCAIL) model in order to identify the impact of NH_3 emissions from specific agricultural units on a nearby ecosystem (in this instance a nature reserve). By linking the SCAIL model to the LP model, a cost-effective abatement package can be defined for the installation that will achieve critical loads for N at the nature reserve.

2. Economic model

When analysing the implications of integrating environmental and economic goals, extended economic models are required that include parameters for the