Spatial Fertiliser Management enhances the Efficiency of Policies

An international team of researchers has investigated the potential benefits of taking spatial considerations into account when designing policies to manage the use of fertilisers containing nitrogen. They have shown that nitrogen management based on the spatial variation of soil characteristics can reduce the use of nitrogen fertilisers by up to 25% without decreasing production yields, in comparison with uniform management. These findings highlight the importance of considering geographic specificities in the design of policies intended to control nitrate concentration in soils and groundwater.

In order to improve crop yields, the use of fertilisers containing nitrogen (N) has increased in the last few decades. Some of the nitrogen contained in such fertilisers leaches below the plant-root zone and into groundwater sources. In the latter, this leaching can cause an excessive development of certain types of algae that disturb aquifer ecosystems. In this regard, the European Union has set several Directives, including Directive 91/676/EEC, for the protection of waters against pollution caused by nitrates from agricultural sources which provides incentives for farmers to reduce the use of fertilisers containing nitrogen.

In response to this legislation, the State of Baden-Württemberg in Germany has a policy to increase reduction of the use of nitrogen-based fertilisers. Farmers receive 165€ per hectare if they manage to reduce nitrogen levels in the upper soil layer (0-90cm) below 45 kg/ha after harvest. This compensation payment is designed to compensate the yield decrease due to the reduction in the use of fertilisers.

In a recent paper, an international team of scientists has investigated to what extent spatial variations in soil properties are important in the design of policies intended to control groundwater nitrate concentration under EU legislation. To this end, they have computed the optimum N-based fertiliser application rate that maximises the marginal net profit of farmers given the targeted N-level in soil after harvest. They have simulated and compared the effects of the current management policy in Baden-Württemberg (uniform application of nitrogen over the field) and those of a policy with nitrogen targets depending on soil properties on the net return of producers and on the quantity of N-fertilisers used.

The results of their simulations show that the variable nitrogen management policy induces:

- A use of N-based fertilisers up to 25% lower than with current uniform management.
- Slightly higher net returns for the producers over the 28 years of the simulation using different weather pattern compared to current returns.

The authors conclude that there is a potential to increase the net return of producers by shifting from current uniform management of N-based fertilisers to variable-rate management, but the benefit of variable-rate management is strongly related to the current prices of nitrogen and corn, respectively. However, these findings highlight the advantage of taking into account the spatial variations of fields when designing such N-fertiliser policies.


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Additional information: The EC’s LIFE-Environment programme has funded several projects dealing with nitrogen and nitrogen management. These include the Italian LIFE project OptiMa-N (LIFE04 ENV/IT/000454) which seeks to establish a network for nitrate monitoring in order to help evaluate the contribution to nitrogen pollution made by agriculture. It also aims to foster the application of environmentally as well as economically sustainable practices (see project summary and website). The optimisation of the level of nitrogen in pig manure was the objective of a French project (LIFE98 ENV/F/000279) entitled ‘Nitrogen and odours destruction, and sterilisation of manure spreading - Smelox process’ (see project summary and website).

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