

Groundwater nitrate pollution: High-resolution approach of calculating the nitrogen balance surplus for Germany

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The latest inventory of the EU Water Framework Directive determined that 26.3% of Germany's groundwater bodies are in a poor chemical state regarding nitrate. As of late October 2016, the European Commission has filed a lawsuit against Germany for not taking appropriate measures against high nitrate levels in water bodies and thus failing to comply with the EU Nitrate Directive. Due to over-fertilization and high-density animal production, Agriculture was identified as the main source of nitrate pollution.

One way to characterize the potential impact of reactive nitrogen on water bodies is the soil surface nitrogen balance where all agricultural nitrogen inputs within an area are contrasted with the output, i.e. the harvest. The surplus nitrogen (given in kg N per ha arable land and year) can potentially leach into the groundwater and thus can be used as a risk indicator.

In order to develop and advocate appropriate measures to mitigate the agricultural nitrogen surplus with spatial precision, high-resolution data for the nitrogen surplus is needed. In Germany, not all nitrogen input data is available with the required spatial resolution, especially the use of mineral fertilizers is only given statewide. Therefore, some elements of the nitrogen balance need to be estimated based on agricultural statistics. Hitherto, statistics from the Federal Statistical Office and the statistical offices of the 16 federal states of Germany were used to calculate the soil surface balance annually for the spatial resolution of the 402 districts of Germany (mean size 890 km²).

In contrast, this study presents an approach to estimate the nitrogen surplus at a much higher spatial resolution by using the comprehensive Agricultural census data collected in 2010 providing data for 326000 agricultural holdings. This resulted in a nitrogen surplus map with a 5 km x 5 km grid which was subsequently used to calculate the nitrogen concentration of percolation water. This provides a considerably more detailed insight on regions where the groundwater is particularly vulnerable to nitrate pollution and appropriate measures are most needed.