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The effect of winter crops and crop residue management on nitrate leaching during winter

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Background & Objectives
Nitrate (NO_3-) leaching from farmland remains the predominant source of nitrogen (N) loads to ground- and surface waters. As residual soil mineral N (RSMN) content at harvest is often high and may increase by mineralisation from crop residues and soil organic matter, it is critical to understand which post-harvest management measures can be taken to restrict NO_3- leaching.

Materials & Methods
We simulated "worst-case" and alternative post-harvest management scenarios with the EU-rotate_N model [1]. The simulations started at a given RSMN content after applying the Flemish maximum allowed N fertilisation rates. Monte Carlo simulation were performed to assess the combined effect of variability in RSMN and weather conditions on NO_3- leaching [2]. We evaluated the different scenarios by comparing the mean NO_3- concentration after dividing the simulated NO_3- concentration at 90 cm by various values to include natural attenuation processes [3].

Results & Discussion
Monte Carlo simulations showed that RSMN and attenuated mean NO_3- concentration (ANCatt) were positively correlated for most scenarios and that the variability in ANCatt due to different weather conditions increased with higher RSMN. In the worst-case scenarios, the simulated ANCatt was lowest for cut grassland, intermediate for winter wheat, sugar beet and silage maize and highest for potatoes and lower for a silt loam than sandy soil. All of the simulated measures (catch or cash crop and crop residue management) significantly reduced the NO_3- concentration in the leaching water. For crops which are harvested late, the potential management measures are limited. Especially potatoes are a problem crop because of the high RSMN values. Undersowing grass in silage maize and removing N rich crop residues are promising options. The number of scenarios with an ANCatt complying with the Nitrates Directive depends on the local attenuation factor [2].

Conclusion
The NO_3- concentration was significantly reduced by the simulated measures. Regions with a small attenuation factor will require site specific plans with preconditions for specific crops or adaptation of crop rotations. A well-balanced crop combination on a subcatchment level is essential to achieve good ground- and surface water quality.

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