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## Does temperate agroforestry reduce nutrient leaching losses compared to cropland monocultures?

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Over the past decades, excessive use of fertilizers in cropland monocultures in combination with a decrease in fertilizer use efficiency, have led to an increase in nutrient leaching losses, especially for nitrate. Consequently, ground water pollution is widespread and starting to be recognized and potentially sanctioned by the European Union. Unfertilized tree rows alternating with crop rows (e.g. alley-cropping agroforestry) are hypothesized to act as a safety net by taking up excess nutrients below the crop-rooting zone. Here, we measured leaching losses of nitrogen (N), phosphorus (P) and potassium (K) during two growing seasons in agroforestry systems and adjacent monocultures at three sites in Germany, representing a wide range of soil characteristics. Leaching losses of N, P and K were generally lower under agroforestry tree rows at all sites compared to agroforestry crop rows or crop monocultures. Overall, agroforestry reduced nitrate leaching losses by up to 82% compared to monocultures, but showed comparable losses of P and K. Nutrient leaching losses were high in the agroforestry crop rows close to the tree rows where crop productivity is lowest due to resource competition with trees. An adjusted management, e.g. reduced fertilizer inputs close to the tree rows, may counteract these losses. Our results suggest that agroforestry has the potential to reduce nutrient leaching losses through the trees and the application of fertilizer should be reduced in the agroforestry crop row close to the trees. The reduction in nutrient leaching losses in agroforestry indicates an increase in the soil function of water filtration. In order to achieve large-scale implementation of temperate agroforestry, its environmental benefits need to be financially valued for farmers to adapt this widely applicable land use alternative. The presented project, SIGNAL (Sustainable intensification of agriculture through agroforestry) is part of the German research initiative BonaRes (Soil as a sustainable resource).