Estimation of long-term environmental inventory factors associated with land application of sewage sludge - DTU Orbit (08/11/2017)

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Land application of sewage sludge has a number of advantages over other alternatives, but is also associated with environmental impacts. To make proper assessments of different sludge treatments, it is crucial to have reliable estimates of emissions after the application of different sludge types. However, because of the complexity of the agricultural production system, it is difficult to estimate emissions consistently under different conditions. In the current paper, a mechanistic agro-ecosystem model was calibrated to be able to simulate different sludge types stabilized using different techniques. Subsequently, 100 year model simulations were used to provide emission factors as well as harvest and carbon sequestration factors (collectively called environmental inventory factors) under a variety of environmental conditions. Environmental inventory factors were calculated under both high crop response conditions (i.e. when nitrogen was limiting) and low crop response conditions (i.e. when nitrogen was not limiting). The average high response nitrogen harvest factor over the tested environmental conditions was ranging from 0.06 to 0.30 for the different sludge types included. This means that if an additional 1 kg of nitrogen is applied with sludge, between 0.06 and 0.30 kg additional nitrogen is harvested. This is considerably lower than for mineral fertilizer with an average value of 0.63. The low response harvest factors were considerably lower, ranging from 0.03 to 0.13. The emission factor for nitrous oxide nitrogen was ranging from 0.024 to 0.034, consistently being higher under high response conditions. For nitrogen leaching to the groundwater, the high response emission factor ranged from 0.20 to 0.50 for the different sludge types while the low response were slightly higher ranging from 0.18 to 0.55. The average carbon sequestration factor across the different environmental conditions ranged from 0.03 to 0.05 for the different sludge types. In conclusion, the approach using an agro-ecosystem model to estimate inventory factors associated with land application of sludge under varying conditions proved very powerful and would have been virtually impossible by experimental means.

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