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Quantification of mitigation potentials of agricultural practices for Europe

J.P. Lesschen (1), P.J. Kuikman (2), P. Smith (3), R.L. Schils (2), and D. Oudendag (2)

(1) Alterra, Wageningen UR, Wageningen, Netherlands (janpeter.lesschen@wur.nl), (2) Alterra, Wageningen UR, Wageningen, Netherlands, (3) Institute of Biological and Environmental Sciences, University of Aberdeen, Scotland, UK

Agriculture has a significant impact on climate, with a commonly estimated contribution of 9% of total greenhouse gases (GHG) emissions. Besides, agriculture is the main source of nitrous oxide and methane emissions to the atmosphere. On the other hand, there is a large potential for climate change mitigation in agriculture through carbon sequestration into soils. Within the framework of the PICCMAT project (Policy Incentives for Climate Change Mitigation Agricultural Techniques) we quantified the mitigation potential of 11 agricultural practices at regional level for the EU. The focus was on smaller-scale measures towards optimised land management that can be widely applied at individual farm level and which can have a positive climate change mitigating effect and be beneficial to soil conditions, e.g. cover crops and reduced tillage.

The mitigation potentials were assessed with the MITERRA-Europe model, a deterministic and static N cycling model which calculates N emissions on an annual basis, using N emission factors and N leaching fractions. For the PICCMAT project the model was extended with a soil carbon module, to assess changes in soil organic carbon according to the IPCC Tier1 approach. The amount of soil organic carbon (SOC) is calculated by multiplying the soil reference carbon content, which depends on soil type and climate, by coefficients for land use, land management and input of organic matter. By adapting these coefficients changes in SOC as result of the measures were simulated. We considered both the extent of agricultural area across Europe on which a measure could realistically be applied (potential level of implementation), and the current level of implementation that has already been achieved

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The results showed that zero tillage has the highest mitigation potential, followed by adding legumes, reduced tillage, residue management, rotation species, and catch crops. Optimising fertiliser application and fertiliser type are the measures with the largest positive effect on N2O emissions. Overall the results showed that the additional mitigation potential of each individual measure is limited, but taken together they have a significant mitigation potential of about 10 percent of the current GHG emissions from agriculture. Besides, most of the measures with high mitigation potentials are associated with no or low implementation costs. Although CH4 and N2O are the most important GHG emitted from agricultural activities, it is more difficult to mitigate these emissions than increasing soil organic carbon (SOC) stocks and thus compensate them through carbon sequestration. However, the effect on carbon is only temporary and sequestered SOC stocks can easily be lost again, while for N2O the emission reduction is permanent and non-saturating. Another important implication that follows from our results is the large regional difference with regard to mitigation potential and feasibility of implementation. Policy measures to support agricultural mitigation should therefore be adjusted to regional conditions.