# Field emissions of $N_2O$ during biomass production may affect the sustainability of agro-biofuels

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One way of reducing the emissions of fossil fuel-derived $CO_2$ is to replace fossil fuels with biofuels produced from agricultural biomasses or residuals. However, cultivation of soils results in emission of other greenhouse gasses, especially nitrous oxide ($N_2O$). Previous studies have shown that field emissions of $N_2O$ contribute significantly to total greenhouse gas emissions during biofuel production, and in terms of global warming $N_2O$ emissions may counterbalance a considerable part of the avoided fossil $CO_2$ emissions that are achieved by fossil fuel displacement. In the present study, we relate measured field emissions of $N_2O$ to the reduction in fossil fuel-derived $CO_2$, which is obtained when agricultural biomasses are used for biofuel production. The analysis includes five organically managed crops (*viz.* maize, rye, rye-vetch, vetch and grass-clover) and three scenarios for conversion of biomass to biofuel. The scenarios are 1) bioethanol, 2) biogas and 3) co-production of bioethanol and biogas. In scenarios 3, the biomass is first used for bioethanol fermentation and subsequently the residue from this process is utilized for biogas production. The net reduction in greenhouse gas emissions is calculated as the avoided fossil fuel-derived $CO_2$, where the $N_2O$ emission has been subtracted. This value does not account for $CO_2$ emissions from farm machinery and during biofuel production. We obtained the greatest net reduction in greenhouse gas emissions by co-production of bioethanol and biogas or by biogas alone produced from either fresh grass-clover or whole crop maize. Here the net reduction corresponded to about 8 tons $CO_2$ $ha^{-1}$ $yr^{-1}$.