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European greenhouse gas fluxes from land use: the impact of expanding the use of dedicated bioenergy crops.

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Bioenergy derived from vegetation cycles carbon to and from the atmosphere using the chemical energy fixed by the plants by photosynthesis using solar energy. However bioenergy is not carbon neutral as energy is used and greenhouse gasses (GHG) are emitted in the process of growing bioenergy feeedstocks and processing them into a usable fuel, whether it is biomass or liquid fuel such as biodiesel or bioethanol. Using bio instead of fossil fuels replaces greenhouse gas emissions from coal, oil and gas by those of the biofuel. To estimate the impact on European greenhouse gas fluxes of expanding the use of bioenergy, it is necessary to quantify the difference between the GHG emissions associated with producing and using the biofuel and the fossil fuel it replaces, and to take into account any emissions associated with the change from the original land use to that of growing the bioenergy feedstock. This involves estimating any displacement of food, fibre and timber production to other geographical areas. Here we report on a study of the GHG emissions from the potential increasing use of a variety of biofuels produced from feedstocks grown in the EU countries. The GHG emissions of the historical land use of EU27 have been modelled using ECOSSE on a 1 km grid to estimate the impact the agriculture intensification and land use change of the last 50 years and the associated crop yield gains. The excess land made available from the yield gains is considered to be available for use for bioenergy, and the yields of potential bioenergy feedstocks are estimated from EUROSTAT data or modelled using the bioenergy crop growth model MISCANFOR. These yields are used to calculate the energy used and GHG emissions associated with the use of the resulting biofuel using a life cycle analysis, and to estimate the organic matter input into the soil. The ECOSSE model is then used to estimate the soil carbon change and GHG emissions associated with the land use change to growing the bioenergy feedstock. This data has been used to quantify the net change in GHG emissions and the quantity of energy produced. We conclude that home grown bioenergy will be a modest contributor to both GHG emission reduction and energy demand.