Crop management to reduce biofuels’ carbon debt

It is widely considered that using biofuels produces less greenhouse gas (GHG) emissions than using fossil fuels. However, there are concerns that the possible effects of land use change (LUC) may outweigh these benefits. New research looks at the effects of sustainable crop management as a means of reducing the negative impacts of LUC.

Biofuels form an important part of the EU’s strategy for renewable energy, which stipulates that 10 per cent of fuel used for transport should be derived from biofuels by 2020. However, there is concern that GHG release as a result of LUC could produce a “carbon debt”. The time it takes to overcome this carbon debt and begin providing cumulative GHG benefits is called the “payback period”. For biofuels, this is estimated to be 100–1000 years, depending on the ecosystem involved.

The researchers modelled the payback period of E85 (a fuel comprising of 85 per cent bioethanol and 15 per cent petrol) production and use in forty American counties that represented a wide variety of soil, climate and crop production practices. The biofuel in this study was produced from maize. Direct and indirect LUC from grassland and forest within these counties were considered. Direct LUC is supply-chain orientated and links the conversion of a specific piece of land to resulting GHG emissions, whereas indirect LUC links biofuel production to the conversion of undisturbed land elsewhere through market forces. For example, if a farmer chooses to grow his or her corn for biofuels, this could lead to another farmer clearing forest elsewhere to grow more corn in order to meet demand for more traditional uses of the crop.

Several variables that have not been addressed in previous land use change studies were also included, such as tilling and winter cover crop practices. A number of scenarios were studied and the payback period calculated by plotting the cumulative GHG benefit against the years of cropping. In addition, the soil organic carbon (SOC) levels were also considered. Cropping management greatly influences SOC levels and can increase the carbon sequestration rates.

The analysis shows that cropping management is a key factor in estimating GHG emissions associated with LUC. In the study’s worst case scenario of plough-tillage, the payback period for temperate zone grassland conversion is 18 years and for temperate zone forest conversion is 37 years. Sustainable cropping practices (such as no-till and the planting of winter cover crops to improve soil quality) reduce the payback period to 3 years for the grassland conversion and to 14 years for forest conversion. No-till and cover crop practices also yield higher soil organic carbon (SOC) levels in maize fields derived from former grasslands or forests than the SOC levels that result if these grasslands or forests are allowed to continue undisturbed.

This study highlights the important need to incorporate the effects of indirect LUC in life-cycle analyses and calls for more research to help lead to consensus on how to analyse its effects in order to produce better estimates of payback periods.


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