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Bioenergy Ecosystem Land-Use Modelling and Field Flux Trial

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Climate change impacts resulting from fossil fuel combustion and concerns about the diversity of energy supply are driving interest to find low-carbon energy alternatives. As a result bioenergy is receiving widespread scientific, political and media attention for its potential role in both supplying energy and mitigating greenhouse (GHG) emissions. It is estimated that the bioenergy contribution to EU 2020 renewable energy targets could require up to 17–21 million hectares of additional land in Europe (Don et al., 2012). There are increasing concerns that some transitions into bioenergy may not be as sustainable as first thought when GHG emissions from the crop growth and management cycle are factored into any GHG life cycle assessment (LCA).

Bioenergy is complex and encapsulates a wide range of crops, varying from food crop based biofuels to dedicated second generation perennial energy crops and forestry products. The decision on the choice of crop for energy production significantly influences the GHG mitigation potential. It is recognised that GHG savings or losses are in part a function of the original land-use that has undergone change and the management intensity for the energy crop. There is therefore an urgent need to better quantify both crop and site-specific effects associated with the production of conventional and dedicated energy crops on the GHG balance. Currently, there is scarcity of GHG balance data with respect to second generation crops meaning that process based models and LCAs of GHG balances are weakly underpinned. Therefore, robust, models based on real data are urgently required.

In the UK we have recently embarked on a detailed program of work to address this challenge by combining a large number of field studies with state-of-the-art process models. Through six detailed experiments, we are calculating the annual GHG balances of land use transitions into energy crops across the UK. Further, we are quantifying the total soil carbon gain or loss after land use change at 100 fieldsites which encapsulate a range of UK climates and soil types. Our overall objective is to use our measured data to parameterise and validate the models that we will use to predict the implications of bioenergy crop deployment in the UK up to 2050. The resultant output will be a meta-model which will help facilitate decision making on the sustainable development of bioenergy in the UK, with potential deployment in other temperate climates around the world. Here we report on the outcome of the first of three years of work.

This work is based on the Ecosystem Land Use Modelling & Soil Carbon GHG Flux Trial (ELUM) project, which was commissioned and funded by the Energy Technologies Institute (ETI).

Don et al. (2012) Land-use change to bioenergy production in Europe: implications for the greenhouse gas balance and soil carbon. GCB Bioenergy 4, 372-379.