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Whole system analysis of second generation bioenergy production and Ecosystem Services in Europe

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Bioenergy crops are an important source of renewable energy and are a possible mechanism to mitigate global climate warming, by replacing fossil fuel energy that has higher greenhouse gas emissions. There is, however, uncertainty about the impacts of the growth of bioenergy crops on ecosystem services. This uncertainty is further enhanced by current climate change. It is important to establish how second generation bioenergy crops (Miscanthus, SRC willow and poplar) can contribute by closing the gap between reducing fossil fuel use and increasing the use of other renewable sources in a sustainable way. The project builds on models of energy crop production, biodiversity, soil impacts, greenhouse gas emissions and other ecosystem services, and on work undertaken in the UK on the ETI-funded ELUM project (www.elum.ac.uk). We will present estimated yields for the above named crops in Europe using the ECOSSE, DayCent, SalixFor and MiscanFor models. These yields will be brought into context with a whole system analysis, detailing trade-offs and synergies for land use change, food security, GHG emissions and soil and water security. Methods like water footprint tools, tourism value maps and ecosystem valuation tools and models (e.g. InVest, TEEB database, GREET LCA Model, World Business Council for Sustainable Development corporate ecosystem valuation, Millennium Ecosystem Assessment and the Ecosystem Services Framework) will be used to estimate and visualise the impacts of increased use of second generation bioenergy crops on the above named ecosystem services. The results will be linked to potential yields to generate “inclusion or exclusion areas” in Europe in order to establish suitable areas for bioenergy crop production and the extent of use possible. Policy is an important factor for using second generation bioenergy crops in a sustainable way. We will present how whole system analysis can be used to create scenarios for countries or on a continental scale. As an example, we will present two scenarios for the whole system on a country basis, based on current renewable energy policy, to visualise the impact of changing policy on the use of bioenergy crops. This will include the economic implications which are directly linked to renewable energy policy, best practice management recommendations, impacts on land use change and food security as well as synergies and trade-offs on other ecosystem services (GHG emission, soil C, nitrogen, water and air security). The aim is to show how second generation bioenergy crops can be used sustainably and what is needed to do this successfully on a large scale. The results can form a basis for future policy development in order to reach the goals of the Paris 2015 agreement.