Life Cycle Assessment of biogas production in central Germany – a regionalized approach

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The contribution of Biogas production to a climate-friendly and sustainable energy supply plays an integral role in the German “Energiewende”. A major argument for the promotion of biogas was the climate change mitigation potential. Heavily subsidized, the installation of biogas plants developed rapidly during the last decade and experienced a massive increase. To the end of 2013, there are more than 750 Biogas plants installed with a total capacity of approximately 370 MWel in the states of Central Germany (Saxony Thuringia, Saxony – Anhalt).

Recently, skepticisms were growing in the public due to increased production of energy crops. The farmers are expected to act prudently also in relation to landscape conservation and economics. Therefore, development options for more diverse agricultural production systems need to be analyzed. A large variety of studies was produced assessing the environmental effects, especially energy efficiency and greenhouse gas (GHG) emissions using Life Cycle Assessment (LCA) based approaches. Most of them are applied on national level using average or case specific input data. This approach leads to inaccurate results when drawing conclusions for environmental effects on a regional level, capturing spatial heterogeneities and effects on the regional systemic level of substrate and biogas production which is required e.g. for the calculation of GHG mitigation potentials in greater detail and the evaluation of potential regulative approaches.

Bringing together regional infrastructure, spatial variation of natural conditions, agricultural management systems and regional characteristics of biogas production, an improved, regional applicable LCA modelling approach is developed. For each region, specific agricultural management regimes are developed. Crop cultivation, biogas production and use are estimated on a regional level using agroclimatic conditions as delimitation for production regions. The regionalization of the agricultural data inventory is based on work developed in the project group by Witing et al. As a first result, substantial differences in the GHG mitigation potential were found between different biogas production pathways for the region central Germany. However, it is quite evident that the overall averaged impact strongly depends on the level of regionalization and data aggregation.