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1S1a Models and tools for estimating circularity of alternative food and agricultural systems

Circular bio-economy as a climate strategy: an integrated quantitative assessment of its potential and costs in agri-food sector

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In line with the Paris Agreement, the EU agri-food system is challenged to bring GHG emissions towards neutrality in 2050. There are an increasing number of studies trying to quantify the overall synergistic effects and the potential of circular economy as a climate strategy to reach this target. However, a reliable quantification of the extent that these measures can actually contribute to climate change mitigation is still lacking. This is mainly because often models from specific discipline and impact domains are uses, which neglect the spillover effects across the other domains and possible offsetting impacts. In this paper we explore solutions for this shortcoming by using the WR modelling toolbox which uses the synergies and complementary features of models from different disciplines to quantify a wider impact of circularity measures on climate mitigation and their costs. To illustrate this solution, we perform an ex-ante analysis of the potential effects of a set of specific agri-food circularity measures in the EU by 2050 and use socio-economic models MAGNET and BIOSPACS, land use and land use change model iClue, livestock model GLEAM and food safety models to quantify a wider range of impact domains and provide a better picture of the net sustainability benefit of these measures. The circularity measures include aspects of the reuse of human excreta, food waste, feeding loss, process waste, and use of manure (than as fertilizer), crop losses and crop residues. The socio-economic aspects of these scenario include reducing EU feed imports, and diet change as an important underlying factor. For the latter a diet scenario is based on Eat-Lancet diet is developed. To provide a more realistic view of the potential and costs of these selected circularity measures, a crucial aspect is the overall level of economic activity in terms of production, driven by technological change and population growth, and the emission intensity of production which is driven by technological change and mitigation policies. Therefore, the scenarios are analyzed using a contextual baseline, which includes assumptions on demography, economic growth, innovation, productivity, and other related policies such as the EU biofuel mandates or NDC pledges. For the baseline, projections from the IPCC based 'Middle Road' Shared Socio-economic Pathway (SSP) and climate scenario RCP 4.5 are used. The results include a set of indicators measuring the net GHG emission impact of the measures, and their impact in the three pillar of the sustainability, People, Profit, and Planet.

Keywords: Circularity, Food system, Integrated Modelling, Land use, Food Safety