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CLIMATE CHANGE MITIGATION

Bioenergy potential and food system pathways

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As highlighted by the latest Intergovernmental Panel on Climate Change reports, bioenergy is essential for the achievement of long-term climate change mitigation targets. Yet, estimates of its potential contribution towards these targets — and associated impact on land use and food production — vary widely. Uncertainty exists concerning future agricultural yields, the resources required to sustain different diets, and several other parameters related to population growth, food prices and trade.

Gerald Kalt, from BOKU-Vienna, and colleagues estimate the bioenergy potential of energy crops, manure and crop residues compatible with projections for the parameters above proposed in the FAO report *Alternative Pathways to 2050*. Using the 'BioBaM' model (K.-H. Erb et al., *Nat. Commun*. 7, 11382; 2016), they calculate the balance between biomass supply and demand for 11 world regions, 14 biomass demand categories, and respective primary commodities. Greenhouse gas (GHG) emissions from the livestock sector, agricultural activities and changes in biomass and soil carbon stocks (from grassland conversion into cropland, livestock intensification and crop residue removal) are also considered.

Resulting GHG cost supply curves reveal how the effects of biomass on GHG emissions vary depending on local conditions, and indicate the potential of biomass consistent with given GHG emission levels. Implied in these estimates is the GHG opportunity costs of bioenergy production — specifically natural vegetation regrowth that should occur had land been put aside instead of used for growing energy crops. Among major conclusions is that healthy, low-meat diets can substantially increase the climate change mitigation potential of biomass through energy crop plantations (which outweighs the effect that less manure would have on bioenergy potential). Besides, bioenergy potentials are highly dependent on grassland intensification. Without intensification, bioenergy potential is limited but GHG costs of energy crops tend to be low compared to the fossil fuels they intend to replace. Contrastingly, grassland intensification increases bioenergy potential but at high GHG costs relative to natural vegetation regrowth, often rendering the allocation of highly productive areas for energy crops detrimental to carbon balances.

By examining how a given level of food production and consumption affects bioenergy, this study elicits important synergies and trade-offs between dietary choices, agriculture and climate change mitigation, which may be overlooked unless a systemic approach is adopted.

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