GLOBIOM

GLOBIOM is a global recursive dynamic (10-year-step intervals up to 2050) partial equilibrium model for the forest and agricultural sectors. It was created to explore trade-offs and synergies around land use and ecosystem services. By including not only the bioenergy sector but also forestry, cropland, grassland and livestock management, the model allows for a full account of the most important agriculture and forestry GHG sources.

The market equilibrium for agricultural and forest products is computed by allocating land use among production activities to maximize the sum of producer and consumer surplus, subject to resource, technological, demand, and policy constraints. GLOBIOM includes six land cover types: cropland, grassland, other natural vegetation land, managed forests, unmanaged forests and plantations.

Economic activities are associated with the first four types. Total forest area is calibrated according to FAO Global Forest Resources Assessments (FRA). Depending on the relative profitability of production activities, the model switches from one land cover type to another, implying a conversion cost, which increases with the area of land converted. This cost is taken into account in the producer optimization behaviour, which builds up into the supply side of the model.

Demand and international trade occur globally for 57 regional aggregates. Besides primary products for the different sectors, the model has several final and by-products, for which the processing activities are defined. Trade is modelled following the spatial equilibrium approach: the trade flows are balanced out between different specific geographical regions based on cost competitiveness.

GLOBIOM accounts for ten sources of GHG emissions, inventories of which are based on IPCC accounting guidelines. The sources of carbon stocks depending on the land cover include G4M, the 2010 Forest Assessment Report (FAO, 2010) and Ruesch et al. (2008). In the model, the mitigation mechanisms in the agricultural sector include technological options, e.g., improved fertilizer management (based on the mitigation option database from EPA – Beach et al. 2015), structural changes, e.g., crop management systems, and consumers' response to price changes.

A number of biofuels feedstock (e.g., crops, oilseeds, perennials, short rotation plantations, woody biomass), and various energy conversion processes (e.g., combustion, fermentation) are modelled in GLOBIOM as well. Competition for biomass resources between the various uses (i.e., food, feed, timber and energy) is simulated based on the relative profitability of these uses, which, in turn, depend on the crop management systems. Within each management system, input structure follows a Leontief production function. However, crop yields can change in reaction to external socio-economic drivers. Long-term technological change and crop rotation (using model CropRota described in Schönhart et al. 2011) are included in the yield functions as well.

The global livestock sector in GLOBIOM distinguishes dairy and other bovines, dairy and other sheep and goats, laying hens and broilers, and pigs. The production activities are defined in several alternative production systems, e.g., grass based (arid, humid, temperate/highlands), mixed crop livestock (arid, humid, temperate/ highlands), and other for livestock. Feed rations are defined with a digestion model RUMINANT (see Havlík et al. 2014). Switches between production systems allow for feedstuff substitution and for intensification or extensification of livestock production (the source for this section is Blanco et al. 2019).

References:

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