A Maximum Entropy Approach to the Hybridization of MRIOs for the Estimation of Biodiversity Footprints

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One of the biggest contributors to global biodiversity loss is land use and land use change, with agriculture being its single largest driver. Nowadays, many environmental footprint approaches connect socio-economic drivers to biodiversity impact through the mapping of supply chains using global multiregional input-output (MRIO) analysis. For calculating land use impacts on biodiversity, researchers have made great progress in mapping the distribution of agricultural activity and the corresponding change in land use, as well as the characterizing these changes in terms of threats to biodiversity at high spatial resolution. Yet, relating spatial patterns of agricultural activity, land use change and biodiversity loss to their socio-economic drivers through the global network of supply-chains is significantly hampered by the resolution of agricultural modelling in MRIO analysis. Agriculture is often modelled as a single sector nationally, with no distinction between, for example, the radically different agricultural practices employed in large-scale grazing to horticulture. At best, a disaggregation of the agriculture sector is done using basic coefficient data. The challenge, however, is common to any that involves integrating highly detailed statistics in mass units into global monetary MRIOs. Typically, constructing hybrid accounting frameworks require a series of successive steps for the imputation of missing information, transformations between units, handling multiple different product and industry classifications, and, finally, reconciling estimates with mass- and financial balances.
This paper builds on a physical MRIO mapping production, trade, and utilization of primary and processed agricultural and forestry products covering about 175 countries and 130 commodities and develops a Maximum Entropy (MaxEnt) model for its integration into a global monetary MRIO database. The MaxEnt model allows for the simultaneous estimation of unobserved commodity flows as well as corresponding prices such that possibly conflicting data constraints in various units of measurement, levels of aggregation and mismatching classifications are simultaneously satisfied.