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‘Energy efficiency of extractive agriculture in Colombia, 1916-2015’

Biomass production is key to deal with current and future human needs for food, biofuels, and raw materials, but it is also paramount to cope with the global ecological crisis. Fund-flow and multi-EROI analysis in agrarian metabolism (AM) give us information on how the agroecosystem works and the relationship between the agrarian sector and the ecological systems in the long-run. This novel methodological approach highlights the energy cost of the reproductive functioning of agroecosystems as a co-production with nature, thus including into the energy analysis the maintenance of biodiversity-related ecosystem services on which society depends on.

Under such a frame, this work aims to measure the changes experienced in energy efficiency and sustainability of the Colombian agrarian system during the 20th century. We analyse the capacity of the agroecosystem to produce food, feed, and raw materials to society while reproducing its living funds. To do that, we use official records, FAOSTAT and secondary data to estimate annual time series on energy flows involved in agroecosystem and to figure a set of Energy Returns On Investment indicators (EROIs). We homogenised the data by using historical energy factors.

The flow analysis reports on the fall of NPP while extraction rose at the pace of agricultural industrialization. The process of change involved less available energy to wild species, the drop of pasture as the major reused biomass and the replacement of forest for tropical crops into the final production. Besides, during the four periods of external inputs entering identified, we stress two waves of technological change which affected the energetic productivity of crop and livestock production. At the international level, Colombia exhibits low rates of EROIs only comparable with the performance of the late-colonizing counties of the Great Plains and the cases where the livestock stands out. Although different in levels, the energy returns measuring efficiency and sustainability of agroecosystem highlight increasing dependence on external inputs and a loss of its reproductive capacity.

This circular multi-EROI energy analysis contributes to place Colombian agriculture into the international debate on the socio-ecological transition of Western Agriculture and give some clues on biomass production at the country level. Time series analysis may help to measure the long-run effect of agricultural industrialization on output and sustainability under the ongoing research.