Carbon Footprint of winter-wheat based cropping systems focused on food production

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This study aims to assess the global warming impact of winter-wheat cultivation under different rotation systems with potato, maize or oilseed rape over a six-year period in the region of Galicia, Spain, to identify the rotation system most favourable from a climate-change perspective, following a Consequential Life Cycle Assessment – (CLCA) approach. The results of this study are intended to guide farmers in their decision making regarding which cropping scenario they should choose in order to produce wheat grain for bread making with the lowest carbon footprint.
In this study, commercial and native varieties were considered for assessment in different crop-rotation systems. Three different crop companion strategies are assessed including potato and maize (traditional crops) and oilseed rape under different management regimes (conventional and organic, the latter only with the native variety). In the case of potato, the rotation system includes two consecutive years of wheat and one of potato. For rotations with maize and oilseed rape, wheat and the alternate crop are alternatively cultivated. The assessment is performed considering 1 kg of grain as functional unit.
The results showed that producing co-products and using animal manure as fertilizer does not necessarily reduce the environmental impact of the target product (i.e. wheat grain). The cultivation of native winter-wheat under organic management with maize is the best choice (-1.86 kgCO2eq·kg-1 grain). Nevertheless, the cultivation of the Galician variety under rotation with oilseed rape and conventional management is the worst choice (3.24 kgCO2eq·kg-1 grain). The reason behind these results is mainly the different delimitation of system boundaries, among other methodological factors. Organic scenarios report a climate-change profile that is penalized by the marginal electricity production. Moreover, these scenarios
report the lowest crop yields in comparison with conventional management, which directly involve highest impacts when the results are quantified per kg of grain.
Therefore, it should be borne in mind that the assumptions necessary for a CLCA have a major impact on the final results. In this regardm the identification of the marginal technology chosen for electricity production has a pronounced influence on the global warming impact and could led to opposing results.