Considering water and soil conservation works in Life Cycle Assessment: focus on contour ridges and erosion impacts

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Abstract

Soil is a rare natural resource and it is at the center of the main issues in agronomy, environment and land use planning. At global level, erosion is one of the major soil degradation processes and it is responsible for the decrease in agronomic potential of soils and in agricultural land surfaces. Water and soil conservation works (WSCW) are built to protect soil from erosion. The financial and environmental cost the WSCW construction is very high. However, the positive impacts of WSCW are not taken into account in Life Cycle Assessment (LCA). The objectives of this study is to intergrate the impact of WSCW on soil quality in LCA. There are different types of WSCW with different functions and they act differently on erosion process. In this study we focussed on contour ridges (CR) because they are associated to crop systems. CR are generally built in upland areas to reduce runoff and erosion, to increase on-site deposition of eroded particles and to increase local water infiltration. They modify water and soil flows at catchment scale, so it is necessary to use a model able to calculate the inventory flow at the catchment and not at the plot level. In this study we present a methodology to integrate the impact of CR on topsoil erosion at the catchment level and to compute characterization factors in presence of such WSCW. The proposed method was applied in a case study in semi-arid context in central Tunisia (Merguellil watershed) which presents the issues of over-exploitation of water resources, accelerated land degradation and a high expansion of conservation works. In order to investigate the impact of WSCW on topsoil erosion, diffrent catchment scenarios (with and without CR) and land use types were tested using soil redistribution model (LandSoil model). For life cycle impact assessment, we focussed on two midpoint impact categories of LANCA soil functions : erosion resistance and mechanical infiltration. The CFs were calculated using the two models : LANCA and LandSoil models. These CFs were then compared. The results showed how contour ridges can modify topsoil erosion process, the erosion impact depend on location of landuse and contour ridges increase mechanical infiltration of soil. However, these impacts were not considered in LANCA model. In conclusion, It is necessary to integrate the positive impacts of contour ridges in life cycle assessment. It will be also neccessary to integrate the impact of the other types of WSCW in topsoil erosion impact modelling.