LCA as a support tool for forecasting scenarios: the case study of Danish spring barley production in a changing climate

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LCA as a support tool for forecasting scenarios: the case study of Danish spring barley production in a changing climate

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One of the most contributing sectors to the global greenhouse gas (GHG) emissions is agriculture, which including crop and livestock production, forestry and associated land use changes is responsible for up to 30% of the emissions according to the Intergovernmental Panel on Climate Change (IPCC). Nowadays, a quarter of the Danish land used as cropland area is cultivated with spring barley for malting and feed, and spring barley is supposed to have an important share of cropland also in the future. To support a development towards a more sustainable Danish agriculture, there is a need to assess the environmental impacts connected with this production system.
Life Cycle Assessment (LCA) methodology can be used to predict how the environmental impacts of production and consumption systems will change in the future as a result of the changing climate. In this paper a consequential LCA is performed to model the main changes in the environmental impact of barley production that can be expected in Denmark in 2075, if the climate changes according to the IPCC A1FI scenario. Considering that the lack of primary data is one of the most important drawbacks affecting the reliability of LCA studies, there is a need to base future predictions on measured data from the system studied. This is rarely possible when studying the impacts of future climate changes; however, in the present study experimental data on realistic future scenarios were available.
The baseline of the study is the current barley production in Denmark, from a cradle to farm gate perspective. The main deviations from the current scenario have been identified for each of the spring barley field work processes. Data about crop yields in the future scenario were obtained from experiments in which growing conditions of the future climate were simulated in the climate phytotron RERAF (Risø Environmental Risk Assessment Facility). The effect of different future

environments were tested, including single factor treatments with increased CO_2 or temperature, as well as more realistic treatments, where increased CO_2 and temperature were combined.
This paper elaborates on the main challenges encountered when assessing barley production in a future climate using LCA, including estimation of future trends in fungal diseases, crop yield and quality of the investigated crop. Preliminary results of the comparative LCA are presented to show which aspects are most important to determine in order to forecast the most realistic scenario. Different options for conducting sensitivity analysis will also be discussed in order to define which aspects need to be prioritized in the LCA modeling. The results of such a study can provide recommendations and suggest strategies for policy makers in the agriculture sector. Possible solutions include the use of adaptive measures, such as crop genotype selection, changed cultivation practice and resource management in order to compensate for possible reductions in the yield and quality of the crops.