Eco-efficient production of spring barley in a changed climate: A Life Cycle Assessment including primary data from future climate scenarios - DTU Orbit (28/12/2018)

The paper has two main objectives: (i) to assess the eco-efficiency of spring barley cultivation for malting in Denmark in a future changed climate (700 ppm [CO2] and +5 °C) through Life Cycle Assessment (LCA) and (ii) to compare alternative future cultivation scenarios, both excluding and including earlier sowing and cultivar selection as measures of adaptation to a changed climate. A baseline scenario describing the current spring barley cultivation in Denmark was defined, and the expected main deviations were identified (differences in pesticide treatment index, modifications in nitrate leaching and change in crop yield). The main input data originate from experiments, where spring barley cultivars were cultivated in a climate phytotron under controlled and manipulated treatments. Effects of changed climate on both crop productivity and crop quality were represented, as well as impacts of predicted extreme events, simulated through a long heat-wave. LCA results showed that the changed climatic conditions will likely increase the negative impacts on the environment from Danish spring barley cultivation, since all environmental impact categories experienced increased impact for all investigated scenarios, except under the very optimistic assumption that the pace of yield improvement by breeding in the future will be the same as it was in the last decades. The main driver of the increased environmental impact was identified as the reduction in crop yield. Therefore, potential adaptation strategies should mainly focus on maintaining or improving crop productivity. The LCA also showed that selection of proper cultivars for future climate conditions including the challenge from extreme events is one of the most effective ways to reduce future environmental impacts of spring barley. Finally, if yield measurements are based on relative protein content, the negative effects of the future climate seem to be reduced. © 2015 Elsevier Ltd. All rights reserved.