Developing tools for quantitative assessment of the environmental impacts of GMO crops under present and future climate circumstances

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Background & objectives
Since the dawn of the industrial age, CO₂ levels in the atmosphere have been rising. For agriculture in temperate regions, this generally results in higher crop yields. However, most of additional biomass is starch, resulting in a dilution of the mineral and protein content of crops. Billions of people are already suffering from zinc deficiency or are at risk of zinc deficiency. Mineral dilution will make this problem even more severe. Therefore, the research scheme ‘Development of genetically modified cereals adapted to the increased CO₂ levels of the future’ aims to develop a cis-genetically modified barley crop, which takes up more zinc from the soil. The aim of this PhD project is to develop tools to assess the sustainability aspects of the GMO crop under current and future climate circumstances.

Main activities
The first stage of the project aims to improve and expand the pesticide emission model PestLCI for use in the Life Cycle Assessment (LCA). Pesticide emissions are one of the dominant sources of toxicity in the life cycle of agricultural/food products, necessitating accurate emission estimates.

The updated version of PestLCI will be used in the second stage of the project, where an LCA will be carried out, comparing the environmental impacts of conventional and GMO barley under both current and future climatic circumstances. In addition, the results of the LCA will be compared to the results of an environmental risk assessment.

Expected outcome
The first outcome of the project will be an updated version of the PestLCI model. The new model will see a broadening of its geographic applicability to the whole of Europe. The model will become available for other researchers.

The second part will result in a balanced comparison of the environmental impacts of GMO crops as compared to the impact of traditional crops, illustrating the trade-offs of introducing the GMO crop. A comparison with an environmental risk assessment will probably show that the two methods complement each other.

New value in relation to existing knowledge
The new version of PestLCI can be used to develop more accurate and spatially resolved LCA inventory data, resulting in higher quality LCA studies. The LCA will contribute to the discussion about the advantages and drawbacks of the introduction of GMO crops in general, and will be one of the first studies to consider a broad range of environmental impacts of GMOs in a life cycle perspective.

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