Environmental impact assessment of organic and conventional farming of wheat

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Assessing the environmental consequences of agricultural practices stands as a crucial element in mitigating human influence on the food production chain. Given the escalating demand for wholesome foods grown through sustainable methods, an investigation into the impact of an ancient wheat variety cultivated in both organic and conventional farming assumes significant importance. Hence, the study aimed to evaluate the environmental effects and resource utilization between organic and conventional farming techniques applied to an ancient soft wheat variety (var. Verna) in Tuscany, Italy. Especially, the classification of Verna wheat within the PDO bread specification, a rare designation at the European level, magnifies the significance of this research. Furthermore, considering the primary role that bread plays in the Mediterranean diet, assessing the environmental impacts of its production cycle is of paramount interest. Employing a cradle-to-grave life cycle assessment (LCA), spanning from raw material extraction through industrial processing, field application, grain harvesting, and transportation to storage centres, this study analysed data gathered over a five-year period (2014/2015 to 2018/2019) from five organic and five conventional farms. System boundaries were defined at the harvesting stage without taking into account the transformation process. The study considered various impact categories, encompassing global warming, freshwater, seawater, and terrestrial ecotoxicity, human toxicity, acidification, eutrophication, photo-oxidant formation, non-renewable and renewable energy resource consumption, water usage, and land utilization. Across almost all these categories, organic farming demonstrated lower environmental impacts, although conventional farming showed a lesser impact on land usage. Notably, acidification, photo-oxidant formation, ozone layer depletion, and non-renewable energy resource consumption appeared relatively consistent between the two cultivation systems. Normalization of the findings revealed seawater ecotoxicity as the most significant impact among all categories (> 99%) for both farming methods. Additionally, notable environmental concerns in conventional farming included the use of synthetic N fertilizers, while organic farming faced challenges with lower yields. The results projected that sustaining current wheat production in the EU would require 192 $\times 10^6$ hectares of organic farming compared to 99 $\times 10^6$ hectares cultivated using conventional methods. Therefore, increasing yields in organic farming and reducing nutrient losses/emissions from conventional farming emerge as the most promising strategies to uphold high agricultural production while concurrently reducing associated environmental footprints.

Keywords

Carbon footprint; Life Cycle Assessment; Sustainable agriculture; Eutrophication; Acidification

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