**What is the climate and environmental impact of organic food? A meta-analysis of food LCA studies**

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# Introduction

In recent years, there has been a growing interest in investigating the climate and environmental impacts of organic food in comparison with conventional food. To assess and compare the environmental impact of organic with conventional food, as well as to evaluate the impact of methodological choices of Life Cycle Assessment (LCA) for food products, we conducted a meta-analysis that systematically examined a large number of LCA studies on either organic food or a comparison of conventional and organic food considering both mass and area functional units.

# Methods

A systematic review of the scientific literature on organic food LCA identified 2177 publications, after screening out irrelevant studies, a meta-analysis was performed on 100 published studies on both animal and plant products. This was done by investigating eight impact categories of global warming, acidification, eutrophication and eco-toxicity potential plus potential biodiversity loss, and energy, water, and land use for both mass- and area-based functional units from cradle-to-farm gate.

# Results and discussion

The review shows that most studies were from North America and Europe and focused mainly on global warming potential with few studies considering soil carbon sequestration. There was also little focus on potential biodiversity loss and eco-toxicity potential. The meta-analysis showed no significant differences in global warming, acidification and eutrophication potential and energy use per kilogram of organic and conventional food, but higher land use. Futhermore the analysis showed a significantly lower global warming potential, eutrophication potential and energy use per hectare of organic food compared to conventional food. All studies that compared biodiversity found organic farming to have higher potential biodiversity per kilogram and hectare, and most of the studies that compared eco-toxicity potential in organic and conventional food found lower impacts from organic farming.

# Conclusions

There are still methodological challenges in LCA of food products regarding i) improving the methods for assessing biodiversity, toxicity, and land degradation; and ii) improving models for better estimation of changes in soil carbon and nitrogen stocks resulting from different land management options. Furthermore, the choice of the functional unit can affect the policy decisions. What may seem as an effective option to reduce a given impact at the global scale (assessed per kg) may not be an efficient option at the local scale (assessed per ha) or when looking at the effect on other impact categories. Therefore, including several functional units (per kg and per ha) and impact categories for LCA of organic food are important. Including results both at the product and dietary levels may further provide insights towards more holistic assessments that can form the basis for comprehensive decisions.

# Acknowledgements

This study was part of the Climate friendly and SUSTAINable ORGANIC food and diets (SustainOrganic) project as part of the Organic RDD 4 program, which is coordinated by International Centre for Research in Organic Food Systems (ICROFS). It has received grants from the Green Growth and Development Program (GUDP) under the Danish Ministry of Environment and Food.

