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## Life cycle assessment of organic versus conventional agriculture. A case study of lettuce cultivation in Greece

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### ABSTRACT

The environmental sustainability of a conventional and an organic lettuce cultivation system, situated at Northern Greece, was investigated. Data from all stages (i.e. irrigation, machinery used, and fertilizing) of lettuce cultivation were collected and their sustainability was assessed by means of the life cycle assessment (LCA) methodology. Two different functional units, namely per hectare of cultivation and per ton of lettuce produced, were used and the environmental impacts, on mid and endpoint level, and CO<sub>2</sub> emissions were estimated by means of the SimaPro 8 LCA software. It was found that the environmental footprint and the CO<sub>2</sub> emissions, were lower by 11% and 15%, respectively, for organic than for the conventional lettuce cultivation, when sustainability was assessed per area (ha) of cultivation. On the contrary, conventional lettuce cultivation showed a better environmental performance than organic by 51% and 53% in terms of CO<sub>2</sub> emissions and total environmental impacts, respectively, when the amount of lettuce produced is used as the functional unit of calculations. This is attributed to the fact that the organic system, due to its lower crop yields, requires significantly larger cultivation area to achieve the same crop production with conventional. Moreover, it was found that in all cases the irrigation stage primarily contributed to all impact categories, due to its high energy demands for ground water pumping and the fossil-dependent Greek electricity grid. In addition, in all cases the conventional lettuce cultivation system yielded a significantly high impact onto freshwater eutrophication, due to the use of chemical fertilizers, thus posing serious stresses on local freshwater ecosystems. A sensitivity analysis was carried out and alternative, more sustainable, scenarios were proposed.

**Keywords:** environmental footprint; LCA; sustainable agriculture; non-organic; organic farming; vegetables

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