

## **SUMMARY**

The study compared the life cycle impacts of hyperlocally and conventionally produced and consumed lettuce with the aim of finding out the environmental impacts and to pinpoint the most critical processes to improve. To the knowledge of the author, it was the first LCA done to analyse a hyperlocal food growing device and to compare the results with conventionally produced and consumed lettuce. It also utilized an approach of modelling food waste and subsequent higher production needs. The addition of finding out the environmental impacts of providing the same amount of nutrients with different food systems, not just by the mass of food, proved to be an insightful method and should be further utilised among food LCAs.

The environmentally critical aspects of growing food were first highlighted in the literature overview. The LCA was conducted using secondary LCI data which was modelled with OpenLCA software and results were compared in climate change, agricultural land occupation and water depletion categories. Three research questions were answered along with three hypotheses. The modelling considered Europe and European averages were taken as input data.

The first research question was set to find out the life cycle impacts of hyperlocal lettuce production. And the accompanying hypothesis proposed that over 90% of the life cycle impacts of hyperlocal lettuce come from the electricity use of LED grow lights. This hypothesis was proven true only in climate change impact category where it was responsible for 94.34% of the CO<sub>2</sub> emissions, but not in the agricultural land occupation category where it was responsible for 75.58% of land use, with the majority of the rest being the result of coconut coir production for growth medium. In the water depletion category only 0.30% of impacts came from electricity consumption. As an interesting and somewhat surprising find, the majority of it came from an upstream input process, lettuce seed production instead.

The second research question compared the life cycle impacts of hyperlocal and conventional lettuce. The accompanying hypothesis proposed that conventional lettuce has lower impacts in all impact categories compared to hyperlocal. The hypothesis was proven true in climate change and agricultural land use categories but not in water depletion category. While the additional processes making up the conventional system which are not in the hyperlocal system such as retail step, consumer transportation and produce refrigeration did not add up to make conventional system more impacting in climate change and land use, they did so in

the water depletion category. A notable difference in the impacts of different processes between two systems came from the raw materials used for growth medium production in the hyperlocal system, mainly from coconut husk, that causes agricultural land use. The conventional system doesn't have a comparable process for this and the importance of choosing sustainable providers for growth medium was suggested. An important finding for both systems was that the specific energy production mix plays an important role in the total life cycle impacts of both systems, especially the hyperlocal. When more sustainable sources are used, their impacts could become drastically lower.

The third research question compared conventional and hyperlocal methods with the added assumptions that conventional system causes 50% food waste rate with packaged lettuce and 60% food waste rate with non-packaged lettuce and that the first has 1.8 times lower and the second a 3.0 times lower nutritional value than hyperlocal lettuce. The accompanying hypothesis stated that when food waste rates are added, the impacts of both methods become levelled and when nutritional value is added then the hyperlocal system has lower impacts. The impacts did become similar with food waste accounted for. The results also showed hyperlocal lettuce is significantly more efficient than conventional lettuce at utilising the environmental resources it uses up and the impacts it causes to provide nutritional value.

Further studies should be conducted that would consider lettuce grown on open fields as research suggests open field production has lower environmental impacts in many categories compared to greenhouse production that was studied here. Also, further studies need to be conducted that would compare nutritional value of differently produced and distributed lettuces using more nutritional value indicators as the current study only applied antioxidative activity measured in ascorbic acid content. An important part of looking at the total life cycle of hyperlocal devices would be the modelling of the materials used to make the device and modelling different lengths of people using the devices at home. The current study only looked at the resources needed to operate and continuously grow with these devices and their use was considered as indefinite. The hyperlocal method also needs further modelling with different real life scenarios regarding last mile transportation.