

Analysis of the sustainability of an aquaponic farm through a life cycle analysis

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Introduction: "Abbaye farm" is commercial aquaponics exploitation located in Chaumousey, France, created in 2019. The farm's management includes a high diversity of vegetables (more than 30 species throughout the year), seasonal production, no heating of air or water, no artificial lighting, and the rearing of non-carnivorous fish species. The primary aims of this work are (i) identifying the "hot-spots" of the environmental impact of commercial-scale aquaponics systems by using the normalized LCA method; (ii) comparing the results to other LCA publications; (iii) proposing effective strategies to reduce the overall impact of the "Abbaye farm". Method: A method-based Life Cycle Assessment (LCA) analysis was used to assess the environmental impact of "Abbaye farm". SimaPro software was used for LCA as the modelling platform and data for the life cycle inventory were modelled for each sub-system production using this software. A comprehensive cradle-to-gate LCA using multiple midpoint environmental impact categories (such as global warming (GW), land use (LU), water dependency (WD), freshwater/marine ecotoxicity (EC) and eutrophication (EU)) was analyzed in this case study of a commercial aquaponic system. Some authors have used the LCA tool to investigate the environmental sustainability of aquaponics, and it is typically utilized on small-scale systems, research pilots, or even modelled aquaponics Results: The main contributors to the aquaponic system's environmental impact hotspots were identified: equipment, fish feed, and electricity contributed to more than 90% of environmental impacts in all investigated categories. These values were then compared with other LCA literature studies on aquaponics, hydroponics, and aquaculture. The comparison with other aquaponics and alternative systems showed that Abbaye farm is more sustainable regarding environmental impacts. Finally, effective strategies were proposed for leading to better system management and supporting the long-term decisions on the environmental sustainability of aquaponics as a promising agri-food production system.