Life cycle assessments of aquaculture systems: a critical review of reported findings with recommendations for policy and system development

The aquaculture sector is anticipated to be a keystone in food production systems in the coming decades. However, it is associated with potentially important environmental damages caused by its contribution to eutrophication or climate change, for example. To comprehensively quantify those impacts, life cycle assessment (LCA) studies have been conducted on several seafood farming systems for the past 15 years. But, what major findings and common trends can we draw from this pool of studies? What can we learn to provide recommendations to decision and policymakers in the aquaculture sector? To address these questions, we performed a critical review of 65 LCA studies of aquaculture systems from the open literature. We conducted quantitative analyses to explore which impacts can be identified as dominating and to compare different types of aquaculture systems. Our results evidenced that the feed production is a key driver for climate change, acidification, cumulative energy use and net primary production use, while the farming process is a key driver for eutrophication. We also found that different aquaculture systems and technology components may exert considerably different environmental impacts. Based on identified patterns and comparisons, we therefore provided specific recommendations to aquaculture stakeholders for future policy and system development. Overall, the analysis of existing studies demonstrates that important insights can be gained by applying LCA to aquaculture systems, and, to move towards an environmentally sustainable aquaculture sector, we recommend its systematic use in the design of new aquaculture systems or policies, and/or in the evaluation and optimization of existing ones.

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