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Abstract
Purpose: The primary purpose of this study is to estimate the life cycle greenhouse gas emissions (carbon footprint) and criteria pollutant emissions during honey production and processing for U.S. conditions based on several case studies of different scale beekeeping and processing operations. Commercial beekeeping operations yield two co-products, honey and pollination services. These two products present an interesting co-product allocation problem since beekeeping operations cannot be clearly subdivided, pollination services do not have a substitutable product or service, and pollination services cannot be characterized by physical properties for value-based allocation. Thus a secondary purpose is to identify an appropriate allocation method and to discuss how the choice of allocation strategies influences the outcomes.

Methods: The commercial honey production supply chain comprises the following two primary steps: raw honey production by beekeepers, and honey processing and packaging by processors. A case study approach was used based on detailed operation data provided by several beekeepers and processors from key honey-producing regions in the U.S. Process-based LCA was conducted following the ISO guidelines, and economic allocation was used as a baseline method for co-product allocation.

Results and conclusions: Life cycle modeling of one complete commercial supply chain (raw honey production, transport to a processer, and processing) shows that total life cycle greenhouse gas emissions range from 0.67 to 0.92 kg CO2-equivalent per kilogram of processed honey; however, outcomes show significant variability. Results show commercial honey production emits more GHGs and criteria pollutants than processing. Truck transport of bees is the dominant contributor of both GHG emissions and criteria pollutants within the life cycle of raw honey production. However, honey processing, which depends on natural gas and electricity, contributes a significant fraction of SOX. These results are based on economic allocation among beekeeping co-products. In addition to economic allocation, subdivision was applied to beekeeping activities. Because hive management (feed and medication) could not be further subdivided, a bounded range was generated for raw honey production, where the lower and upper bounds represent two extremes where all the environmental burdens associated with hive management were allocated to pollination or honey production. Economic allocation tends to fall near or below the lower bound for the subdivision method. Interestingly, some beekeepers reported that their hive management practices were driven more by demand for pollination services than honey, which seems to be reflected in the coordination of lower-bound subdivision and economic allocation results.

Read the full publication: http://link.springer.com/article/10.1007/s11367-012-0487-7/fulltext.html