Impact of shelf life on the trade-off between economic and environmental objectives: A dairy case

Abstract:
Food manufacturers introduce more environmentally friendly processes to account for increasing sustainability concerns. However, these processes often go along with a reduction of product shelf life, limiting the delay of sales to future periods with higher prices. We develop a framework to analyze the impact of shelf life on the trade-off between economic and environmental performance of two types of dairy products. Since the differences in shelf life have their key impact at the tactical planning level, we develop an optimization model for this aggregation level. Its objectives reflect profit and relevant environmental indicators. A rolling horizon scheme is used to deal with price uncertainty, using Eurex futures as price predictors. Our framework uses these tactical planning results for strategic decisions on product and process selection. A real-life case study contrasts traditional milk powders against novel milk concentrates. Concentrates require less energy in processing, but have a shorter shelf life. Results show that powders offer a potential profit benefit of up to 34.5%. However, this economic value of shelf life is subject to a priori perfect price knowledge. If futures are used as price predictors, the value of shelf life is reduced to only 1.1%. The economic value of shelf life is therefore not a strong argument against the substitution of powders with more environmentally friendly concentrates. We also show...
that two objectives, profit and eutrophication potential, are sufficient to capture trade-offs in the case. Several product mixes are determined that omit powders and perform well with regard to profit and environment.

Stichworte:
dairy industry; Multi-objective optimization; Objective reduction; Perishability; Sustainability

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