Supply chain planning with sustainability considerations: a multi-objective modeling approach

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Supply chain planning with sustainability considerations: a multi-objective modeling approach

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AIMS

• To develop a modeling framework for combining supply chain planning and environmental sustainability assessment
• To illustrate how environmental sustainability assessments of logistic activities can be improved by supply chain planning input
• To show that supply chain planning can in turn make use of the results from environmental sustainability assessments.
• To assess a new food processing technology

ILESSIVE RESULTS

General LCIA results (see below):
- Raw materials impact dominant
- Processing and distribution only minor impact (EDIP 1997)

Alternative supply chain scenario:
- Different processing method:
  - Using superchilling in stead of chilling
- New production & distribution plan

Δ-LCA (see right) show us:
- Increased energy intensity in food processing more than compensated

SCENARIO DEVELOPMENT:
- Distribution of meal elements
- Several processing and packaging options, most importantly:
  - Chilling vs. superchilling
  - Cardboard vs. polystyrene

INTEGRATED ASSESSMENT:
- LCA results partially provide SCP model parameterization in terms of the environmental performance measures.
- SCP in turn generates new supply chain planning

REFERENCES:

CONCLUSIONS

• Model able to present a comprehensive overview of economic considerations and environmental impacts in supply chains
• Trade-offs easier to quantify and illustrate.
• Especially beneficial in the design of supply chains, and the introduction of new technologies or product concepts
• Case results: minor increase of impacts in production, but significant savings upstream in the supply chain (i.e. identification of trade-offs).

METHOD

Supply Chain Planning (SCP):
- Integer programming model¹
- Economic and environmental objectives
- Detailed modelling of thermodynamic behaviour of the food products
- Software: OPL 6.0 + CPLEX 11.1

Life Cycle Assessment (LCA):
- Product system model² of production and distribution components
- Several tailor-made submodels, especially to do detailed modelling of distribution phase based on SCP input
- Gives feedback to SCP model
- Software: GABI 4 + EcoInvent 2.0

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