Global warming potential of Swiss arable and forage production systems

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Overview

• LCA methodology
• Impacts of organic and integrated farming on global warming:
  ➢ Farming system experiments
    - DOC
    - Burgrain
  ➢ Arable crops
  ➢ Forage production systems
• Conclusions
Life cycle assessment (LCA): characteristics

- Life cycle assessment: „from cradle to grave“ (or farm gate)
- Environmental management tool:
  - Process optimisation („hot spots“)
  - Choice of the best option (comparative LCA)
- Comprehensive assessment of environ. impacts:
  - Energy demand, global warming, ozone formation, eutrophication, acidification, ecotoxicity, human toxicity, biodiversity, soil quality
- Potential environmental impacts assessed by models
- Environmental impacts related to functional units:
  - 1 ha*year for function “land management”
  - 1 kg dry matter of main products for productive function
  - 1 currency unit for the financial function

System description

Infrastructure: Buildings, Machinery
Field production: Soil cultivation, Fertilisation, Crop rotation, Chemical plant protection, Management, Harvest, Transport
System boundary: Manure storage
Inputs: Seed, Fertilisers (min. & org.), Pesticides, Energy carriers, Irrigation water
Products: Slope maize, Sugar beets, Fodder beets, Barley, Cabbage, Wheat, Barley, Rye, Oats, Grain maize, CCM, Faba beans, Soya beans, Protein peas, Sunflowers, Rape seed
Co-product: Straw
Product treatment: Grain drying, Potato grading
Direct and indirect emissions
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Source: FAL report 58 (2005)
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Burgrain farming systems
Contribution of GHG

Source: FAL report 58 (2005)

Burgrain farming systems
Contribution of inputs and processes

Source: FAL report 58 (2005)
Organic arable crops: Need for improvement

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-60%  -40%  -20%  0%  20%  40%  60%

winter wheat  winter rye  winter barley  spring barley  grain maize  potatoes  faba beans  soya beans  protein peas  rape seed  carrots  cabbage

Source: FAL report 58 (2005)

Organic forage production: Slightly lower GWP

NEL: net energy for milk production
fa int = fairly intensive

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Conclusions (1)

- Organic farming system as a whole: lower global warming potential (GWP)
  - Less nitrous oxide (no mineral N fertilisers, lower N inputs)
  - Less carbon dioxide (no mineral N fertilisers)
- Advantages bigger per ha (25-37%) than per kg (6-20%), due to lower organic yields
- Higher GWP for several organic products from arable crops

Conclusions (2)

- Options to reduce GWP in organic farming:
  - Increase yields
  - Use the machinery efficiently
  - Implement minimum tillage techniques
  - Reduce nitrogen losses contributing directly (N₂O) or indirectly (NH₃, NO₃, NOₓ) to the GWP
- Methodical aspects:
  - Consider farming systems as a whole
  - Life cycle perspective is crucial
  - Do not focus only on global warming