Can on-farm bioenergy production make organic farming more sustainable?

- A model for energy balance, nitrogen losses, and green house gas emissions in a 1000 ha energy catchment with organic dairy farming and integrated bioenergy production

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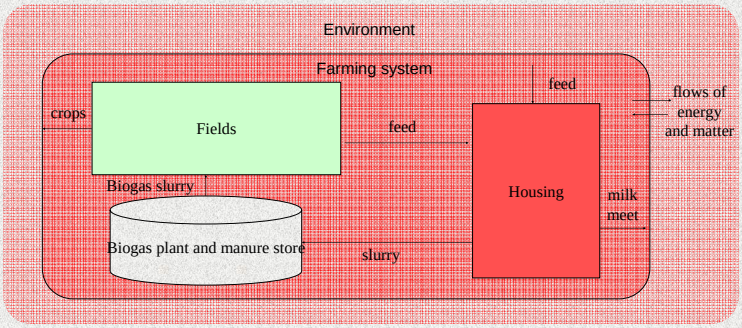
Introduction

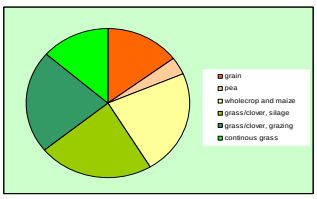
One of the principles of organic farming, the principle of ecology, implies that non-renwable inputs to the farming system, e.g. fossil energy, should be reduced. However, although the energy use in organic farming systems is usually slightly smaller than in conventional systems, both agricultural systems rely on fossil energy for fuel and electricity.

Bioenergy production might be an opportunity for organic farmers to become self-sufficient in energy. In addition to that, bioenergy production could possibly improve nutrient efficiency and reduce Greenhouse Gas (GHG) emissions. This is investigated for a 1000 ha organic farming system.



Materials and Methods

The organic dairy system analysed is designed to represent standard Danish organic dairy farms on sandy soil. The cropping system and the milk production system on a standard organic Danish dairy farm is scaled up to cover 1000 ha and analysed with and without production of biogas. Only manure was used for biogas production, most of the crops were used to feed the livestock.



1000 ha
~ 9 dairy farms
702 milking cows
milk yield: 6958 kg cow^{-1} year^{-1}
1.08 livestock units (LSU) ha^{-1}

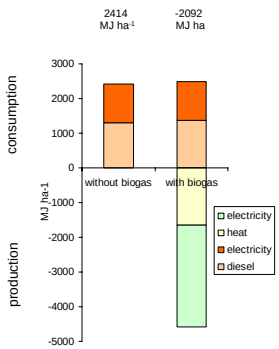
The farming system was analysed using the whole-farm model FarmGHG (www.agrsci.org), which is designed to quantify the flows of carbon and nitrogen on dairy farms. The model provides assessments of GHG-emissions from both the production unit and the supply-chains.

Results

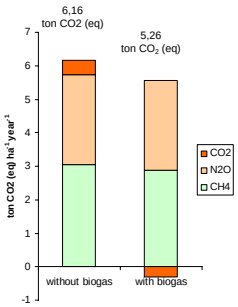
The preliminary calculations with FarmGHG show that biogas production from the available animal manure on an organic dairy farm can change the energy balance on the farm from negative to positive.

Biogas production also reduces GHG-emissions from the farm. The overall GHG-emissions are decreased by 15 %, when the manure is used for biogas production before recycling. The CO_2-emission is negative due to the biogas production, but the emissions of CH_4 and N_2O are not decreased substantially.

Energy Balance



GHG-emissions



Plans for further research

The production system analysed is an intensive dairy farm, where most of the crop production is used to feed the livestock. The future plans for analysis of organic production systems include:

- analysis of 1000 ha with 0.7 and 0.35 LSU ha^{-1}
- use of various crops for the bioenergy production
- combination of bioethanol and biogas production in the organic farming system.
- update of the farmGHG model

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