

Title of project: Modelling of processes at the farm level, with special emphasis on nitrogen and carbon flow and turnover.

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Background

The challenge in organic farming is to optimise short-term productivity while maintaining long-term soil fertility. The organic farming system is very complex, with multiple interactions and feedbacks. One way of analysing the behaviour of whole systems is to integrate the process-based knowledge in dynamic models. Such models may also be powerful tools in generalising results both from short and long-term experiments. A prerequisite is that the models are general, reliable and thoroughly validated.

In low input cropping systems, as organic farming, the utilisation of N mineralisation from soil organic matter (SOM) is of major importance. Therefore modelling of organic crop rotations will rely heavily on the performance of the SOM turnover model. Despite this, it can be demonstrated that commonly used SOM models have very varying properties, and in many cases fail to yield acceptable simulations when comparing with measurements. Therefore further model development in this area is needed.

Objective

The objective of the Ph.D.-project was to improve the modelling of the turnover of organic matter in soil. The project gave special focus to:

- Good representations of the effects of climate, management and texture
- Contributions to the modelling of the turnover of nitrogen in grazed pastures
- Contributions to establishing a modelling framework (FASSET), in order to make improved assessments of the nitrate leaching from conventional and organic farms.

Progress - 2006

The software C-TOOL was developed in 2003 to handle the combined C and N turnover, and has further been incorporated in the whole-farm model FASSET. Also in 2003 a large database regarding the short- and long-term turnover of organic matter was completed.

Utilising C-TOOL and the database, the model CN-SIM (Petersen et al., 2005a,b) has been developed, and is presently used within FASSET to simulate the N-turnover of as well organic and conventional farms. Ten articles plus a number of reports and presentations using this model within FASSET, DAISY or as a stand-alone application have been published from FAS and DARCOF.

No funding specifically for the Ph.D. has been received since medio 2003. The thesis was completed in 2006. All the three focal points (see Objective) have been addressed during the study.

Plans - 2007

The thesis was defended on the 20th September 2007 at KU-Life.

Publications

Only publications related to the Ph.D. project are listed. The list is taken from Organic Eprints.

Berntsen, J.; Grant, R.; Olesen, J.E.; Kristensen, I.S.; Vinther, F.P.; Mølgaard, J.P. and Petersen, B.M. (2006) [Nitrate leaching from organic farming systems with rotational grass-clover and arable crops](#). *Soil Use and Management*(22):pp. 197-208.

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Berntsen, Jørgen; Petersen, B.M.; Pedersen, A. and Jensen, L.S. (2003) [Simulating leaching losses following incorporation of grass and grass-clover leys](#). *DARCOFenews*(4). Online at <<http://www.darcof.dk/enews/dec03/biomod.html>>

Hutchings, Nicholas J.; Petersen, Bjørn M.; Olesen, Jørgen E. and Berntsen, Jørgen (2004) [Does modelling of spatial heterogeneity matter?](#). [oral] Presentation at *Joint meeting of COST Action 627*, Ghent, Belgium, 3-4 May 2004.

Knudsen, Marie Trydeman; Kristensen, Ib Sillebak; Berntsen, Jørgen; Petersen, Bjørn Molt and Kristensen, Erik Steen (2006) [Estimated N leaching losses for organic and conventional farming in Denmark](#). *Journal of Agricultural Science* 144(2):pp. 135-149.

Olesen, J.E.; Berntsen, J.; Petersen, B.M. and Kristensen, I.S. (2004) [Nitrate leaching from organic and conventional crop production farms](#). Paper presented at The role of part-time and pluri-active farmers in rural development and natural resource management, Hotel Propellen, Billund, 22-24 April 2004; Published in *The role of part-time and pluri-active farmers in rural development and natural resource management. Abstracts*, page 19. NJF Seminars 357.

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