

Title of project: Influence of cropping systems on greenhouse gas emission

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Background

The conventional farming strategy of intensive fertilizer and pesticide use has increased productivity in modern agriculture albeit with negative environmental impacts (Conway and Pretty, 1991; Schjønning, et al, 2004). Various organic farming methods provide alternatives that could be pursued at reduced environmental costs (Drinkwater et al, 1998; Jacobsen, Lars-Bo 2002; Reganold et al, 2001). In spite of this, few thorough studies have been done to adequately ascertain the environmental effects of the various organic farming systems (Stokstad, 2002; Læg Reid et al, 1999; Ball et al, 2002). With various researchers arguing that some organic farming methods could actually be equally or more detrimental to the environment than conventional farming (Trewavas, 2004; Pickett and Goulding, 1999; Stopes et al, 2002), the need for further insights cannot be over-emphasized.

Concerns on the rates of global warming have increased focus on greenhouse gas emission from agriculture (IPCC, 2007; Oreskes, 2004). Greenhouse gas emissions from cropping systems arise from changes in soil carbon and nitrogen (Hansen et al., 2001; Komatsuzaki and Ohta, 2007). Proper management of cropping systems to improve crop yields and reduce greenhouse gas emissions requires a comprehensive understanding of soil processes and carbon and nitrogen dynamics and their effects on crop growth. A better understanding of how different organic and conventional management practices influence greenhouse gas emissions is critical before providing recommendations for improvement.

While the Kyoto Protocol (1997) gives agriculture and forestry as carbon sinks, it is silent on the different effects of different types of agriculture. This study seeks to explore different cropping systems with regards their contribution to greenhouse gas emission. The study will be based on four different cropping systems in an organic crop rotation experiment which was initiated at Foulum, Jyndevad and Flakkebjerg research centres in 1997 (Olesen et al 2000). In 2005 the rotation experiment was modified to include a conventional system which will also be part of this study. Simulations will be run with two contrasting models to estimate GHG emissions from conversion to organic farming on the short and long-term.

Objective

The overall objective of this study is to quantify the effect of organic and conventional arable cropping systems on greenhouse gas emissions and to assess the various management options that could make the systems environmentally benign.

Specific objectives:

1. To evaluate soil C and N transformations in 3 contrasting cropping systems.
2. To quantify soil N₂O and CO₂ gas emissions by 3 different cropping systems.
3. To predict short and long-term environmental impacts of conversion to various organic cropping systems.

Progress – June – October 2007

1. Attended course on introduction to PhD studies
2. Familiarization with laboratories.
3. Tried out various methods of analysis that will be used in this study.
4. Documenting analysis methodology
5. Collecting soil and root samples and carrying out variability tests after harvest of 2007 winter wheat crop.
6. Development of PhD plan.
7. Development of hypothesis.
8. Carried out soil sampling and laboratory analysis for total carbon and nitrogen; organic carbon; mineral N; Microbial Biomass N; potential mineralization, nitrification and denitrification.
9. Field monitoring of N₂O emissions.
10. Submitted paper to ISOFAR conference scheduled for Modena, Italy, 2008.

Plans – October – December 2007

1. Monitoring of N₂O emissions.
2. Measuring CO₂ emissions
3. Attending the following course: Presentation techniques (Foulum); and Systems thinking and environment (Ulna).
4. Familiarization with databases, models and modelling.
5. Analysis of data from the initial 6 Month period.

Time schedule details:

Month 0-3:	Orientation,
Month 3-6:	Planning and carrying out preliminary studies
Month 3-15:	Field work, laboratory work and attending seminars, conference and courses,
Month 18:	Vacation
Month 19-21:	Stay abroad (Germany)
Month 21-22:	Teaching
Month 8-28:	Modelling and data analysis including attending seminars, conference and courses,
Month 11-34:	Writing papers
Month 30-31:	Thesis write-up.
Month 32-36:	Thesis submission and defence

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