Preliminary life cycle comparison of corn grown with and without cover crop

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INTRODUCTION

This is a preliminary life cycle assessment of the corn-soybean rotation with and without cover crop. The LCA is a "cradle to gate" study that evaluates the environmental impacts of corn production from planting to harvest at Gilmore City, Iowa. The system boundary is the farm edge and the functional unit is 1 kg yellow dent corn grain (@15.5% moisture w.b.). A detailed life cycle inventory has been built, which includes not only farm inputs but also the emissions and resource consumption related to the production of these inputs. In this study corn grown with and without cover crop are compared in terms of energy consumption, GHG emissions, and nitrate leaching and the trade-offs among impacts are quantified. Yield in the cover crop treatment was impacted by one plot suffering heavy weed pressure from an herbicide resistant ragweed. We have computed results both including and excluding this plot. Inventory data are estimated for farm-scale production, but erosion has not been estimated because a specific geography has not been defined for this analysis.

MATERIALS & METHODS

1. Denitrification-Decomposition (DNDC) modeling
- N_2O emission data from the ISU research farm (Parkin & Kaspar 2006) have been used to calibrate DNDC model.
- Calibrated DNDC model is used to predict N_2O emissions from the field.

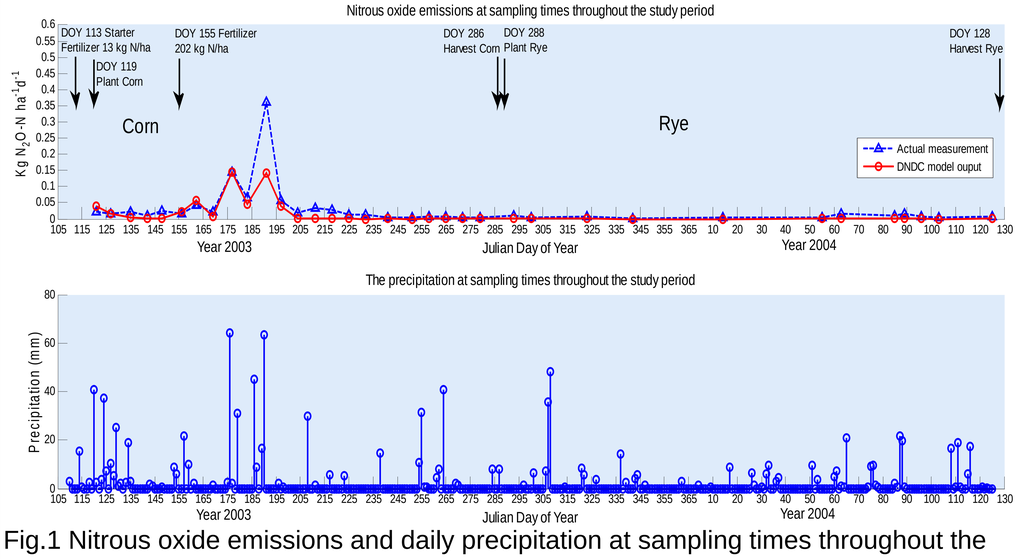

Fig.1 Nitrous oxide emissions and daily precipitation at sampling times throughout the calibration period

* Predicted cumulative N_2O emissions are 45% less than measured, because the model fails to capture peak emission events. Model uncertainty will be quantified when more measured data are available.

2. Life Cycle Inventory (LCI)
- A detailed life cycle inventory has been built which includes energy use and environmental impacts of all the upstream processes.
- Diesel and lubricant use of tractors and implements under different field conditions were calculated according to ASAE standard D497.4 FEB03 and ISU Extension publications specifying appropriate implement and power unit combinations .
- Sources of data include: field logs, Ecoinvent database, IPCC Fourth Assessment Report, DNDC model, published studies.

3. Life Cycle Impact Assessment (LCIA)

• Energy Use Analysis

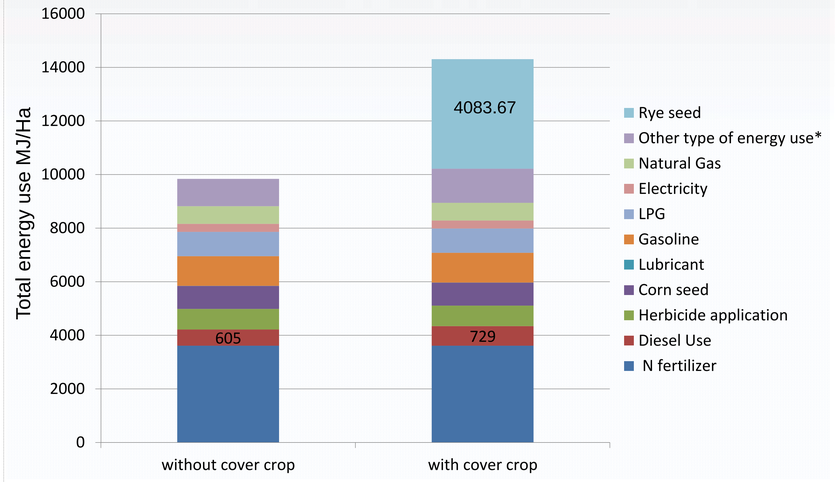

Fig.2 Total energy use with and without cover crop

*The other types of energy use include: transportation of inputs, packaging, labor, labor transportation and farm machinery.

• GHG emissions Analysis

❑ This study accounts the GHG emissions from the three major GHGs: CO_2, CH_4 and N_2O.

❑ The impacts of GHGs are normalized with IPCC 100 year global warming potential factors.

❑ Both soil emissions and upstream emissions are included.

ACKNOWLEDGEMENTS

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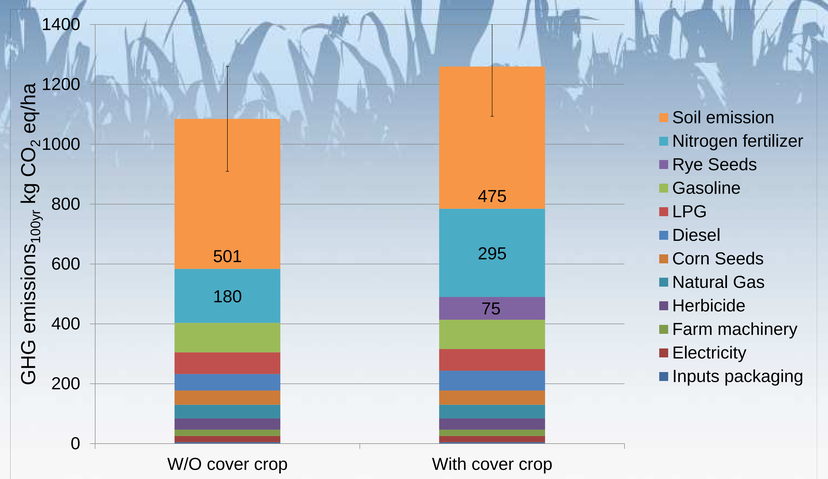

Fig.3 Total Life Cycle GHG emissions

•Impact Trade-offs

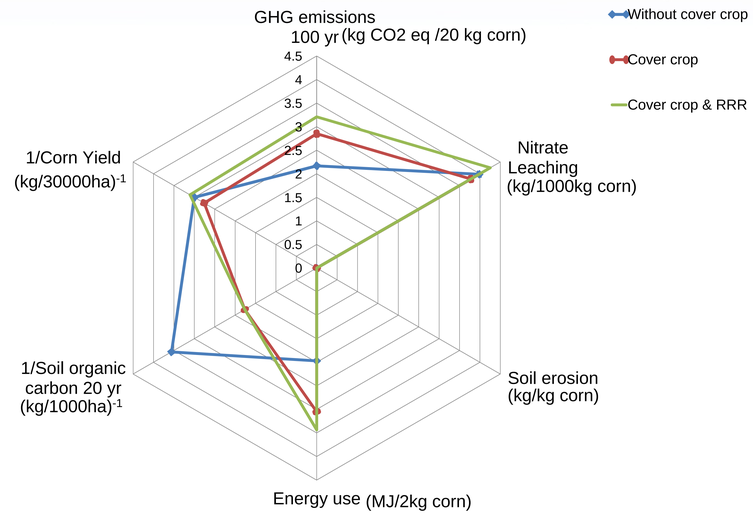

Fig.4 Comparison of Impact Trade-offs

CONCLUSIONS

- This is a preliminary study relying heavily on model output.
- At Gilmore City, cover crop does not significantly affect the nitrate leaching or GHG emissions, but does increase life cycle energy use per kg corn.
- Impact of cover crop depends on fertilization rate, rainfall, and temperature ("Your results may vary.").
- The appearance of glyphosate-resistant ragweed has very significant impact on corn yield, greatly increasing net energy consumption and net GHG emissions per kg corn.
- DNDC model used to estimate ΔSOC has not been calibrated for SOC. More field data are needed.

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