Results from the Network of Pilot Farms

Greenhouse gas balances in organic and conventional farming in Germany

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Introduction

- Agriculture releases greenhouse gases by soil cultivation, livestock emissions and the use of fertilizers and manure. Nevertheless, there are different opportunities existent to reduce emissions (e.g. C-sequestration).
- A network of 80 paired organic and conventional farms in four regions of Germany (Fig.1) was established focusing on research on climate impacts and sustainability indicators in agricultural
- We analyzed material flows in arable and livestock production to study resource efficiency. For this we determined climate effects of production, energy-, nutrient- and soil carbon-balances and evaluate livestock health and welfare. Based on the results we developed with the farmers scenarios for farm specific optimization to improve sustainability and livestock welfare.

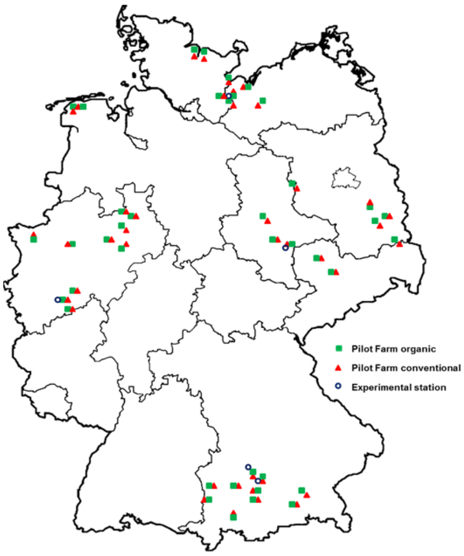

Fig. 1: Network of Pilot Farms in Germany.

Material and Methods

- Balances were assessed with the standardized methods of the model REPRO (REPROduction of soil fertility), which can be used to evaluate and optimize environmental effects of farming systems.
- The GHG-balance of the cropping system is based on the calculation of potential CO_2 and N_2O-emission. The calculation integrates the site conditions, the management intensity (external inputs and used energy), the farm characteristics (e.g. crop rotation, stocking rates) and the treatments and used technic.
- Balances were calculated for 65 pilot farms between 2009 and 2015.
- The elevation of the farms ranged from 0 to 780 m and the annual precipitation from 536 to 1507 mm. The size of the farms was between 30 and 1317 ha.

Results

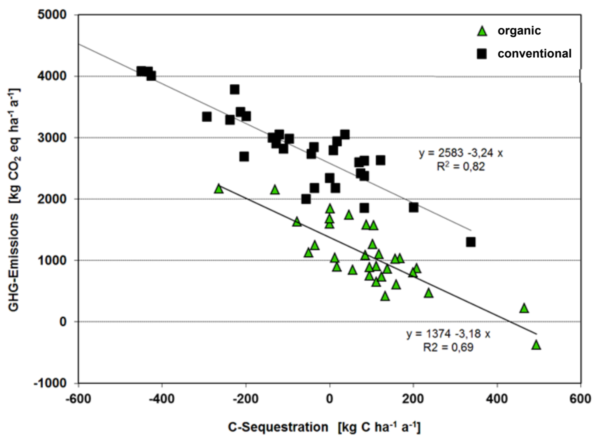

Fig. 2: Relationship between C-Sequestration and GHG-Emissions (related to utilized agricultural area).

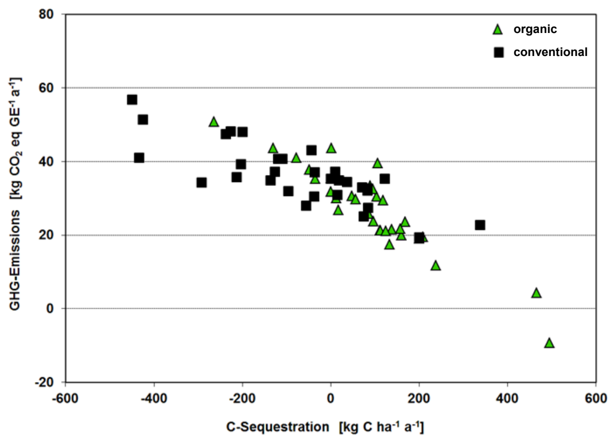

Fig. 3: Relationship between C-Sequestration and GHG-Emissions (related to grain equivalent unit).

- The results suggested differences between systems as well as farm types (cash crop, dairy farm and farming structure - Tab.1). The humus-balance of the farms showed the potential of organic dairy farms to sequester C while organic cash crop systems were estimated to have a constant humus-content. Negative humus-balances were calculated for conventional cash crop farms.
- Emissions from cultivation were dependend by application of fertilizer (mineral and organic) and pesticides suggesting differences in management intensity.
- The dairy farms have lower CO_{2eq}-emissions.
- The organic farms have lower emissions than the conventional farms.
- The variations within the farm types are bigger than between the types of farms.

Tab. 1: GHG-Emissions in organic and conventional cash crop and dairy farming.

		Organic (n = 32)			Conventional (n = 33)		
		mean	cash crop	dairy	mean	cash crop	dairy
Emissions (cult.)	kg $CO_{2\,eq}$ ha^{-1}	556	550	560	1129	1122	1133
Seeds	kg $CO_{2\,eq}$ ha^{-1}	65	102	40	55	76	41
Org. fertilizer	kg $CO_{2\,eq}$ ha^{-1}	182	78	253	273	61	410
Min. fertilizer	kg $CO_{2\,eq}$ ha^{-1}	5	10	2	372	513	280
Pesticides	kg $CO_{2\,eq}$ ha^{-1}	3	7	0	83	140	45
Inv. Items	kg $CO_{2\,eq}$ ha^{-1}	33	41	27	32	26	35
Diesel fuel	kg $CO_{2\,eq}$ ha^{-1}	268	313	238	315	306	320
C-Sequestration	kg $CO_{2\,eq}$ ha^{-1}	-342	-118	-495	324	538	185
N_2O-Emissions	kg $CO_{2\,eq}$ ha^{-1}	865	796	911	1429	1370	1468
GHG-Emissions	kg $CO_{2\,eq}$ ha^{-1}	1078	1228	976	2882	3031	2785
	kg $CO_{2\,eq}$ GU^{-1}	27	33	23	37	34	39
	kg $CO_{2\,eq}$ GJ^{-1}	12	17	8	17	20	15

Conclusion

A generalization of the results is hindered by a high dependency of the results from the individual farming system including site conditions and the management.

Netzwerk von Pilotbetrieben
Forschung zur Nachhaltigkeit von Landbausystemen
pilotbetriebe.de

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