Calculation of C-sequestration – methodological perspectives

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Enita Clermont-Ferrand, Lempdes, France

Univ. Prof Dr. Bernhard Freyer, Vienna, Austria

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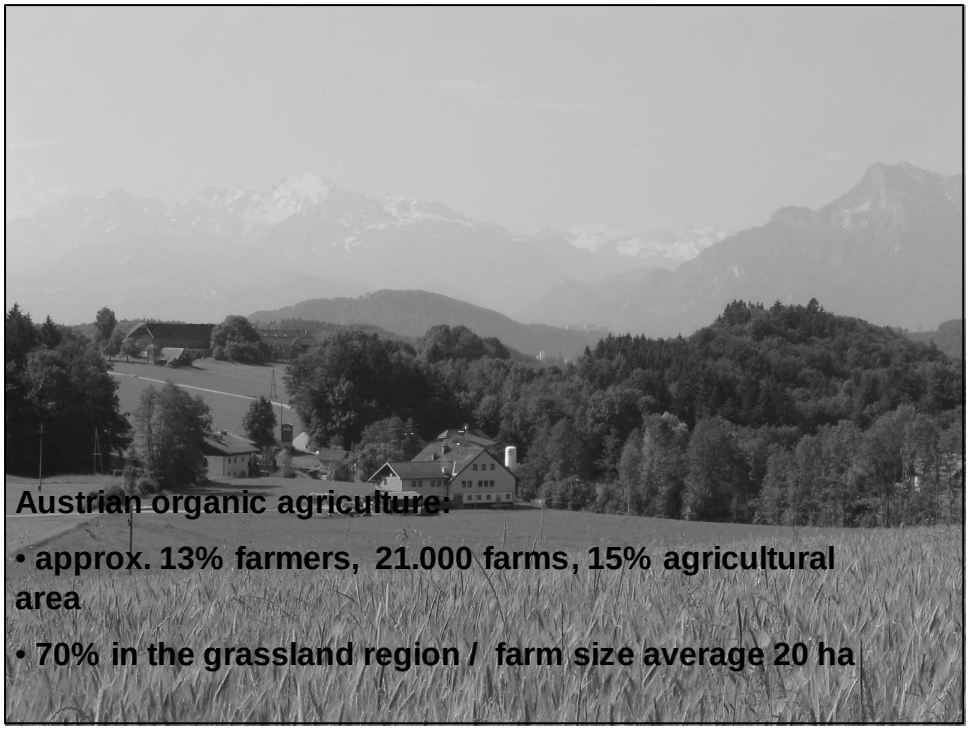

Outline

1. Introduction
2. Results
3. Summary and Conclusions

1 Background

To date, besides the annual CO_2-emission balance of a farm, a product or a food chain, C-sequestration is a new indicator for the sustainability assessment of a farm

2 Challenge

There are different approaches to identify and calculate carbon-sequestration with data from different sources, farms and environmental sites, but often not well defined

3 Objectives

To identify the

- level and the dimension
- the keyfactors and
- further challenges

of potential of Carbon Sequestration in Orgqnic Agriculture

2 Results

A Framework

B Examples

C Synthesis approach

Own source; Bellarby et al. 2008, S. 8

2 Results - A Framework

(1) Scenario for worldwide C-S development:

(1) Status quo: 50 t C ha $^{-1}$; agric. area: 5 Mrd. ha

(2) Goal: + 10 % humus, 25 cm soil depth, 20 years:
- + 5 t C ha^{-1} or 18,5 t CO_2 ha^{-1}; 92,5 Mrd. t CO_2
- development per year: 0,25 t C / 0,41 t CO_2 ha^{-1}

(3) Global agricultural emissions (5 Mrd. ha):
- 5,1 - 6,1 Mrd. t CO_2e a^{-1} / mean 1,12 t CO_2e ha^{-1} a^{-1}

(4) …it is not enough!

Own source; Bellarby et al. 2008, S. 8

(2) Comparison with rain forest slash & burn:

- **(1) Slash & burn: 5,9 Mrd. t CO_2e a^{-1}**
- **(2) Loss of tropical rain forest: 12-15 Mio ha^{-1} a^{-1}**
- **(3) Biomass sink: 235t ha^{-1} C / 870 t CO_2 ha^{-1}**
- **(4) 5,9 Mrd. t / 12 – 15 Mio. ha = 394 - 492 t CO_2 ha^{-1} a^{-1}**

Own source; Bellarby et al. 2008, S. 8

2 Results - A Framework

(3) Questions:

- **(1) Increase of C-content: max. between 15 and 30%?**
- **(2) Time: 10-80 years ?**
- **(3) Organic manure effects: amount and quality?**
- **(4) Crop rotation: % clover?**
- **(5) Soil tillage effects: no tillage?**

Own source; Bellarby et al. 2008, S. 8

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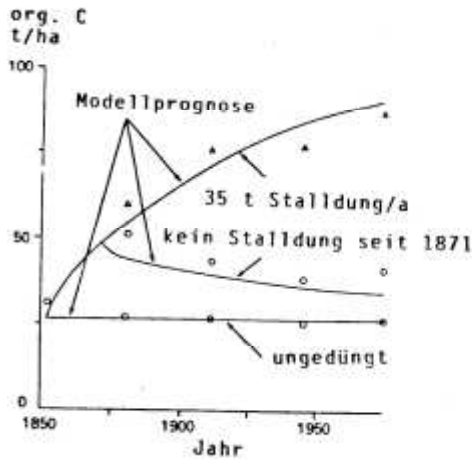
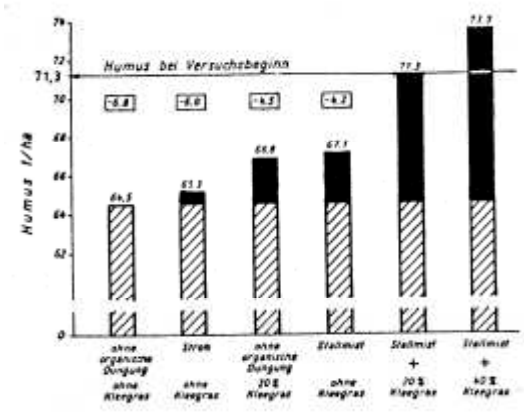
Humus content of arable soils from longterm trials related to fertilizer and trial duration

Place	Halle	Askov	Askov	Lauchstädt	Bonn
years	80	50	50	52	52
clay	13	4	9	26	7
ph	6,4	5,9	7,2	7,0	7,0
FYM dt/ha a-1	120	95	95	100	108
C %					
without	1,14	0,79	1,3	1,49	1,12
NPK	1,29	0,96	1,43	1,61	1,18
FYM	1,69	1,09	1,52	1,77	1,21
NPK FYM	-	-	-	1,,86	1,29

Humus content after long term farm yard manure



Humus development – factors FYM and clover



clover			20%		20%	40%
straw		x				
FYM				x	x	x

(1) 40% clover = 4ha in 10ha rotation

(2) 4 ha x 12,5t DM=50t = 5t per cow=10 cows= 1LU =10t FYM=2.5t DM x 10 cows=25t FYM

(3) 4ha x 300N=1200kg N=120 N/ha yr

(4) 4ha x 5t roots=20t

(5) 20t roots +25t FYM=45t/10ha=4.5t/ha DM yr

(6) 20 yr x 4.5t=90t

(7) Start of soil C: 50t/ha; after 10 yr: 60t/ha / +10t C

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Soil tillage and cropping system

(1) No tillage (NT):

(1) NT: Increase of 570 ± 140 kg C ha^{-1} a^{-1}

(2) SOC new equilibrium in 15-20 a^{-1}:
+11,4 t C ha^{-1} / 43,32 t CO_2 ha^{-1}

Tristam and Post 2002 / global database of 67 long-term agricultural experiments, consisting of 276 paired treatments (mainly conv. Cropping systems)

2 Results - B Examples

Soil tillage and cropping system

(2) Rotation development (conv.):

(1) RD: Increase of 140 ± 110 kg C ha^{-1} a^{-1}

(2) SOC new equilibrium in 40-60 (50) a:
+7,0 t C ha^{-1} / 25,90 t CO_2 ha^{-1}

Tristam and Post 2002 / global database of 67 long-term agricultural experiments, consisting of 276 paired treatments (mainly conv. Cropping systems)

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2 Results - C Synthesis approach

(1) Systematical evaluation of long term trials / SOM long term data from farms

(2) Reduced soil tillage in organic farming: effects on SOM

(3) Carbon quality: above and below ground biomass, farm yard manure

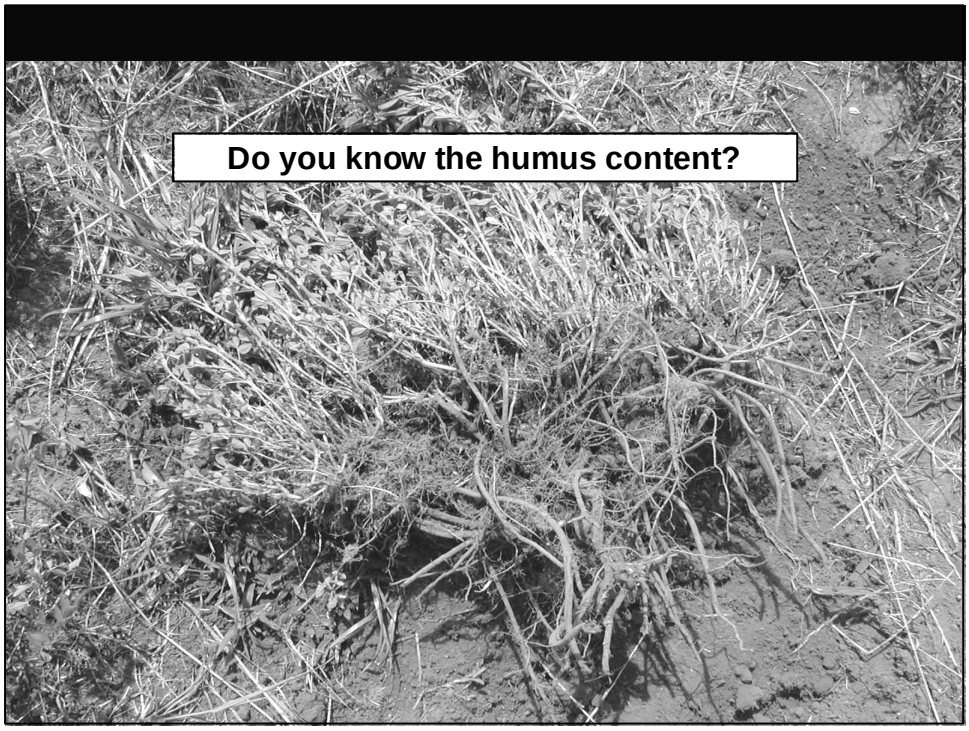
3 Conclusions

(1) Crop rotation, FYM and tillage are the key factors, which defines the potential of C-S

(2) Conventionalisation of organic agriculture would led to critical SOM development

(3) Research: International network for data synthesis and integration in a common model


Do you know the humus content?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Thank you for your attention

Bernhard.Freyer@boku.ac.at

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Institute of Organic Farming, University BOKU, Vienna, Austria