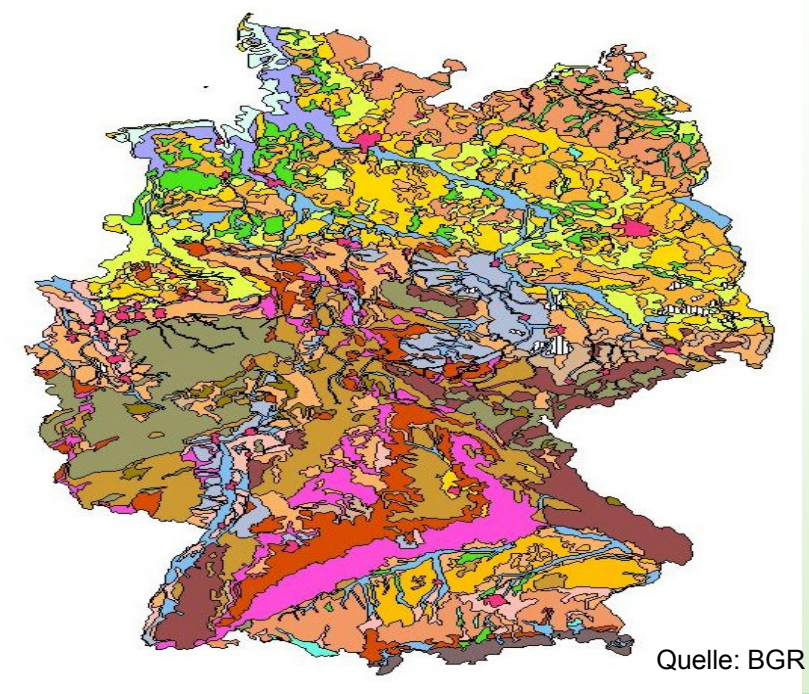
Das Lebensministerium



Quelle: BGR

Site adjusted organic matter balance method for use in arable farming systems

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Contents

- Data collection and analysis from 240 long-term field trials (2800 variants) from Germany and surrounding countries (Central Europe)
- Results from multiple regression analyses determining the quantitative effects of climate, soil and cultivation factors on the organic matter contents from Germany (Poster is not completed)
- Independent examination of the VDLUFA method for organic matter balancing for objectives and method accuracy, using results from 39 long-term field trials (over 300 variants) describing representative arable sites of Germany
- Working out new targets for organic matter balancing that meets nowadays demands
- Working out improvements (higher accuracy) for a site adjusted method of organic matter balancing

Multiple regression analyses for climate, soil and cultivation effects on the organic matter contents of the German soils

(from a total of 2800 variants 1479 variants are selected)

Order of priority	Factor	Multiple r^2 (%)
1	Interaction clay + fine silt (Feinanteil) x precipitation	48,9
2	Temperature, temperature2	12,3
3	Clay + fine silt, clay + fine silt2	6,2
4	Precipitation, precipitation2	5,2
5	Cereal portion of crop rotation	4,3
6	N-surplus	1,5
7	Soil type[1)]	1,5
8	Legume portion, legume portion2 of crop rotation	0,7
9	Total DM supply	0,3
	Altogether	**80,9**

[1)] 1 = S; 2 = Sl; 3 = lS; 4 = SL; 5 = sL; 6 = L; 7 = LT; 8 = T; 9 = M

Not in the analysis: Root crop portion, N-output, Total N input, pH value

Principle of organic matter balance

Organic matter surplus	=	Organic matter input	—	Organic matter decay
Change of the organic matter supplies of the soil		Amount and quality of crop residues, and organic manures		Effects of climate, soil and cultivation (e.g. soil management) on mineralization

With the VDLUFA method an organic matter surplus is calculated by addition of specific humification coefficients using for organic matter depleting crop species (negative values) and for the organic matter inputs (positive values for organic matter increasing crop species and organic material coefficients). The organic matter decay is represented in the coefficients of depleting and increasing crop species.

VDLUFA method for organic matter balance

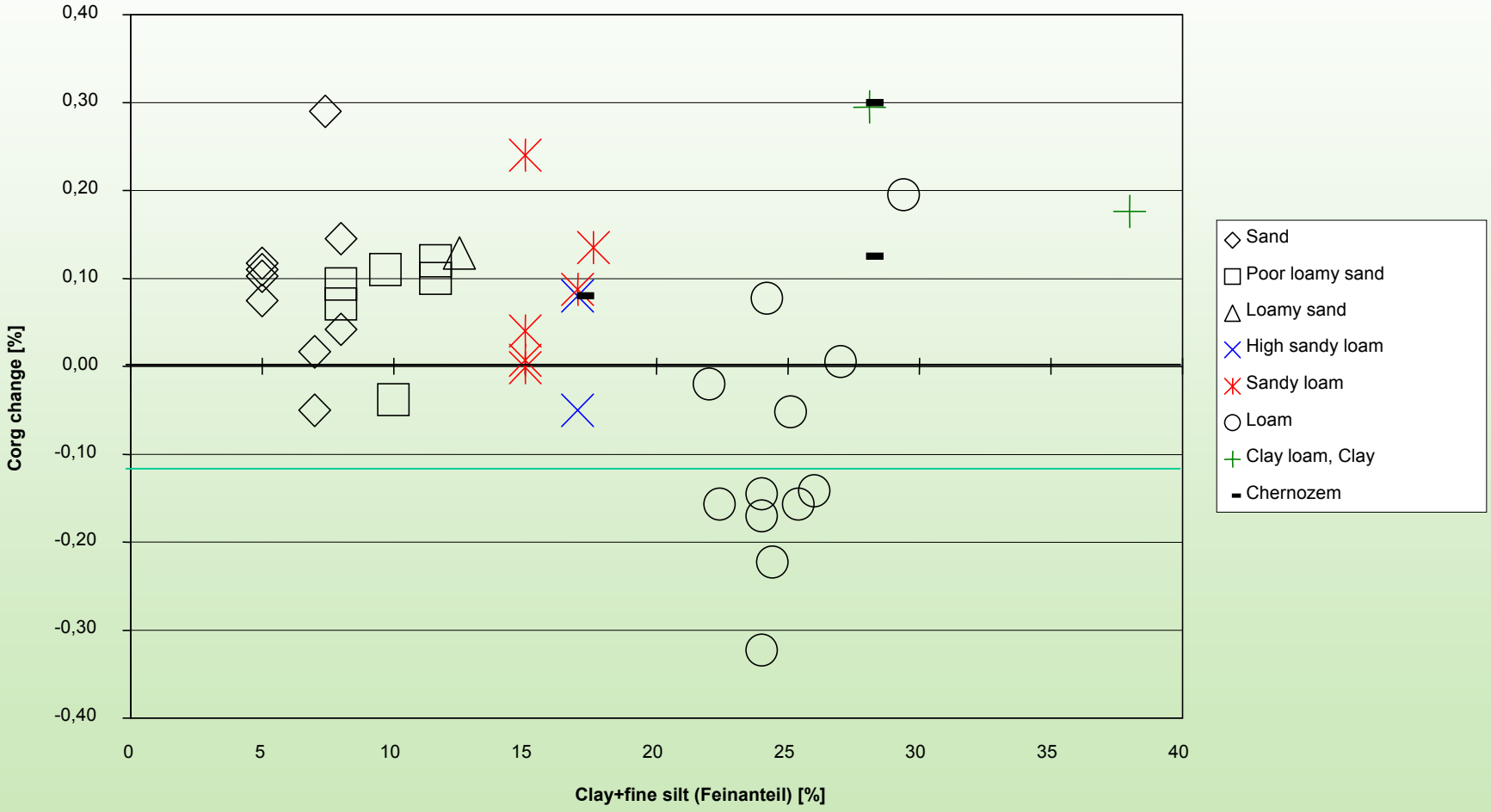
The VDLUFA standpoint method (KÖRSCHENS et al., 2004) **is reunited from the following systems:**

- the ROS method (**R**eproduktionswirksame **O**rganische **S**ubstanz) (AUTORENKOLLEKTIV, 1977; KÖRSCHENS & SCHULZ, 1999) representing the lower values, („einfache Humusreproduktion“)

- the **H**umus**E**inheiten method (HE) (LEITHOLD et al., 1997) representing the upper values, („erweiterter Humusreproduktion“)

Comparison between experimental data and calculated results, using the lower values (ROS) of the VDLUFA method (green line = upper values = 0 % Corg)

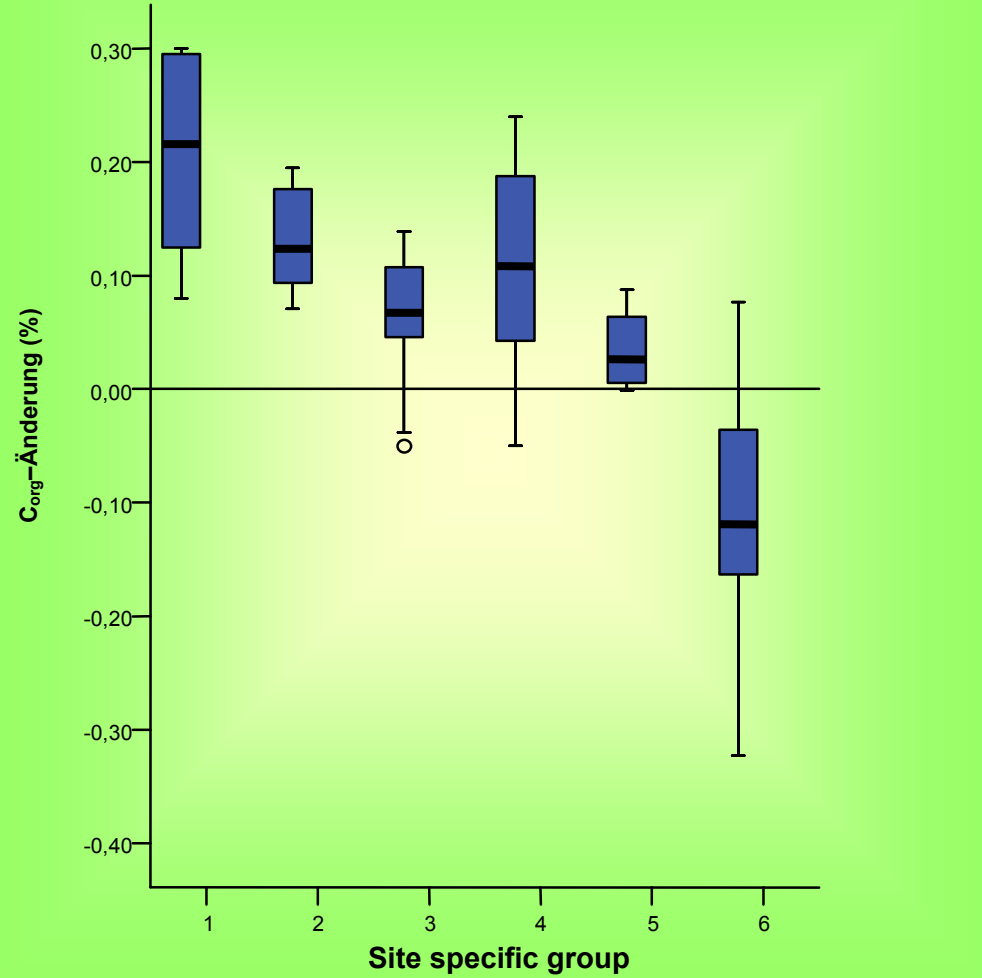
(Ideal value = 0 % C_{org} content change with 100 % demand meeting = 0 kg C/ha surplus)



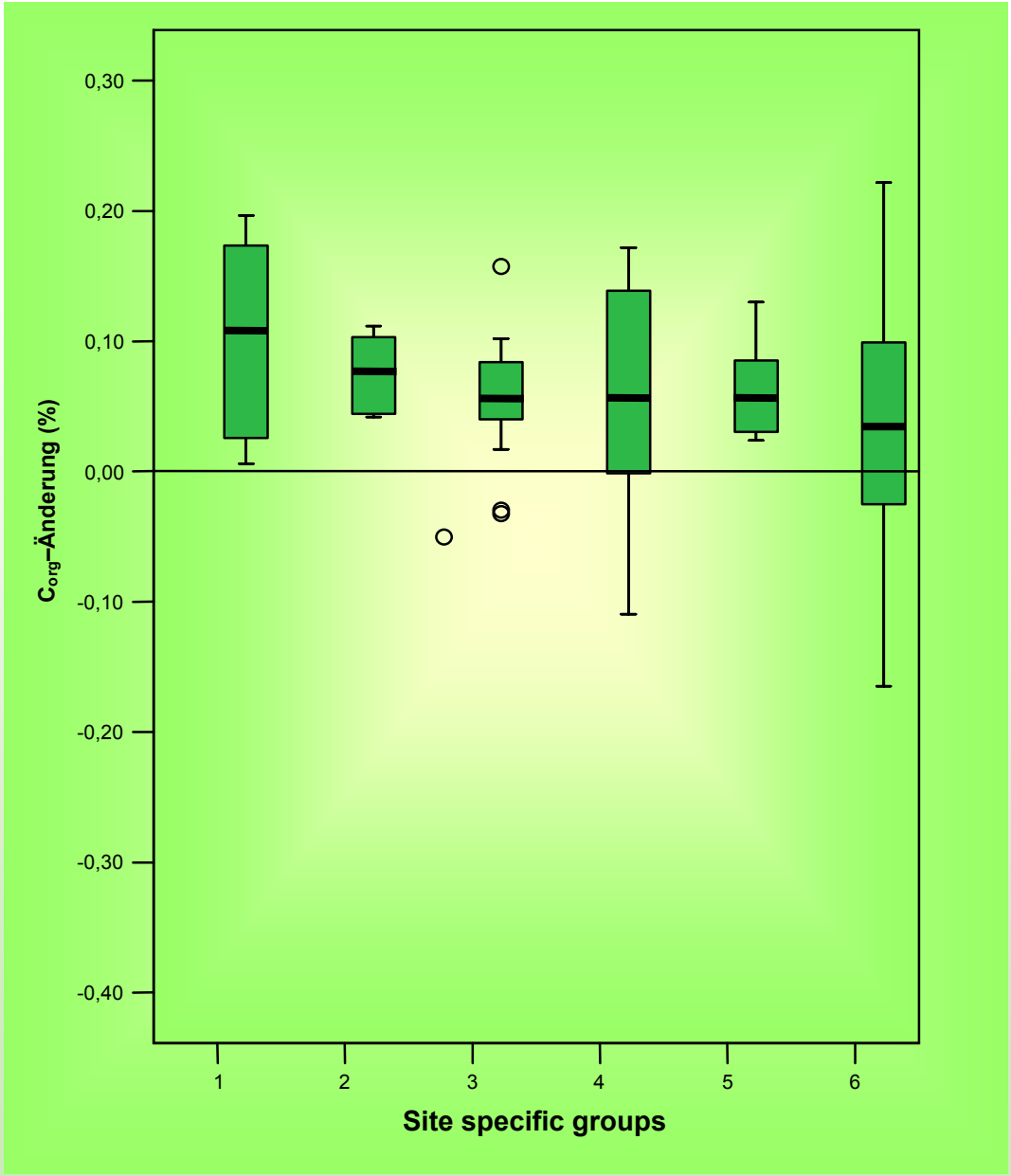
Site effects on the results of the organic matter balancing

(100 % demand meeting, using the lower values (ROS) of the VDLUFA method)

(Ideal value = 0 % C_{org} content change with 100 % demand meeting = 0 kg C/ha surplus)



Basis: before adjustment



After adjustment

Site specific groups with homogenous humification levels

Group 1:
- Chernozem,
- Clay (over 700 mm precipitation/year),
- Sand (C/N ratios over 12-15)

Group 2:
- Sand – loamy sand (under 8,5 °C temperature)
- Clay loam, clay

Group 3:
- Sand – loamy sand (over 8,5 °C temperature)

Group 4:
- High sandy loam, sandy loam (under 8,5 °C temperature)

Group 5:
- High sandy loam, sandy loam (over 8,5 °C temperature)

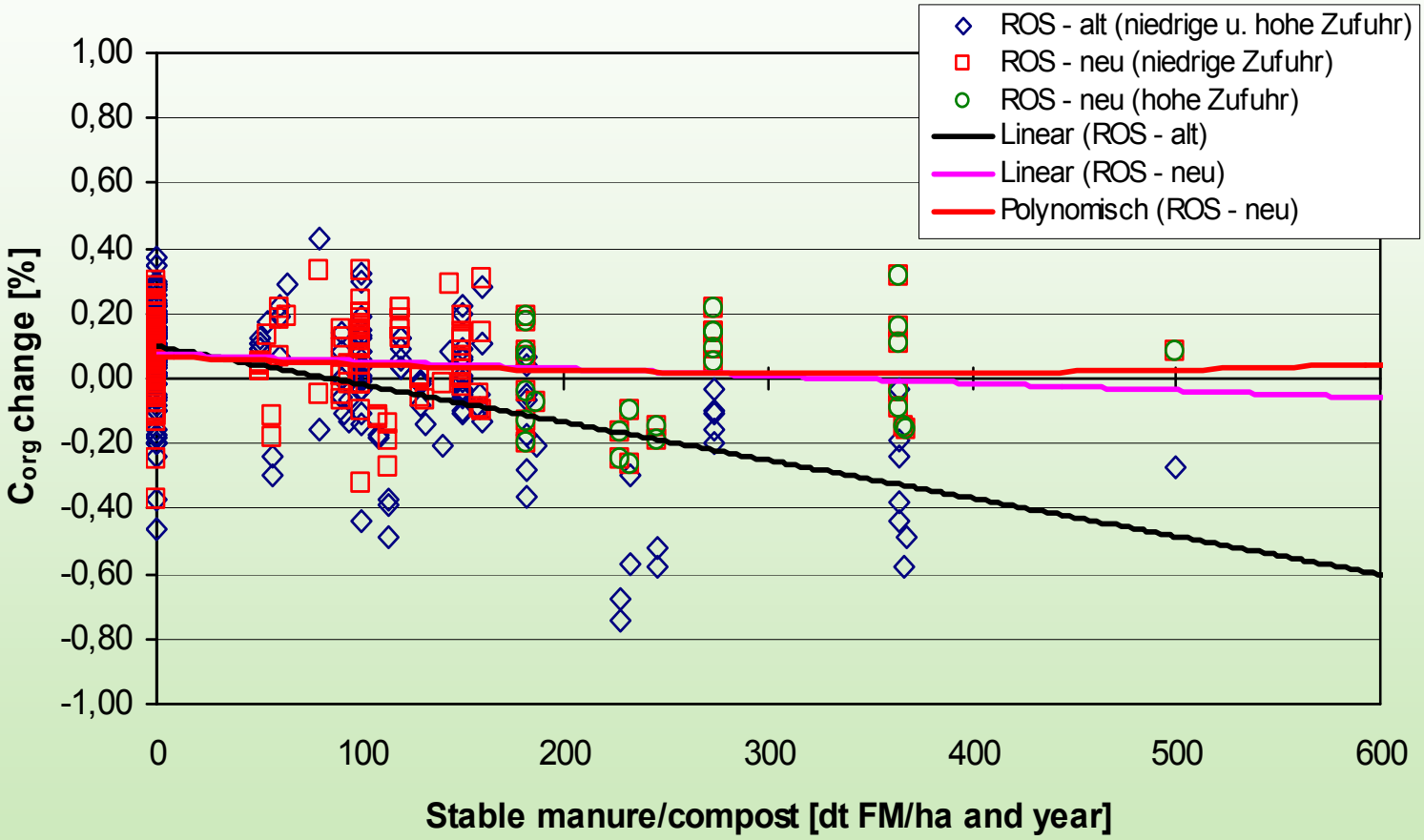
Group 6:
- Loam (C/N ratios under 9,5)

Site specific variation of the crop species humification coefficients (kg C_{org}/ha and year)

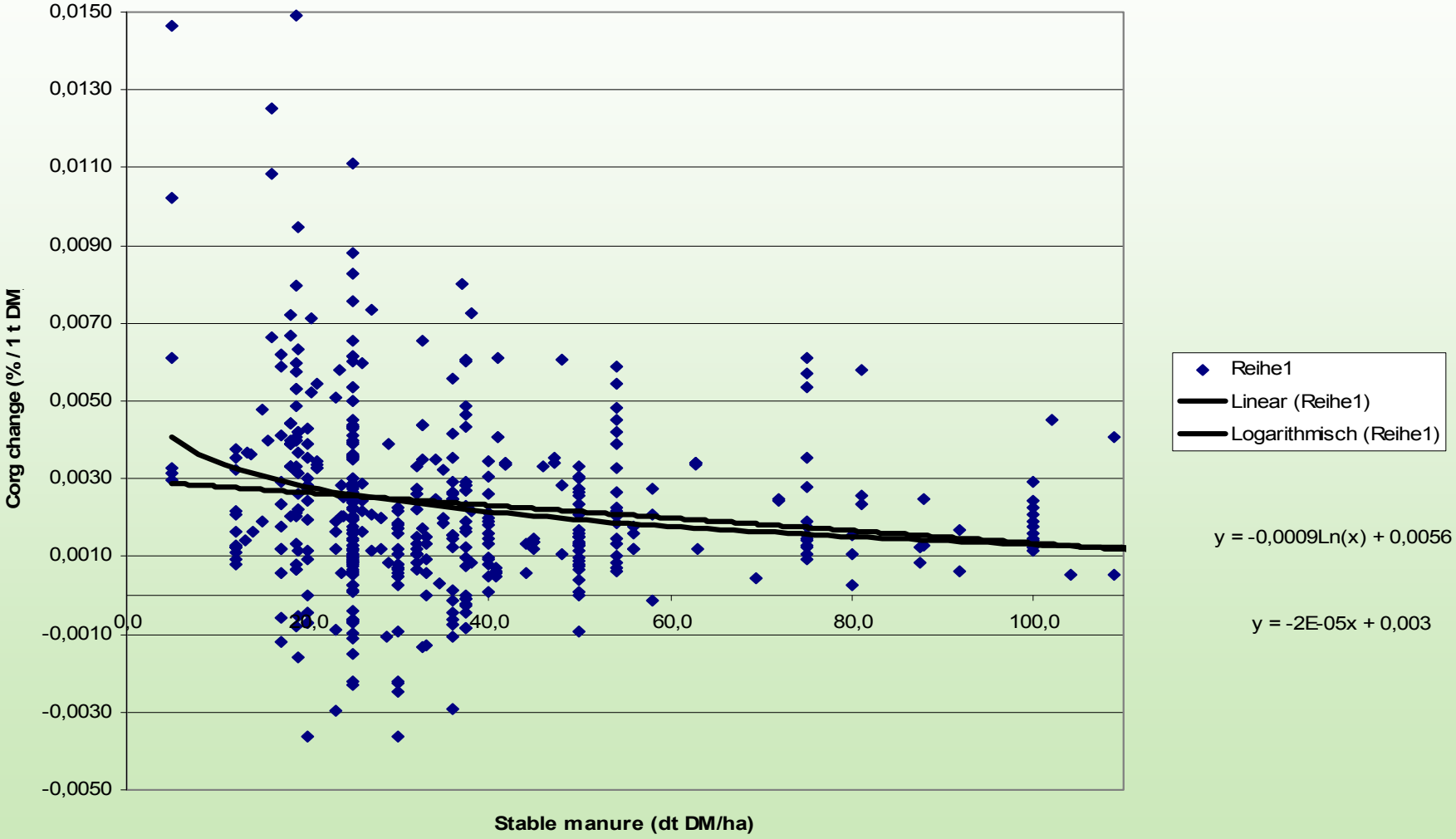
Standortgruppe	1	2	3	4	5	6	Untere Werte (ROS)
	(kg C_{org}/t Substrat)						
Hauptfruchtarten							
Hackfrüchte: Rüben, Kartoffeln	-510	-610	-710	-660	-760	-900	-760
Mais: Silo- u. Körnermais	-310	-410	-510	-460	-560	-700	-560
Getreide: einschließl. Öl- u. Faserpflanzen, So.-Blume	-30	-130	-230	-180	-280	-420	-280
Körnerleguminosen	410	310	210	260	160	20	160
Mehrj. Feldfutter							
Ackergras, Leguminosen, Leg.-Gras, Gemenge, Vermehrung							
je Hauptnutzungsjahr	850	750	650	700	600	460	600
im Ansaatjahr als Frühj.-Blanksaat	650	550	450	500	400	260	400
bei Gründeckfrucht	550	450	350	400	300	160	300
als Untersaat	450	350	250	300	200	60	200
als Sommerblanksaat	350	250	150	200	100	-40	100
Zwischenfrüchte							
Winterzwischenfrüchte	370	270	170	220	120	-20	120
Stoppelfrüchte	330	230	130	180	80	-60	80
Untersaat	450	350	250	300	200	60	200
Brache							
Selbstbegrünung							
ab Herbst	430	330	230	280	180	40	180
ab Frühjahr das Brachejahres	330	230	130	180	80	-60	80
Gezielte Begrünung							
ab Sommer f. folgende Brachejahre	950	850	750	800	700	560	700
ab Frühjahr des Brachejahres	650	550	450	500	400	260	400

Method accuracy before (blue) and after adjustment (red symbols) of the humification coefficients of the organic materials

(Ideal value = 0 % C_{org} content change with 100 % demand meeting = 0 kg C/ha surplus)



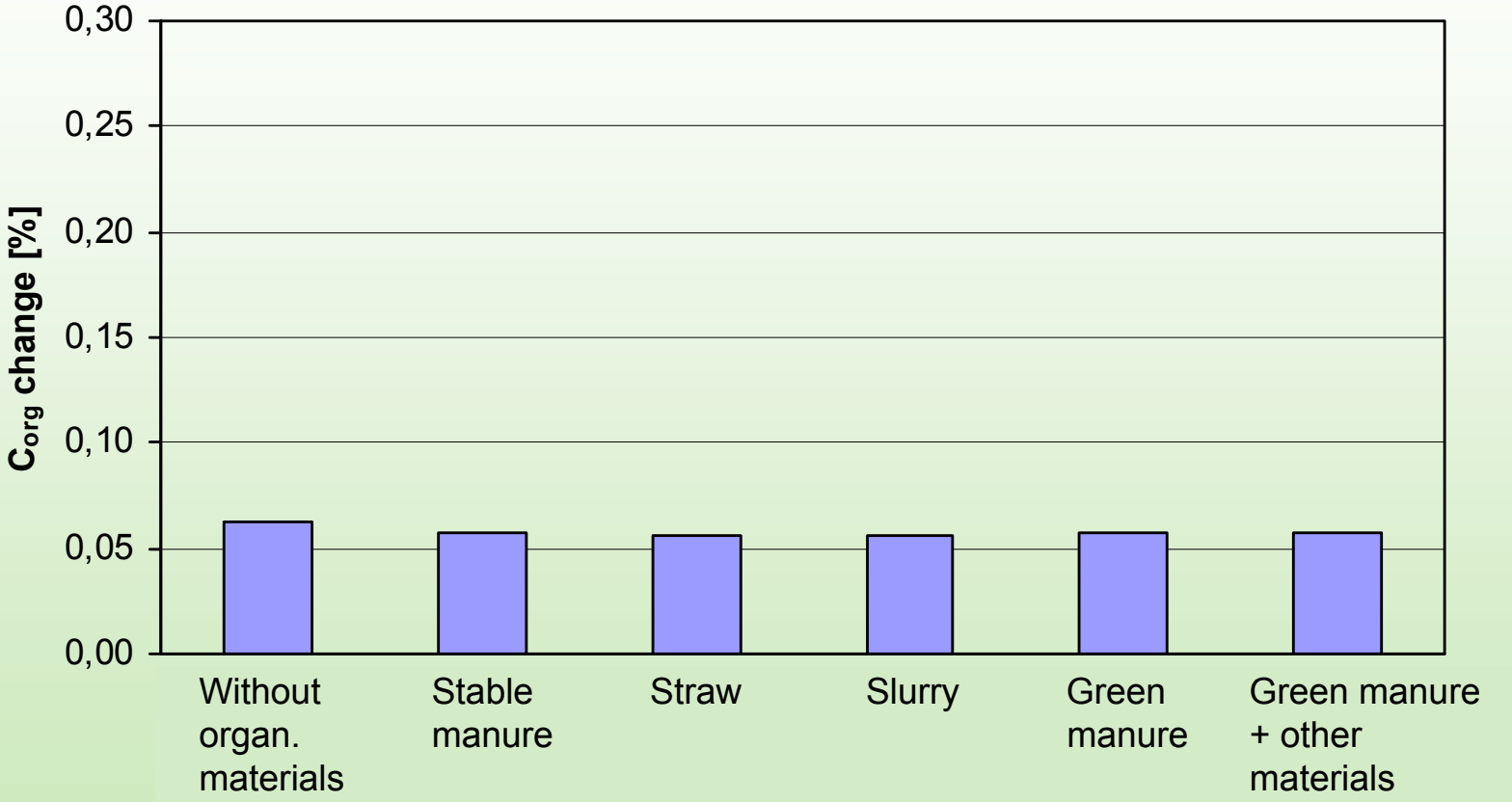
Effects of increasing stable manure supply on the C_{org} content change of the soils (long-term field trials, 471 variants)



Humification coefficients for organic materials

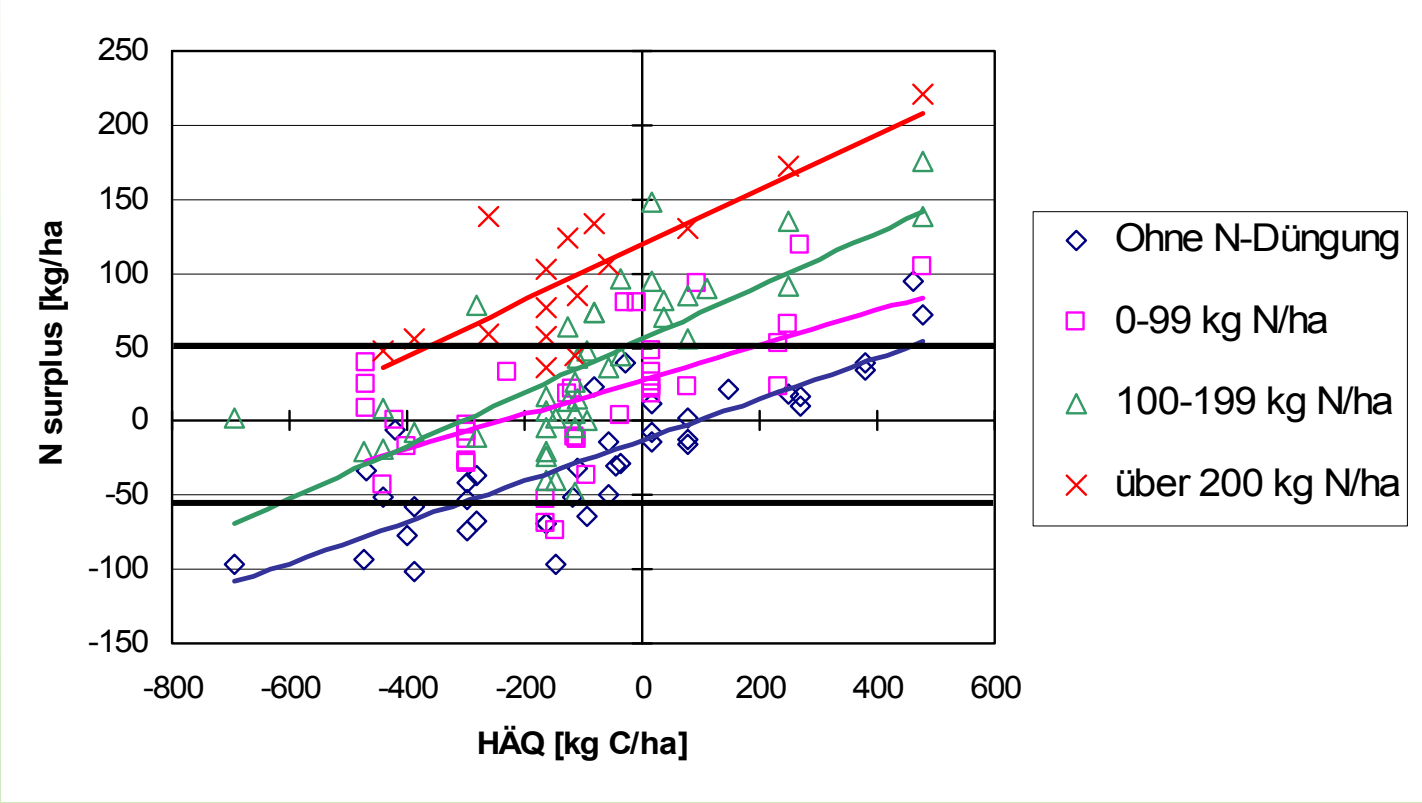
Organic materials Arten organischer Materialien	Supply group Bereich an Zufuhrmengen (t/ha FM)	Humification coeficients derived from field trials Aus Versuchen abgeleitete Reproduktionsleistung (kg C_{org}/t FM)	Adapted humification coefficients Nach Prüfung übernommene Reproduktionsleistung (kg C_{org}/t FM)	VDLUFA method humification coefficients VDLUFA-Methode Reproduktionsleistung (kg C_{org}/t FM)
(Bioabfall)Kompost (55 % TM) (29 Standard- u. 58 Düngungs-Varianten)				96
	bis 10	92 - 99	92	
Compost	10 – 20	74	74	
	über 20	58	58	
Stalldung (25 % TM) (289 Standard- u. 377 Düngungs-Varianten)				40
	bis 10	34	33	
Stable manure	10 – 20	28	26	
	über 20	24	23	
Gülle, Rind (7 % TM) (50 Standard- u. 101 Düngungs-Varianten Rind+Schwein)				9
	bis 35		8,6	
Slurry (cattle)	35 – 70	6,5	8,1	
	über 70		8,1	
Gülle, Schwein (8 % TM) (50 Standard- u. 101 Düngungs-Varianten Rind+Schwein)				8
	bis 35		6,5	
Slurry (pig)	35 – 70	5,0	5,8	
	über 70		5,8	
Stroh (86 % TM) (122 Standard- u. 128 Düngungs-Varianten)				80 – 110
	bis 3	85	83	
Straw	3 - 6	70	68	
	über 6	43	41	
Gründüngung (10 % TM) (97 Standard- u. 88 Düngungs-Varianten)				8
	bis 10	6,8	5,5	
Green manure	10 - 20	4,5	3,2	
	über 20	2,3	1	

Method accuracy (mean values) for the adjusted organic materials after the optimization process

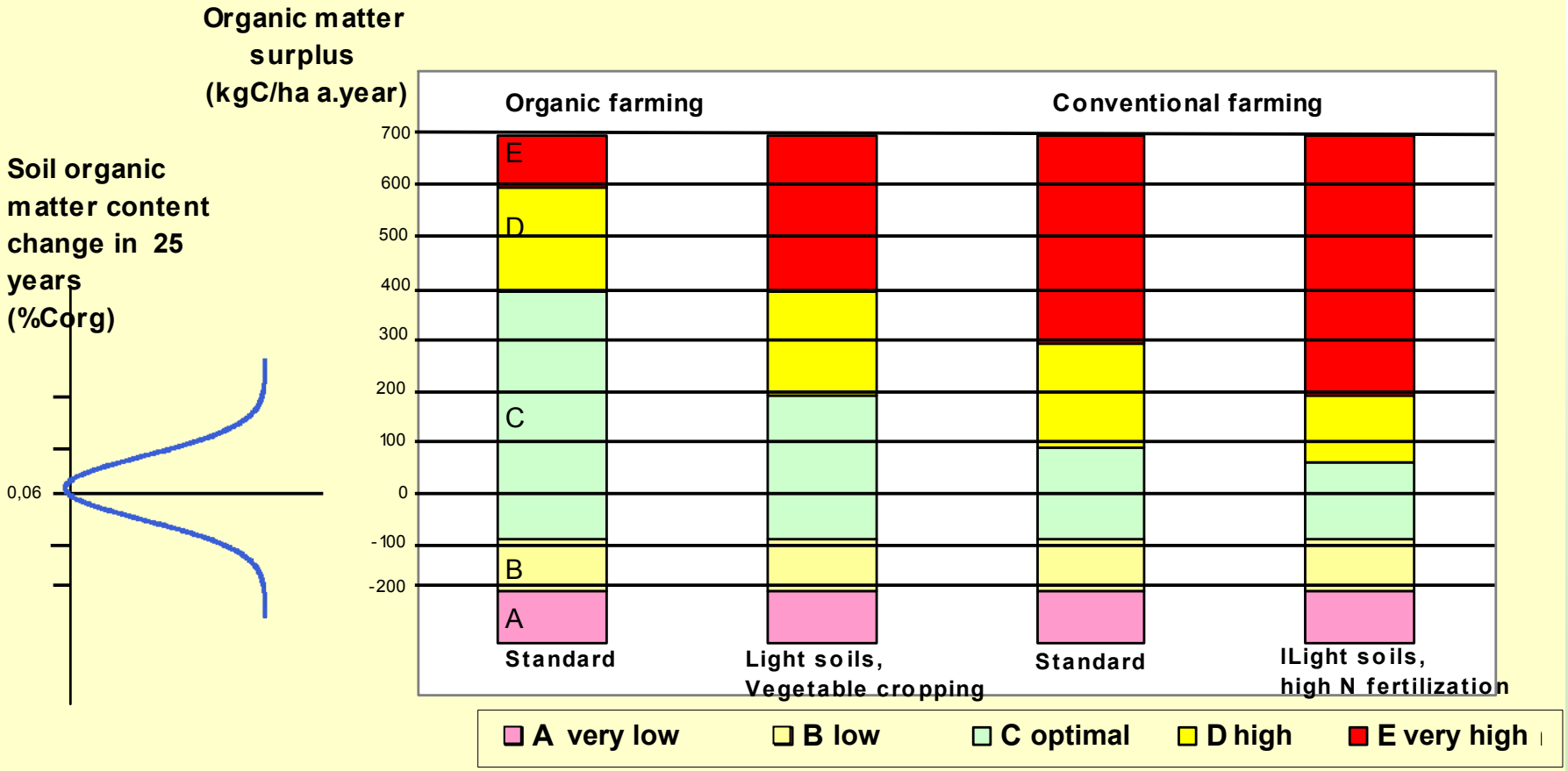


Relationship between organic matter balance results (HÄQ), mineral N fertilization, and the N surplus, calculated from long-term field trials (sample of a site specific group)

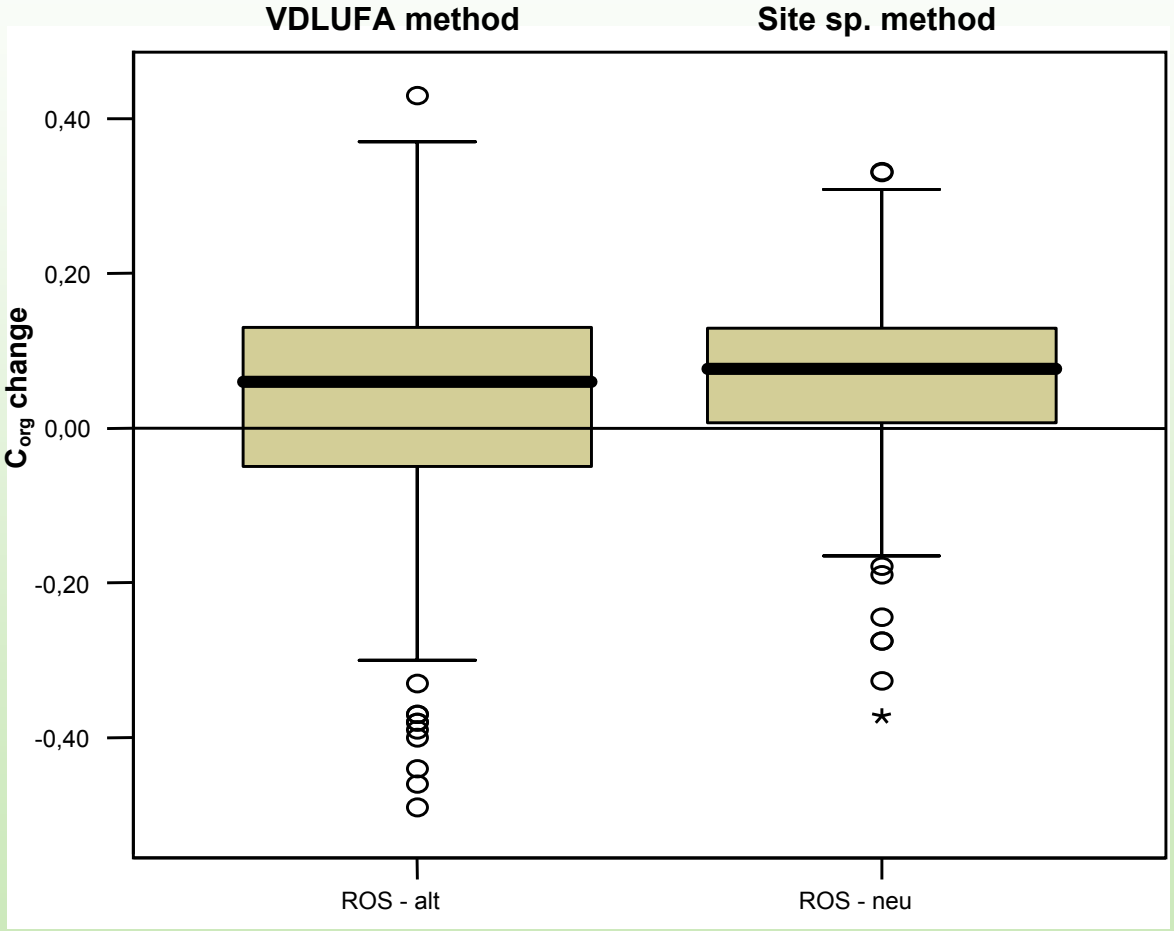
(black lines = +-50 kg N/ha surplus constraints)



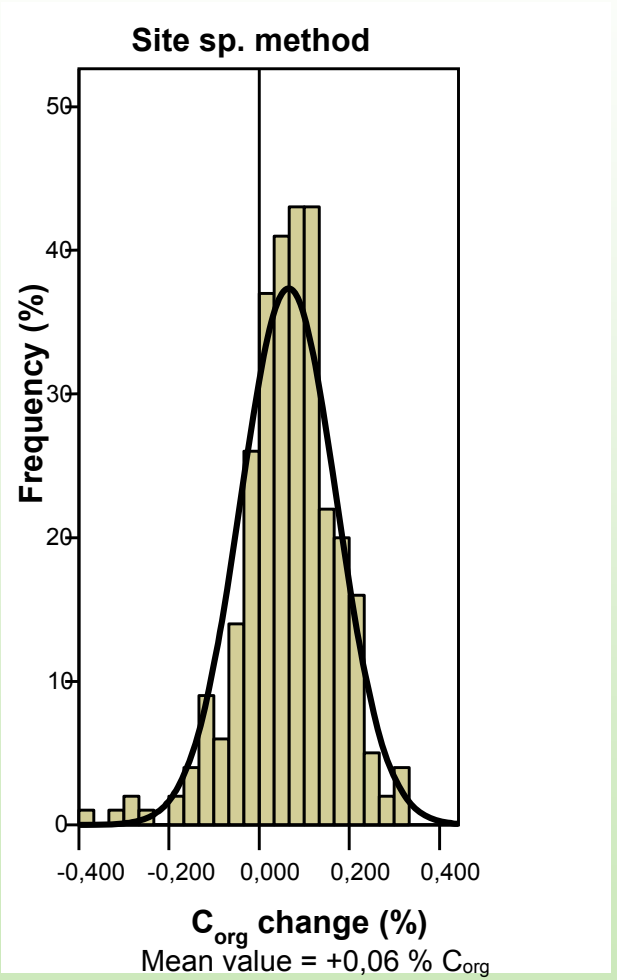
Classification system for the organic matter supply (after VDLUFA)



Boxplots, variance, and distribution curve of the C_{org} content change fequency before and after the optimization process



$S^2 = 0,034$ $S^2 = 0,011$



Demands and targets for organic matter balancing

- ✓ Adjusting the calculation results to the organic matter content changes of the soils.
- ✓ Consideration of site specific effects (climate, soils).
- ✓ Adaptation of the VDLUFA classification system to the following goals (suppy groups A= very low – E= very high):
  - Large areas with optimal values (supply groups C, D), for the reason of multiple functions of the organic matter in the soils and in very different agricultural systems (e.g. commercial and livestock farming; integrated and organic farming).
  - Specification of a lower limit of organic matter supply (A/B), which is permitted to fall below for the reason of observing site specific organic matter contents of the soils and the sustainability of the farm.
  - Specification of upper limits of supply for the reason of environmental and resource protection (E).

Summary

- **Examination of the VDLUFA method accuracy has shown several unfavourable results** (KOLBE & PRUTZER, 2004, http://orgprints.org/2931; KOLBE, 2005; BEUKE, 2006)

- **As a result of an intensive discussion process the demands and targets for organic matter balancing were revised and expanded** (KOLBE, 2006, http://orgprints.org/3516; UDE, 2006, http://orgprints.org/8283)

- **Further development and validation of the method were carried out by the use of 39 long-term field trials (330 variants) with representative distribution over Germany** (KOLBE, 2007, http://orgprints.org/9516, http://www.smul.sachsen.de/lfl/publikationen/download/2990_1.pdf)

- **The accuracy of the method was improved by optimization work as follows:**
  - Identification of site specific groups with homogenous humification levels
  - Adaptation of the humification coefficients of the crop species
  - Adaptation of the humification coefficients of the organic materials
  - Adaptation of the classification system for use in very different agricultural systems and conditions