Impact of best management practice in organic agriculture on aquatic resources

Guido Haas

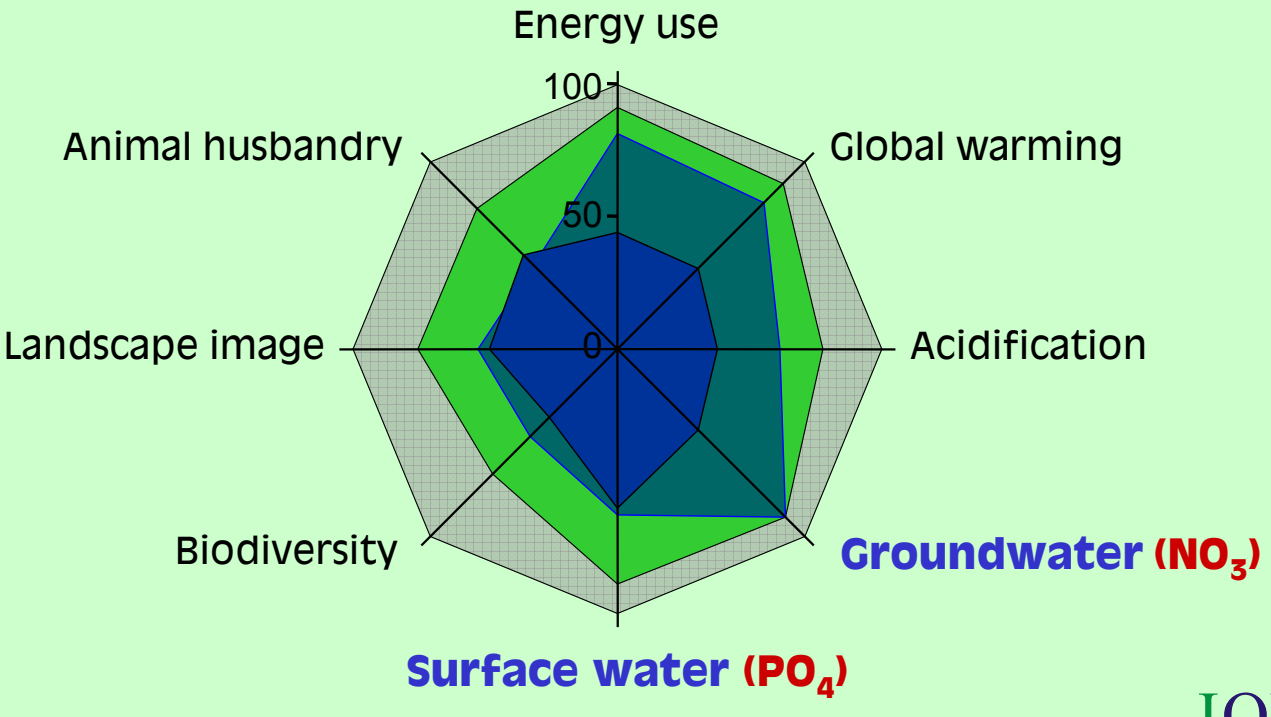
Overview

- Inherent impact of the organic agriculture system
- Best management strategies in organic agriculture

Organic AgroExpertise Guido Haas, Bad Honnef

Comparing conventional,"extensified" and organic dairy grassland farms (n = 18)

by process life cycle assessment (ISO norm 14 040)
in southern Germany (Allgäu)



Haas et al. 2001, AEE 83, 43-53.

IOL
Institute of Organic Agriculture
University of Bonn

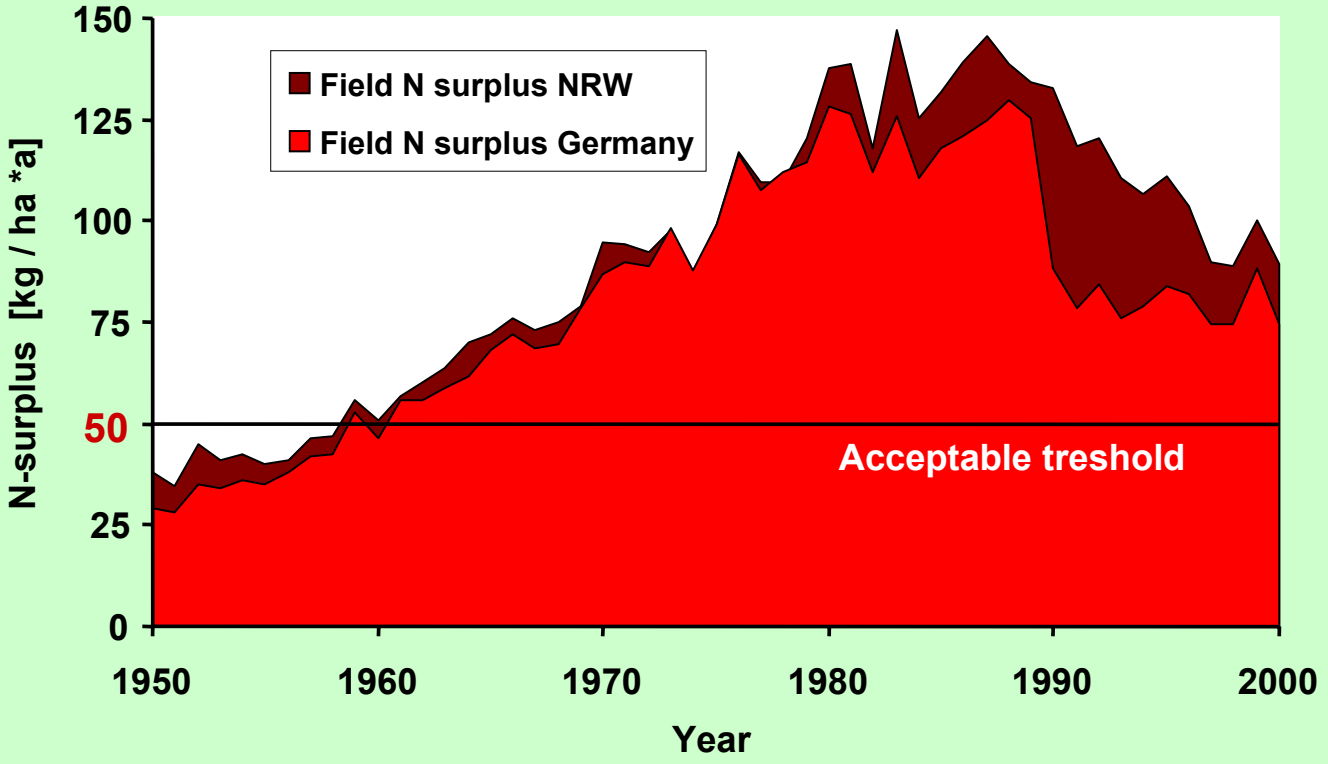
- **No pollution with agrar-xenobiotika because synthetic chemicals (pesticides, fertilizers) are forbidden.**
- **Lower potential of soil erosion due to**
  - **broader crop rotations and spectrum of crops,**
  - **intensive use of undersown crops, catch/cover crops.**
- **Lower risk for germ contamination because of**
  - **strew used for bedding,**
  - **more manure instead of slurry based housing systems**
  - **appriate housing systems and lower intensity level do not induce stress diseases.**
- **Lower nitrate leaching rates**

  content of further presentation

Haas 1997 in AÖGL-BUND Code of practice for water works

IOL
Institut für Organischen Landbau
Universität Bonn

Conventional farming: Nitrogen surplus at field level in Germany and North-Rhine-Westphalia (NRW) in 1950 - 1999

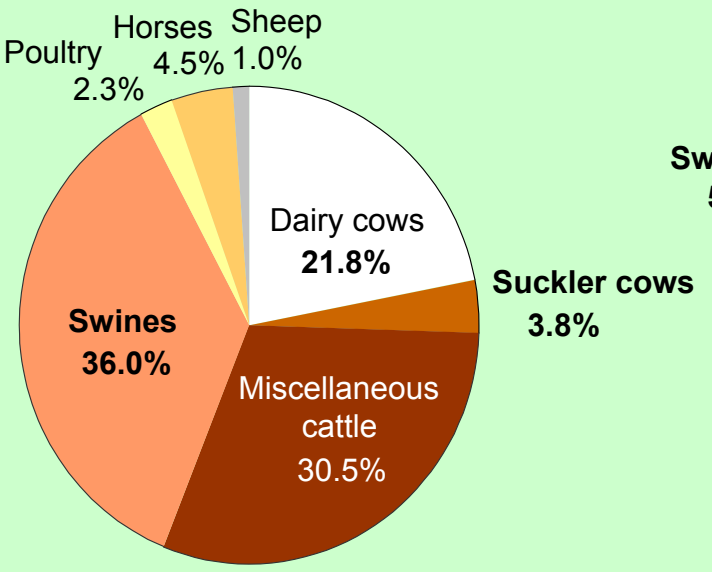


Zerger& Haas 2003, data source: Bach & Frede 2002

IOL
Institut für Organischen Landbau
Universität Bonn

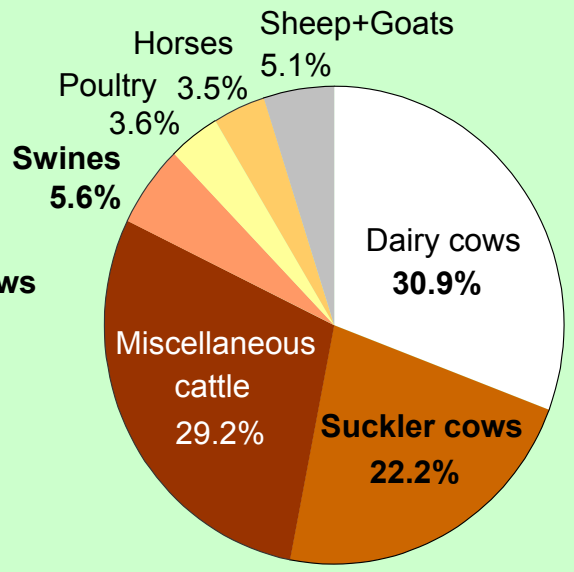
Livestock Farming in North-Rhine Westphalia (NRW)

Conventional



Mean = 1.3 LU/ha

Organic



Mean = 0.7 LU/ha

LU: livestock unit (each 500 kg liveweight)

Zerger & Haas 2003

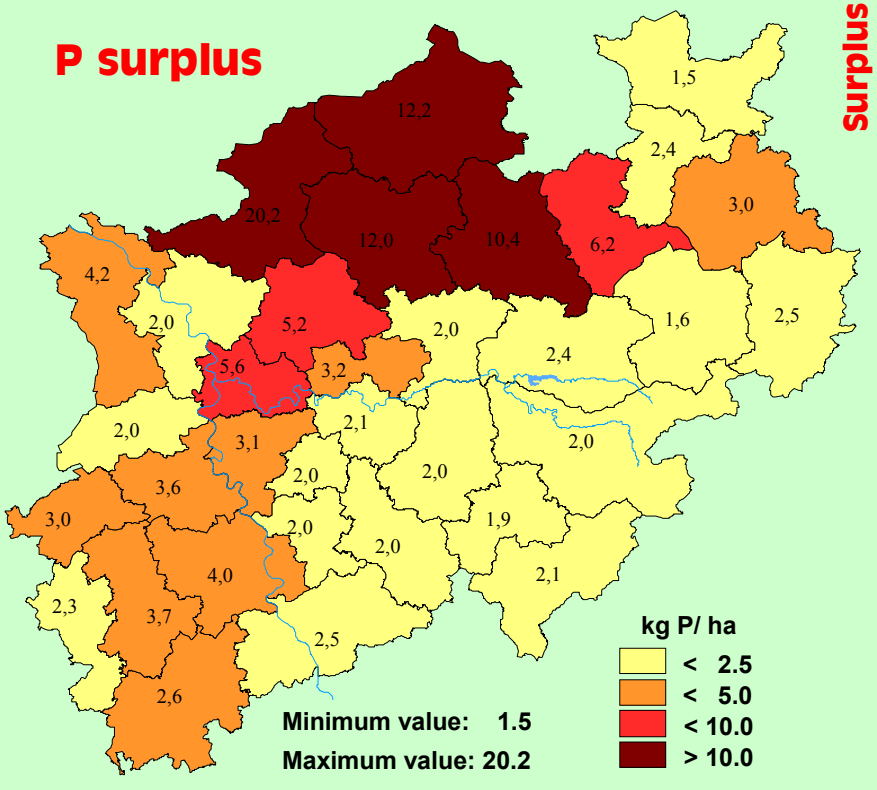
IOL
Institute of Organic Agriculture
University of Bonn

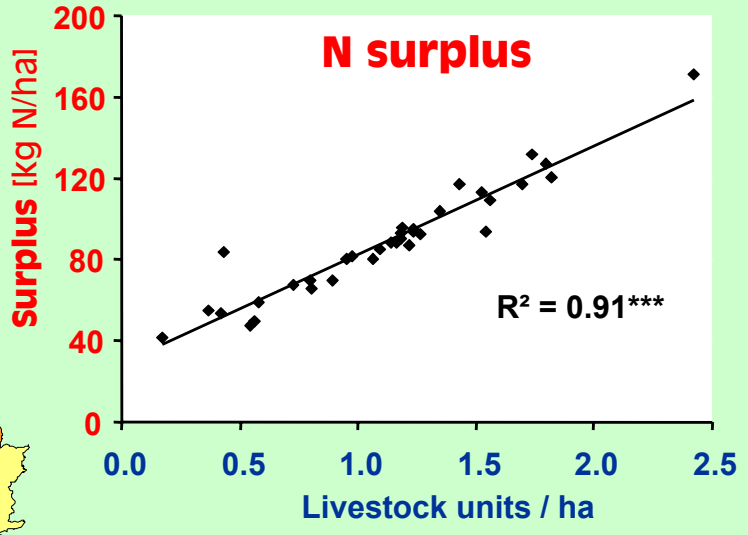
NRW Conventional Agriculture:

As livestock density rises

the surplus of P & N becomes higher

(n = 34 districts, in 1999)



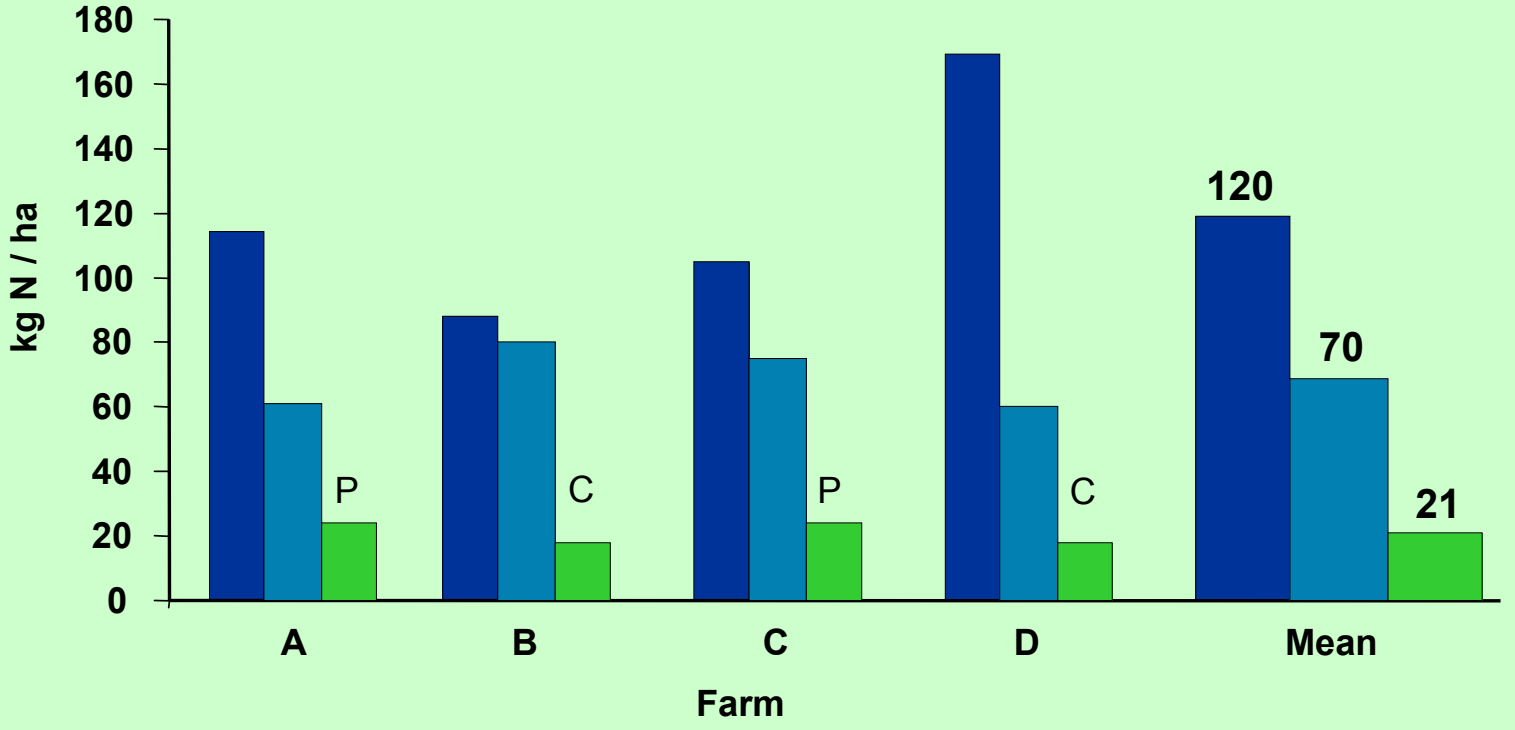


Segregation of farming processes within farms and within regions causes high surpluses of nutrients

Zerger& Haas 2003

Institute of Organic Agriculture
University of Bonn

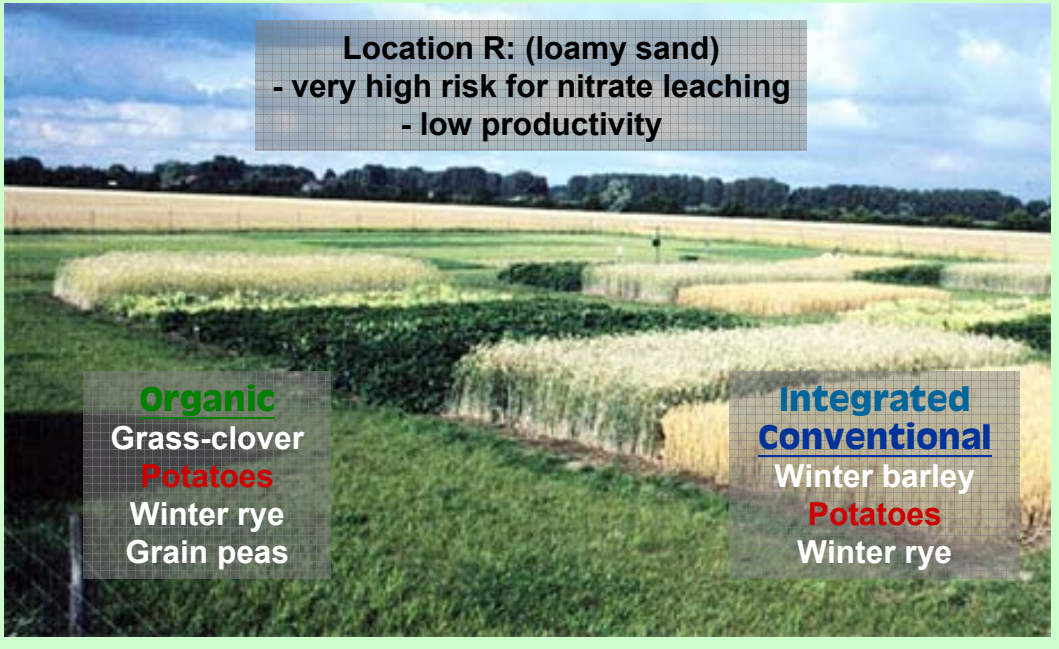
N-farmgate balance (incl. symb. N_2-Fixation) by converting conventional to integrated and organic farming



Haas, Berg & Köpke 1998, DBU-report

IOL
Institut für Organischen Landbau
Universität Bonn

Nitrate leaching: Comparing conventional, integrated and organic agriculture



Definition of the systems

Conventional
local farmer's practice

Integrated
Consulting agency GEOLOG and regional extension service

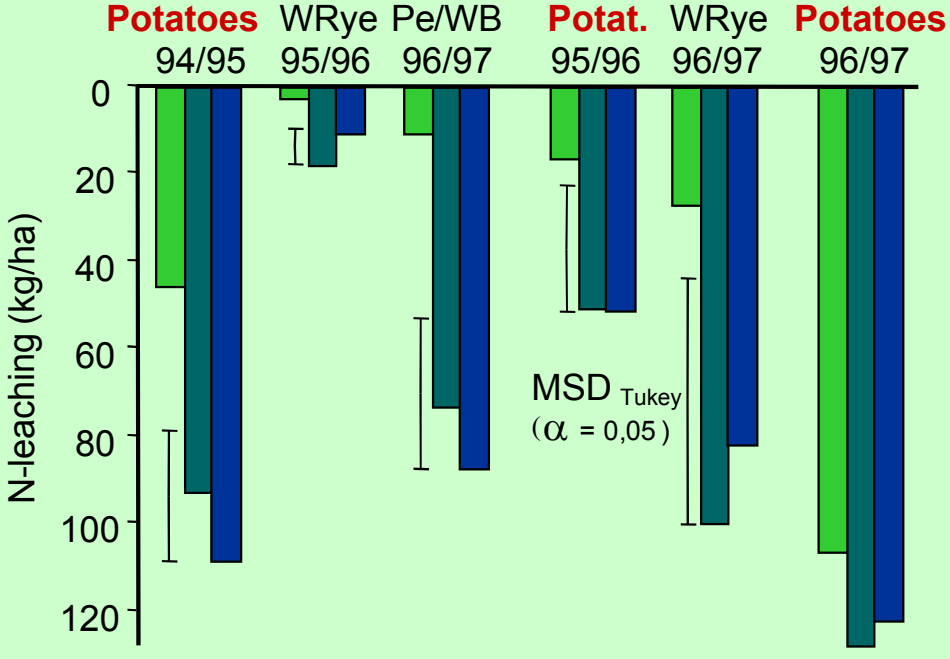
Organic
According to national and European standards and laws

In the project area (Lower Rhine valley) intensive agricultural land use caused high nitrate contents in ground water supplies (approx. 80 mg NO_3/l)

Haas, Berg & Köpke 1998, DBU report.

Institute of Organic Agriculture
University of Bonn

Comparing impact of farming system on nitrate leaching in a watershed



Nitrate-concentration of the percolate (mg/l)

	94/95	95/96	96/97	95/96	96/97	96/97
Organic	55a	24a	17a	83a	44a	152
Integrated	113b	148b	100b	260b	152b	199
Conventional	132b	96b	119b	262b	122ab	186

Haas et al. 2002 WMO

Institute of Organic Agriculture
University of Bonn

Art	Autor/en und Jahr	OL zu Kon/IP	Untersuchungsart, -dauer, -ort
N1	SCHLÜTER 1997	<	Saugkerzen, 2 Betriebe, 2 Jahre
N2	ISERMANN 1987	=	Tiefbohrung, 2 Betriebe, heterogene Böden
N3	SCHINDLER et al. 1999	>	Tiefbohrungen bis 5 m,
N4	WURBS et al. 2000	<	Tiefbohrungen bis 4,2 m,
N5	BRANDHUBER & HEGE 1991	<	Tiefbohrungen bis 5 - 10 m, 99 Praxisflächen
N6	EMMERLING 2001	<	Tiefbohrungen bis 3 m, hohe Variation, n.s.
N7	OOWV 1996, HARMS 1997	<	Oberflächennahes Grundwasser
N8	FEIGE & RÖTHLINGSH. 1990	<	Dränwasser, 2 Betriebe, 5 Jahre
N9a	SATTELMACHER & G. 1989	<	Saugkerzen, 2 Jahre, Betriebspaar Podsol
N9b	SATTELMACHER & G. 1989	=	" , Betriebspaar Parabraunerde
N9c	BLUME et al. 1989	<	Betriebspaar Podsol, 3 bzw. 5 Jahre
N9d	POMIKALKO et al. 1993	<	Boden, Betriebspaar Podsol, 3 Jahre
N10	MEYERCORDT 1997	=	Boden, 3 Betriebspaare, 2 Jahre
N11	JORDAN 1997	<	Boden, Wasserschutzgebietsflächen
N12	PAFFRATH 1993	<	Boden, 2 Betriebe, Fruchtfolgenmittelwert
N13	KURZER & SUNTHEIM 1999	<	Boden, Dauertestflächen
N14	SLUFAK 1994 - 2000	=	Boden, SchALVO-Vergleichsflächen
N15	MIERSCH & VETTER 2000	<	Boden, Baden Württemberg
N16	SCHULTE 1996	(<)	Boden, nur OL, Kon. nach Literatur
N17	KOLBE et al. 1999	(<)	Tiefbohrung bis 5 m, Auswirkung Umstellung
N18	PHILIPPS & STOPES 1995	(<)	Saugkerzen, 3 OL Betriebe, 1988 - 1992
N19	KRISTENSEN et al. 1994	=	Dänemark, 26 OL & 550 Kon.-Praxisbetriebe
N20	LW 1997	<	Boden, Wasserschutzgebietsflächen
S1	HAAKH et al. 1996	<	Interpolation, Wasserschutzgebiet
S2	KERSEBAUM 1999	<	Land Brandenburg
S3a	HANSEN et al. 2000	<	Dänemark, auf Sand
S3b	HANSEN et al. 2000	=	" , auf Lehm
B1a	SMILDE 1989, VEREIJKEN 1990	<	Nagele, Niederlande, 1982 - 1988
B1b	VAN LEEUWEN & W. 1997	>	" , 1992 - 1996
B2a	ELTUN 1995	<	Norwegen, 1990 - 1993, Marktfrucht.
B2b	ELTUN 1995	<	" , Futterbaufruchtfolge
B3	FRIED et al. 2000	=	Burgrain, Schweiz, Boden-Nitrat
L1	SEEGER et al. 1997	>	Lysimeteruntersuchung
F1	ALFÖLDI et al. 1992	=	"DOK-Versuch", nähe Basel, Schweiz
F2	SCHINDLER et al. 1999	<	Müncheberg
F3	HEGE et al. 1996	<	Tiefbohrungen, Puch, Bayern, NO_3/l in IP mit 25% Rotationsbrache geringer als OL
F4	MEUSER/ WESSOLEK et al. 1989	=	Darmstadt, reiner Düngerartenvergleich
F5	DRINKWATER et al. 1998	<	Pennsylvenia, 1981-1995, Nitrat-N 1991 - 1995
F6	SMOLIK et al. 1993	<	South-Dakota, 1986 - 1992, Nitrat-N 1992
F7	BERG 2002, HAAS et al. 1998	<	Rheinland, 1993 - 1997, s. Kap. 4.4

Review: Comparing nitrate concentrations /leaching at different levels of investigation

40 publications listed:

Nitrate leaching or leaching potential in organic compared to conventional agriculture was

28 lower

3 higher

9 similar

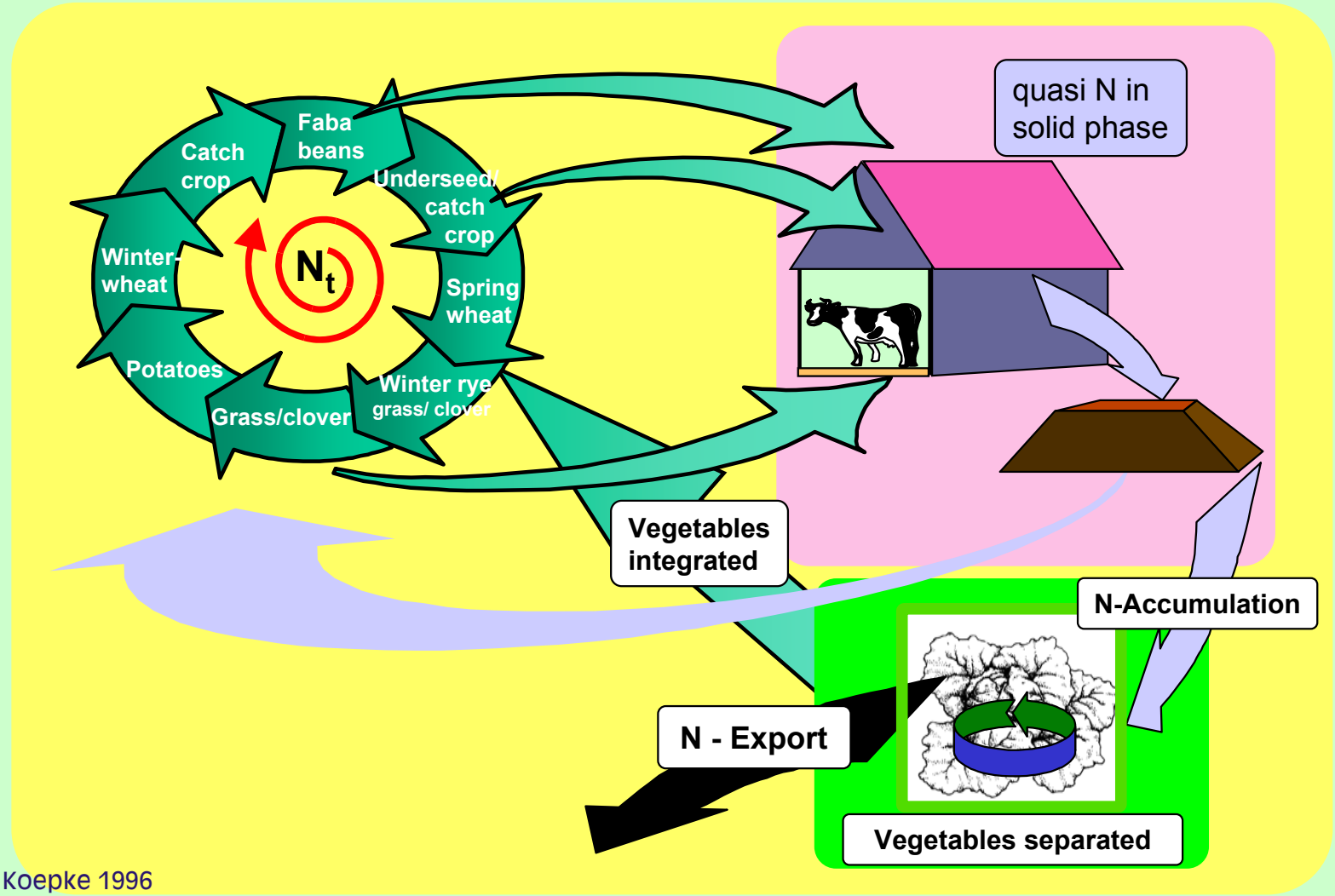
Haas 2002

IOL
Institut für Organischen Landbau
Universität Bonn

Best management practise in Organic Agriculture

N flow chart at research farm Wiesengut - N export via vegetables

Best management practise by quantifying nutrient matter flow



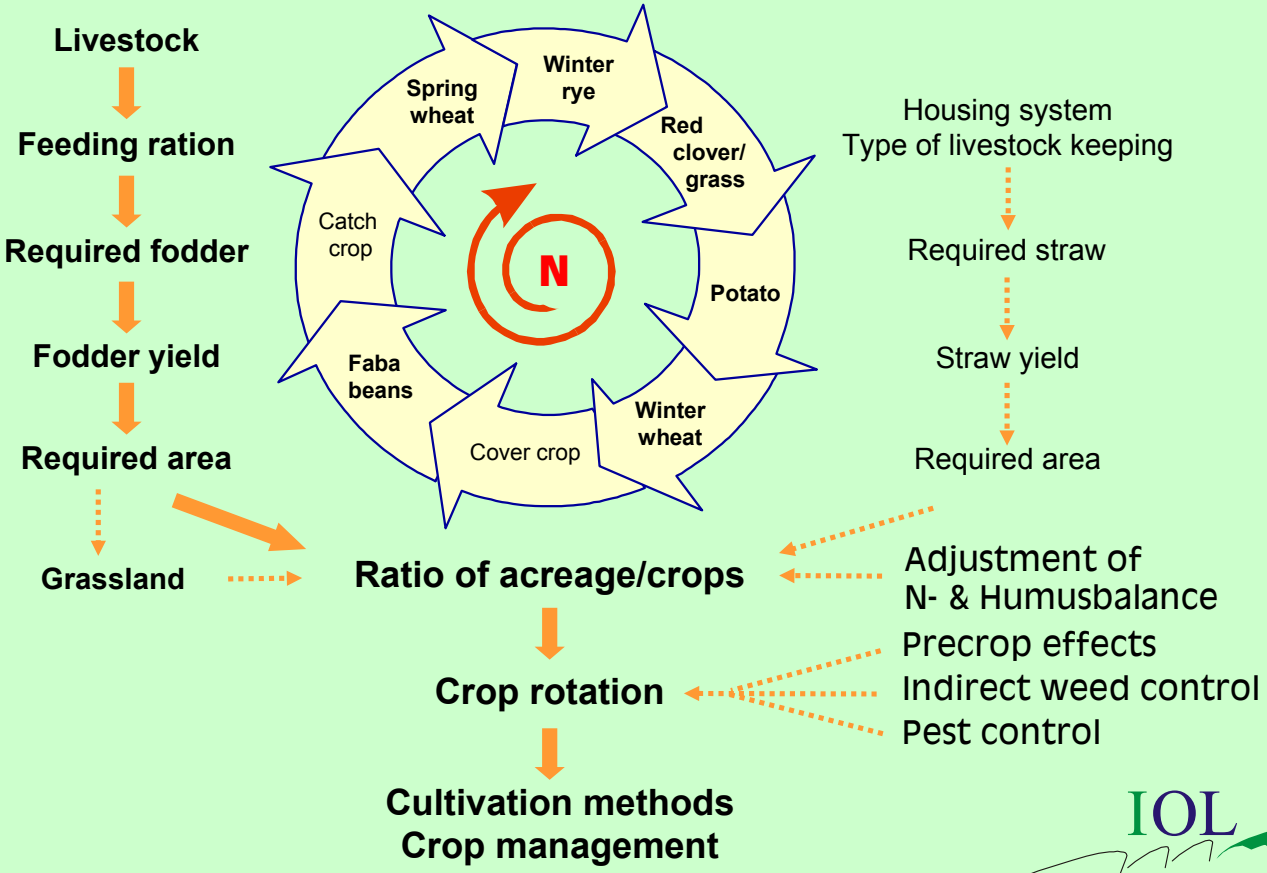
Koepke 1996

Research Farm Wiesengut

Nutrient Matter Flow Analyses

Haas, Caspari, Koepke 2003

Best management practise in O.A. by analysing and planning the production process

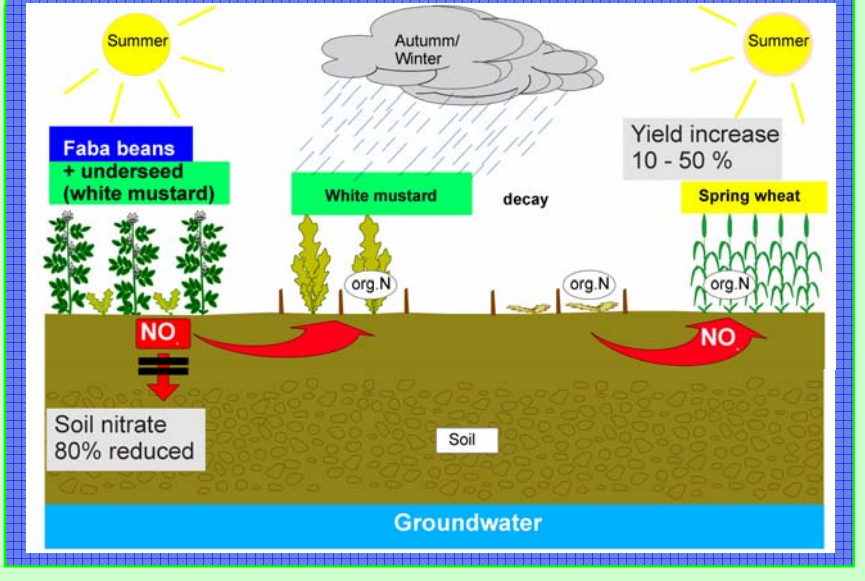


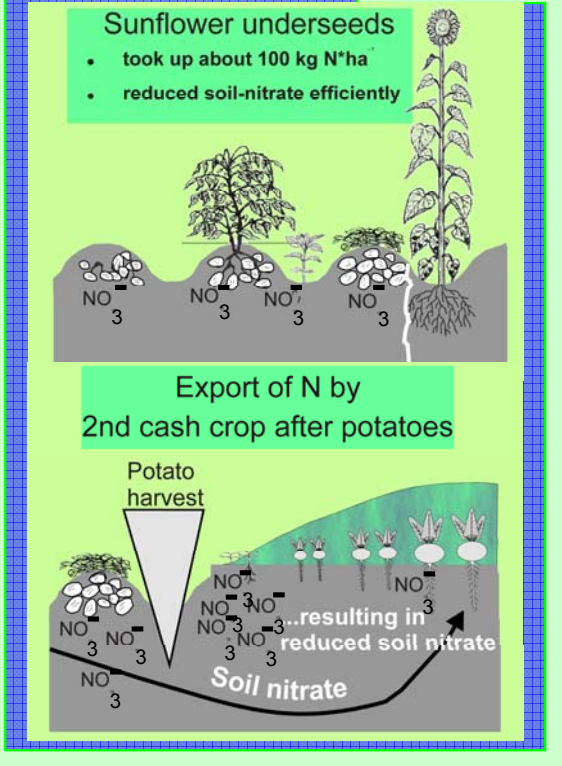
Haas 2003, Pilot farm report

IOL
Institute of Organic Agriculture
University of Bonn

Best management practise in O.A. by adapting efficient strategies to avoid nitrate leaching within crop rotation

Faba-beans	(Undersown) Catch crop	Spring wheat	Winter rye undersown grass/clover	Grass/ clover mixture	Potatoes	Undersown Catch crop/ 2nd Cash crop	Winter wheat	Catch crop





Köpke 1995, 1996, Haas 2002

Overview minimizing nitrate leaching strategies

Best management strategies in organic agriculture to avoid nitrate leaching

Crop/Substrate	Strategy	Author / Location
Manure storage	**refer to separate list with details**	Dewes et al. m.J. (Gießen, Kiel); Heß et al.´92; Köpke ´93; KTBL´96, Falter & Köpke '99 (Wiesengut)
Legumes		
Forage (Red clover/grass)	**Variation of soil tillage timing and following crop depending on site condition**	Heß, Franken et al. 1993 etc. Wiesengut, locations in Germany)
Pulse (Faba beans)	**Variation of row distance, pure crop or mixture, under-/regular sown catch crop / variety**	Justus & Köpke 1993, etc. (Research farm Wiesengut)
Green manure	**Mixture of varieties - adding non-legumes, date of harvest/mulching and soil tillage**	König et al. 1996 (Darmstadt, locations in Germany) Haas 2004, Wiesengut / Pilot farms
Root crops		
Potatoes	**Bi-Cropping** (White mustard after defoliate)	Kainz et al. 1997, Hofgut Scheyern
	Undersowing catch crops	Haas 2002, Wiesengut / Pilot farms
	Simultanious harvest and sow catch crop	Buchner et al. 1998, Gut Köln-Wahn
	Add straw (N-Immobilisation)	Haas 2002, Wiesengut / Pilot farms
	Second cash crop (e.g. turnip)	Kotnik & Köpke 2004, Wiesengut
	Following Crop (variety, seeding time, etc.)	Reents et al. 1997, Hofgut Scheyern

Haas 1997 in AÖGL-BUND, Haas 2002, report

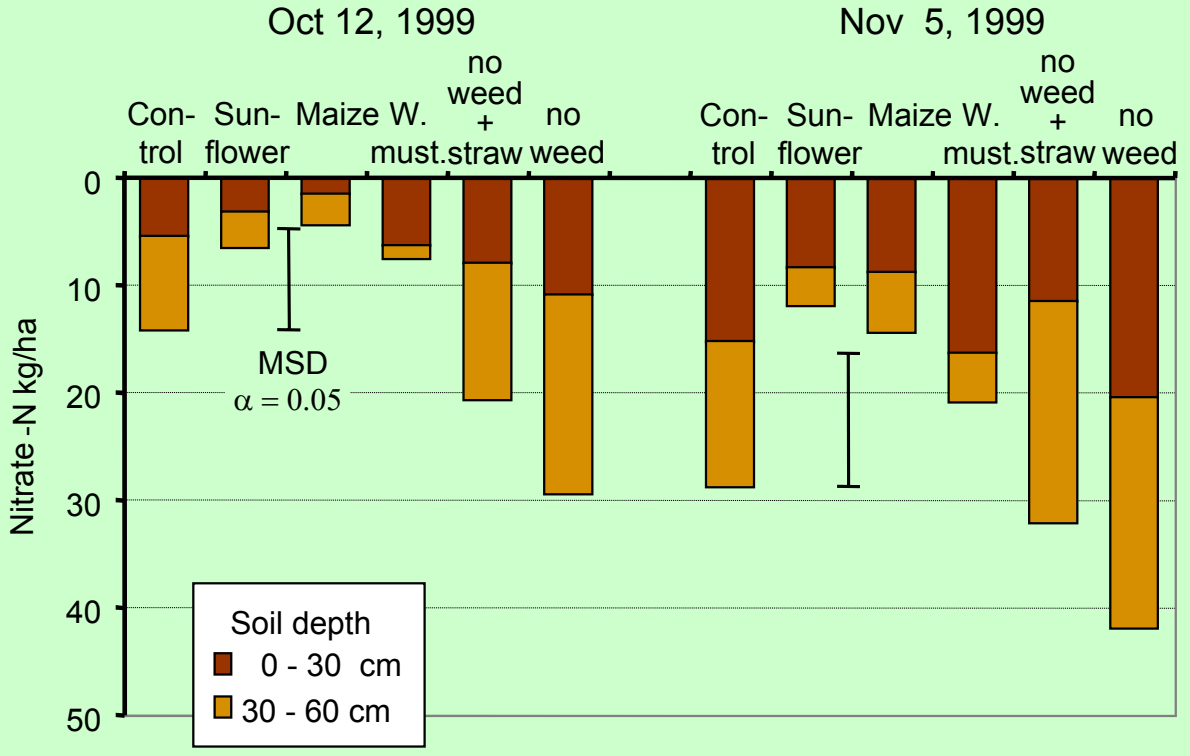
Organic AgroExpertise Guido Haas, Bad Honnef

Sunflower, maize and white mustard undersown in potatoes to minimise environmental burdens

Haas 2002, report

IOL
Institute of Organic Agriculture
University of Bonn

Undersown crops in potatoes reduced nitrate content of the soil after potato harvest (soil-nitrate content in kg/ha - location farm W)



Haas 2002, report

IOL
Institute of Organic Agriculture
University of Bonn

Benefits and limits: Undersown "catch" crops in potatoes

- reduced nitrate content of the soil after potato harvest.
- suppressed weed growth.
- maintained soil organic matter (high dry matter production).
- minimized soil erosion due to heavy rain falls in summer (Gerl & Kainz 1999).
- Flowering sunflowers or white mustard create a positive landscape image and enhance pollinating insects.
- Main problem: Seeding technology for maize and sunflower.
- Successful only if duration of the potato shoots is limited, e.g., early infection of potato blight.

Haas 2002, report

Conclusion

- **Organic agriculture is the best management practice according water quality impact (inherent to the system).**
- **To ensure and enhance that advantage best management strategies in organic agriculture derived from research should be adapted or need to be developped.**

References I (complete list on request)

Haas, G. 1997: Argumentationsleitfaden I. In: Arbeitsgemeinschaft Ökologischer Landbau und Bund für Umwelt und Naturschutz Deutschland (Hrsg.): Wasserschutz durch Ökologischen Landbau - Leitfaden für die Wasserwirtschaft (*Water protection due to organic agriculture - guide for water works*). Darmstadt, Bonn, 2-69.

Haas, G. 2001: Organischer Landbau in Grundwasserschutzgebieten: Leistungsfähigkeit und Optimierung des pflanzenbaulichen Stickstoffmanagements *(Organic Agriculture in ground water areas: performance and optimisation of the agronomic nitrogen management).* Verlag Dr. Köster, Berlin, 165 S.

Haas, G., M. Berg, U. Köpke 1998: Grundwasserschonende Landnutzung - Vergleich der Ackernutzungsformen Konventioneller, Integrierter und Organischer Landbau, Vergleich der Landnutzungsformen Ackerbau, Grünland (Wiese) und Forst (Aufforstung) (*Ground water sound land use - comparison of conventional, integrated and organic arable farming, comparison of the land use options cropping, grassland and forst, research report*). Verlag Dr. Köster, Berlin, 164 S.

Haas, G., F. Wetterich, U. Geier 2000: Life cycle assessment framework in agriculture on the farm level. J. of Life Cycle Assessment 5 (6), 345-348.

Haas, G., M. Berg & U. Köpke 2000: Land use options in watersheds: Afforestation or grassland instead of arable farming?. Proceedings, UNESCO, WMO, European Environment Agency (EEA), Int. Conference Agricultural Effects on Ground and Surface Waters, 1.-4. Oct. 2000, Wageningen, 21 - 22.

Haas, G., F. Wetterich & U. Köpke 2000: Impact on ground and surface water quality of intensive, extensified and organic grassland farms in southern Germany. Proceedings, Int. Conference Agricultural Effects on Ground and Surface Waters, 1.-4. Oct. 2000, Wageningen, 23 - 24.

Haas, G., F. Wetterich, U. Köpke 2001: Comparing intensive, extensified and organic grassland farming in southern Germany by process life cycle assessment. Agriculture, Ecosystems & Environment 83/1-2, 43-53.

References II

Haas, G., M. Berg & U. Köpke 2002: Nitrate leaching: comparing conventional, integrated and organic agricultural production systems. In: Agricultural Effects on Ground and Surface Waters (Steenvorden, J., F. Claessen & J. Willems, eds.) Intern. Association of Hydrological Sci., IAHS Publ. no. 273, Oxfordshire, UK, 131-136.

Haas, G., B. Caspari, U. Köpke 2002: Nutrient cycle on organic farms: stall balance of a suckler herd and beef bulls. Nutrient Cycling in Agroecosystems 64, 225-230.

Köpke 1995: Nutrient management in Organic Farming Systems: The case of nitrogen. Biological Agriculture and Horticulture 11, 15-29.

Köpke 1996: Legume nitrogen in crop rotation: Reducing losses – increasing precrop effects. In: Publications of the Institute for Biodynamic Research, Darmstadt, Vol. 8, 32-51.

Zerger, C., G. Haas 2003: Ökologischer Landbau und Agrarstruktur in Nordrhein-Westfalen - Atlas und Analyse (Organic Agriculture and agricultural structure in North Rhine-Westphalia, research report). Schriftenreihe Institut für Organischen Landbau, Verlag Dr. Köster, Berlin, 90 S.

For any further question do not hesitate to contact me:

Dr. Guido Haas
Organic AgroExpertise Consultancy
Email: g.haas@agroexpertise.de
Internet: www.agroexpertise.de