Organic Agriculture and Climate Change, September 28 - 29, 2009, Sofia, Bulgaria

Relevance of Organic Farming for Climate Change in Germany - wishful thinking?

Guido Haas, Germany

Content

- Conventional versus Organic Agriculture
  Emission of Greenhouse Gases (GHG) $CO_2 – N_20 – CH_4$
- CO_2 Emission of Food (Farming – Processing – Distribution)
- Pork versus Beef
- CO_2-Neutral Organic Food Labeling
  - for each impact a single label?)

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Organic Agriculture in Germany

Not far away to

20,000 farms

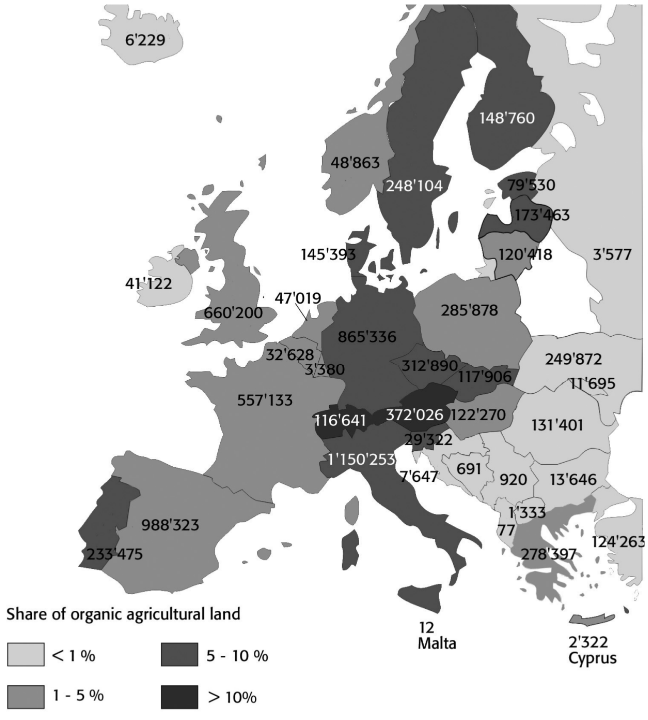
1 million ha

which is still only 5.5%

Source of figure: Europe 2007

FiBL in cooperation with ZMP 2009

www.organic-world.net/maps-2009.html



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CO_2-emission

predominantly due to fossil energy use

in Germany land-use change took place in former times

Comparision of conventional and organic farming

- Several studies since 1994
- All show clear advantages for organic

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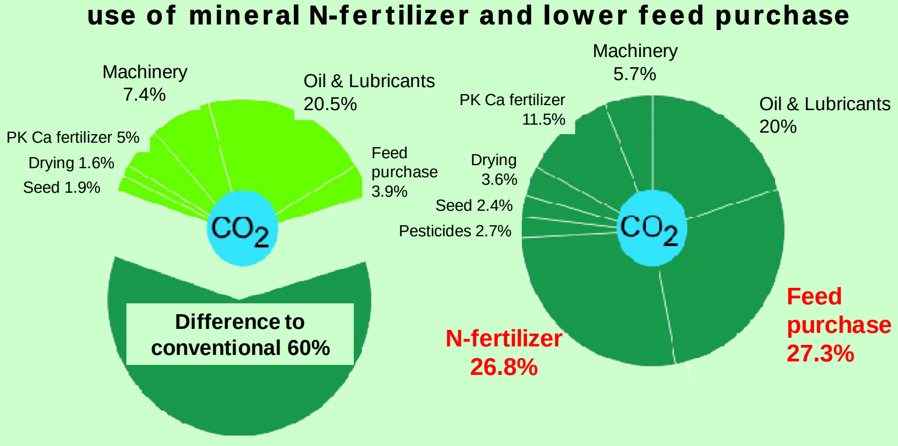
CO2 Comparing Farming Systems

Lower CO_2-emission in organic farming due to non-use of mineral N-fertilizer and lower feed purchase



0.503 t CO2/ha

Mean Organic

1.253 t CO2/ha

Mean Conventional

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Haas et al. 1995, study for the German National Parliament

N_2O-emission

predominantly due to field N input and turnover

Comparision of conventional and organic farming

- No representative on sight field measurements
  (Modeling is not enough)
- but indirect indication by comparing
  - N-surplus / N-input
  - Nitrate content in soil, subsoil and groundwater

N_2O-emission

90% of emission results due to the turnover of nitrogen in the soil and groundwater

(Nitrification (org-N -> NH_4); denitrification of nitrate)

depends on **N-input** (with no difference)

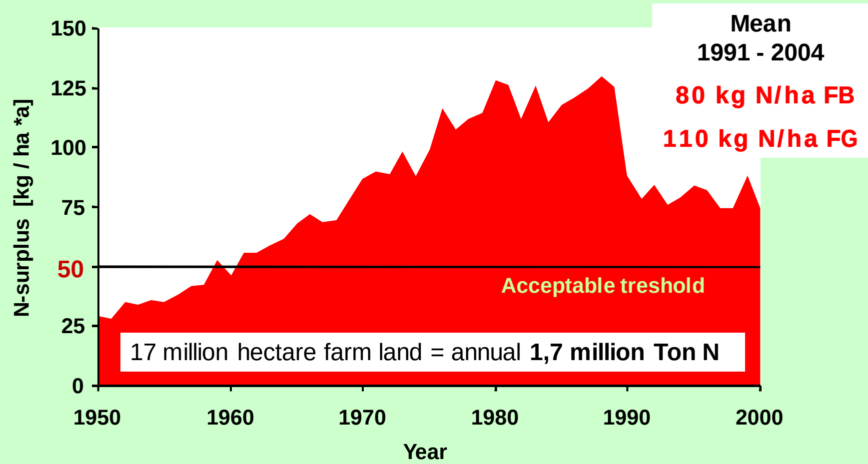
- commercial fertilizer
- farm manure,
- grazing (excrement/urine),
- biological N_2-fixation,
- harvest- and root residues.

natural process – always occurs.

1.25% of total N input is calculated as N_2O emission (rough IPCC-factor)

N-balance Germany

Environmental burden caused by intensifying conventional agriculture: Nitrogen surplus at field level in Germany



Haas et al. 2004/2005, data source: Bach & Frede 2002

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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

40 publications listed:

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

28 lower

3 higher

9 similar

Haas 2002

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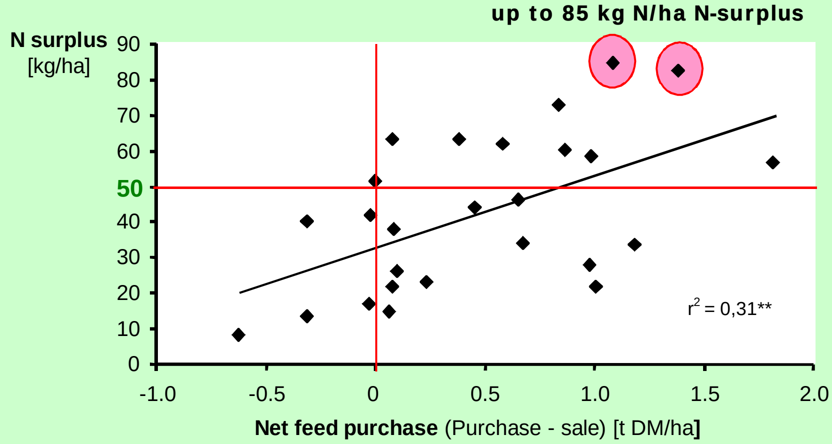
ÖkoMiB I

As higher net feed purchase
as higher nitrogen surplus (farm gate balance)

26 Organic dairy farms in north-west and southern Germany

up to 85 kg N/ha N-surplus



= > up to 58% of N-input due to external sources - still organic?

Haas et al. 2007, RAFS

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ÖkoMiB I

N-Surplus of Dairy Farm Comparisons

Reference, Region/ land and year of investigation	Organic	Conv. optimized integrated	Conventional
Scheringer Niedersachsen 1998/99	**56 kg** ha^{-1} 5,300 kg milk	**77 kg** ha^{-1} 6,660 kg milk	**146 kg** ha^{-1} 6,900 kg milk
Taube et al. Schleswig-Holstein 2005	**31 kg** ha^{-1}		**117 kg** ha^{-1}
Jonsson Schweden 1990 - 2001	<u>27</u> kg ha^{-1} 7,892 kg milk		90 kg ha^{-1} 8,038 kg milk
Cederberg and Flysjoe Schweden 2002	71 kg ha^{-1} 9,400 kg milk	114 kg ha^{-1} 9,130 kg milk	158 kg ha^{-1} 10,100 kg milk
Halberg et al. Denmark 1989-1991	**103 kg** ha^{-1} 5,600 kg milk		221 kg ha^{-1} 8,200 kg milk
Kristensen, Denmark 2002	**104 kg** ha^{-1} 6,958 kg milk	112 kg ha^{-1} 7,764 kg milk	174 kg ha^{-1} 7,764 kg milk
Leach and Roberts, Scottland, (1989-)1996-1998	90 kg ha^{-1} 5,717 kg milk		258 kg ha^{-1} 8,000 kg milk
Veer & Pinxterhuis et al. Netherland 1997 conv. - 2000 organic	**101 kg** ha^{-1} 6,930 kg milk		253 kg ha^{-1} 8,450 kg milk
Smolders and Wagenaar; Beldman et al.; Netherland, 1997 / 2002	**102** kg ha^{-1} 7,350 kg milk	153 kg ha^{-1} 8,073 kg milk	237 kg ha^{-1} 7,837 kg milk

Full table including more comparision Germany and Austria see publication.

Haas et al. 2007, RAFS

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CH_4

Emission of Methane (CH_4)

94% of emission caused by cattle;
since 1990 decrease due to 20% lower number of heads

- **in the rumen of the ruminant**
  depends on performance and feed;
  natural process – always occurs

- **during slurry & manure storage**
  depends on housing and storage and feeding:
  natural process – always occurs

= > Likely that organic farming has higher emission

UBA Umweltdaten 2006;

Agriculture causes Climate Change

- **CO_2** – Carbon dioxide
- **N_2O** – Dinitrogen oxide
- **CH_4** – Methane

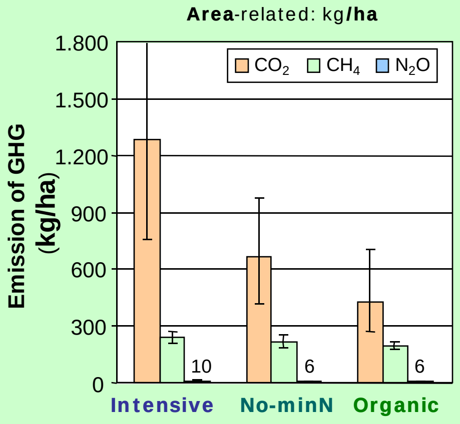
Overall comparision

– choosing appropriate reference unit

= > considering productivity?

Impact category: Global warming

Comparing intensive, no-mineral-N and organic farms



x

Conversion factor for CO_2–equivalents

- CO_2 = 1 CO_2
- CH_4 = 23 CO_2
- N_2O = 300 CO_2

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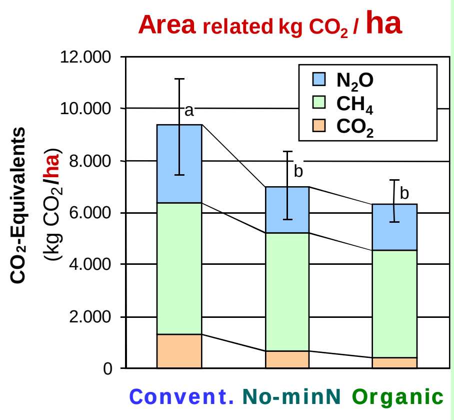
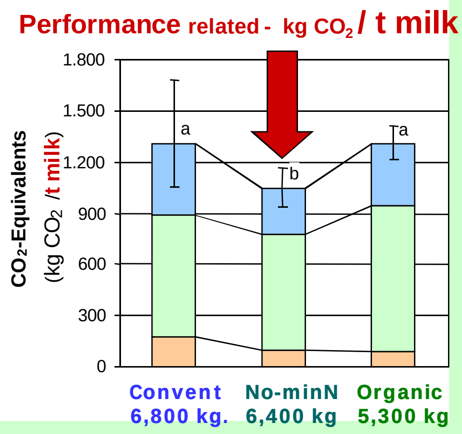
Klima

Global Warming System Comparison
Case study pure grassland dairy farms
in CO_2-Equivalents





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Wetterich & Haas 1999

Allgäu LCA FU Options

Options of reference units of the Allgäu LCA

Indicator / Impact category	Farm	Functional unit Area [ha]	 Livestock [LU*]	 Product [t milk]
Global impact				
Primary energy (resource use)	X	X	X	X
P-fertilizer (resource use)	X	X		X
Emission of CO_2-equivalents (global warming potential)	X	X	X	X
Regional to international impact				
Emission of SO_2-equivalents (acidification)	X	X	X	X
N-balance (groundwater) P-balance (surfacewater)	X	X		(X)
Local to regional impact				
Biodiversity - estimation score	X	(X)		
Landscape image - score	X	(X)		
Animal husbandry - score	X		(X)	

* LU - livestock-unit (each 500 kg liveweight of cattle);
(X) - restricted, only for certain indicators possible or in general not very meaningful

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Haas et al. 2000

Klima

Not only Source also Sink = Humus (Sequestration), but
- timeframe limited
- reversible process

Ensuring and if possible increasing humus content

- Forage legume crops (e.g. grass/red clover, lucerne etc.)
- Soil rest (no tillage for awhile)
- Using farm yard manure / compost

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Climate Change:

of Organic Farming is relevant,

has some benefit

but

lower yields,

thus would not be able

to produce the current food basket

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Calculation of Value Chain Emission

CO_2-neutral “Bratwurst” sausage

Farms → Transport → Slaughterhouse 1
Farms → Transport → Slaughterhouse 2
Farms → Transport → Slaughterhouse 3

→ Transport → Butchery → Transport → Cooling Storage → Transport → 16 Wholesaler → Transport → Retail shops

4 kg CO_2/kg Sausage

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Trace gas emission of food items

conventional farming + processing + distribution

CO_2-equivalents g / kg food

Animal food		Vegetable/crop food	
Cheese	**8.350**	Tofu	1.100
Sausage	**8.100**	Pasta	930
Cream	7.700	Bread 1	820
Beef	**6.450**	Bread 2	780
		Bread 3/buns	**700**
Eggs	1.950		
Cream cheese	1.950		
Pork	**1.900**	**Fruit**	**460**
Poultry meat	1.250	Tomatoes	330
Yoghurt	1.240	Potatoes	240
Milk	**950**	Vegetables	**150**

Nr. 7 **Umweltauswirkungen von Ernährung. Stoffstromanalysen und Szenarien**, Kirsten Wiegmann, Ulrike Eberle, Uwe Fritsche, Katja Hünecke; September 2005

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Less livestock food

for healthier people and healthier environment

- Healthier and sufficient to meet the physical requirements
- to take only **1/3** of the meat
  2/3 of the milk
  1/2 of the eggs of current consumption
- For this only **half** of the current livestock would be needed and
- The global warming gas emission by the German agriculture could be cut off to only **half**.
- If100% OA only 15 – 20%, considering full food chain only 5%
- Full conversion to organic farming would be possible despite lower yields.

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Beef or Pork?

- **17** million farm land, whereof **5** million is permanent grassland
- Main ecosystem function of ruminant livestock is to convert "useless" (grass) fiber into high value protein (milk, meat)
- Additionally n organic farming need to grow legumes for the nitrogen input via N_2-fixation, predominately forage legumes
- Pigs are fed with almost 2/3 of total the cereal harvest
  = > cereal for feed or bred?
- Environmental sound would be = low intensive cattle production
  on low intensive grassland use

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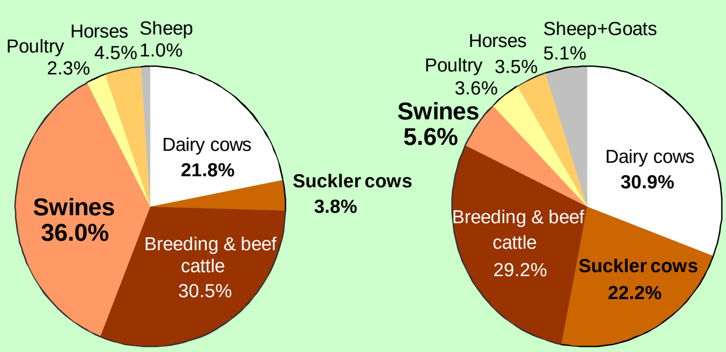
Livestock Farming in NRW:

In O.A. cattle is much more important

in contrast to pigs for several (good) reasons

Conventional | **Organic**



Mean = 1.3 LU/ha | **Mean = 0.7 LU/ha**

LU: livestock unit (each 500 kg liveweight)

Zerger & Haas 2003

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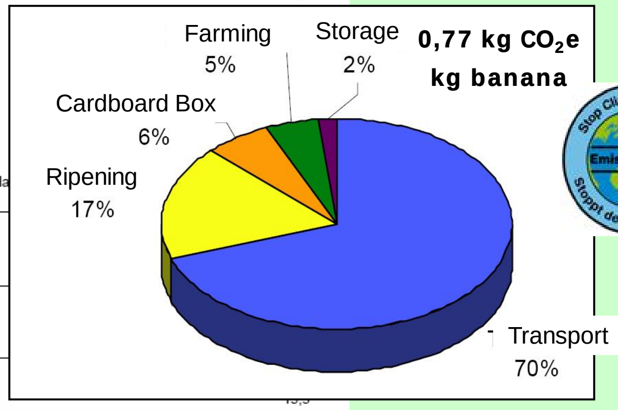
Bereiche	THG-Emissionen (g CO_2-Äquiv./kg Banane)
Landwirtschaftliche Erzeugung	
Pflanzenschutz	13,3
Wirtschaftsdüngung	9,1
Mineraldüngung	6,8
Bewässerung	7,8
Summe (Landwirtschaftliche Erzeugung)	*37,0*
Transport	
Transport nach Manzanillo	23,2
Kühlung in Manzanillo	[illegible]
Kühlschiff (Ver- u. Entladen)	[illegible]
Kühlschiff (Transport)	[illegible]
Transport zur Reiferei	[illegible]
Transport zu BioTropic	[illegible]
Transport zum Großhandel	[illegible]
Transport zum Einzelhandel	[illegible]
Transport per Fähre Dover → Cala	[illegible]
Summe (Transport)	[illegible]
Reifung	
Reifungsprozess	[illegible]
Summe (Reifung)	[illegible]
Karton	
Karton	[illegible]
Summe (Karton)	[illegible]
Lagerung	
Lagerung	[illegible]
Summe (Lagerung)	*13,5*
Gesamt	769,9

Value Chain Emission
CO_2-neutral
Bio-Banana
Dominican Republic



0,77 kg CO_2e kg banana

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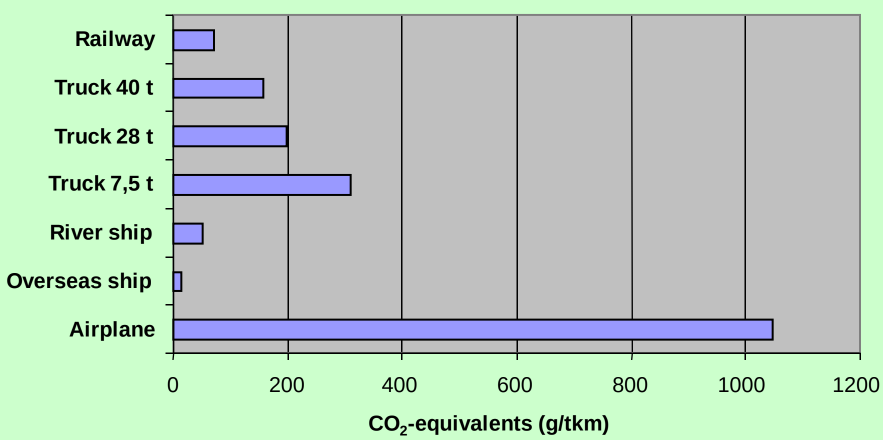
Climate trace gas emission due to different transport vehicles
(per transported tonne and kilometer = tkm; *Demmeler 2007*)



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Global warming gas emission of food depends on transporting distance and vehicle

(Geographical Reference: Munic **g CO_2-equivalents/kg** food; *Demmeler 2007*)

	Overseas (boat/plane)		**Europa (truck)** (Northern Germany)		**Region (truck)**	
Cereal	USA, Ship	**280**	Polen	**328**	Niederbayern	**69**
Apple	**New Zealand Ship**	**513**	**Italy Truck**	**219**	**Lake Constance Truck**	**76**
Strawberry	Südafrika, Airplane	**11.671**	Italien	219	Oberbayern	61
Aparagos	Chile, Airplane	**16.894**	Spanien	359	Schroben-hausen	60
Meet	Argentinien Ship	349	Nieder-sachsen	179	Oberbayern	61
Eggs	-		Nieder-sachsen	179	Niederbayern	60
Milk	-		Mecklen-burg-V.	209	Allgäu	65

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CO_2-neutral labeling - some particular for organic products

STOP CLIMATE CHANGE klimafreundlich

CO_2 Bilanz

Stop Climate Change Emission free Stoppt den Klimawandel

Reduce CO_2 emissions? Reduce costs? *And* climate neutral?

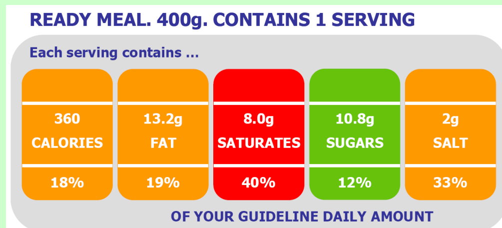
Climate Neutral Group

Soil & More Climate Neutral Product

working with the Carbon Trust 600g CO2 per wash

CarbonFix Standard Quality CO_2-certificates from new forests

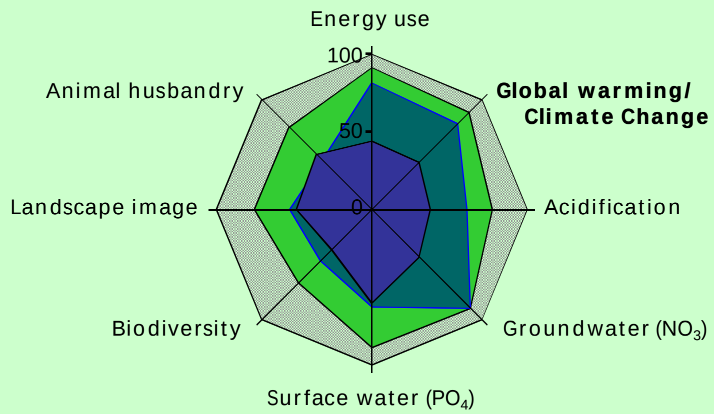
General big discussion in Germany
about easy to get nutrient signpost labeling schemes
recently also a GMO-free label has been introduced by the Federal Government (though not well accepted)



plus many Organic Food Labels in Germany It is too much!

Global Warming is only one Environmental Impact

Case Study of a Process Life Cycle Assessment



Intensive, No-mineral-N and Organic

Dairy-Grassland-Farms in the Allgäu Region (mean of 6 each)

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

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Global Warming is of minor importance among all Environmental Impacts of Agriculture in Germany

Impact category	Agriculture ...
Biodiversity of habitats and species	- creates the **main habitat** for the potentially rich diversity of species in the open land - but has been the **main cause** for the **extinction of** species since 1950
AgroBiodiversity	- is **solely responsible** for the **diversity of crop & lifestock species**
Landscape image & soil functions	- farms **55%** of the land area - often causes to much **soil erosion** in hilly areas
Quality of (drinking) **water**	- has **predominantly** caused the pollution of many upper ground water aquifers with **nitrate**. (100 mm = 1 Mill l per ha) - pollutes ground water with **pesticides**
Eutrophication	causes - **40%** of the N-emission to air - **51%** of the N-input to water - **43%** of the P-input to water
Acidification	causes **20%** of the emissions
Global warming	emits **13 %** of climate relevant trace gases
Resource	uses about **3%** of the primary energy

Environmental assessment has to cover central impacts **(ranking).**

Geier 2000, Haas et al. 1995, Haas 1997, updated Dt.Ldfr.

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Conclusion: Relevance of Organic Farming for Climate Change in Germany

Organic farming has clearly lower CO_2 and N_2O emissions referenced to the farmed area. However, conventionalizing will lower the difference

When considering productivity/yield as a reference unit, GHG emission differences are smaller or diminish.

Highest reduction of GHG emission will be possible by reducing food based on livestock production. Gras fed beef better than pork.

Global Warming is only one of the environmental Impacts of farming.

Too many Organic Food Labels in Germany – in general no label possible for each environmental impact (no fashion hypes).

Consumer expect that organic farming is most sustainable environmental friendly in all ways possible.

For any further question do not hesitate to contact me or visit my website particular the site to download publications:

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Email: g.haas@agroexpertise.de Internet: www.agroexpertise.de

References (complete list on request, much more available in German)

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