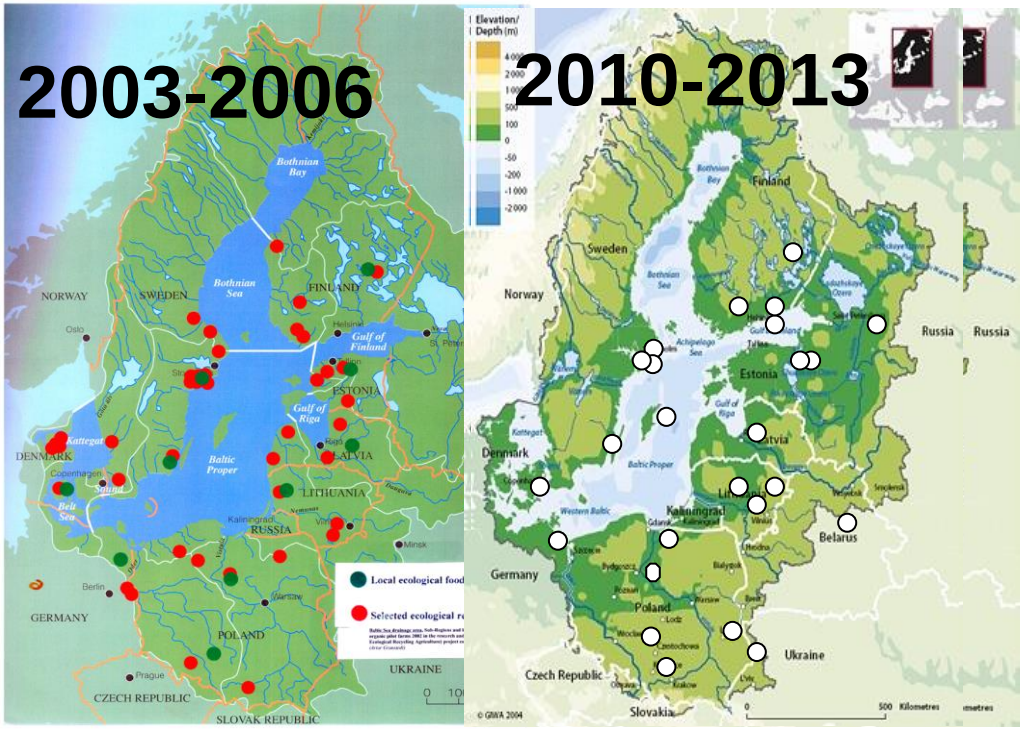
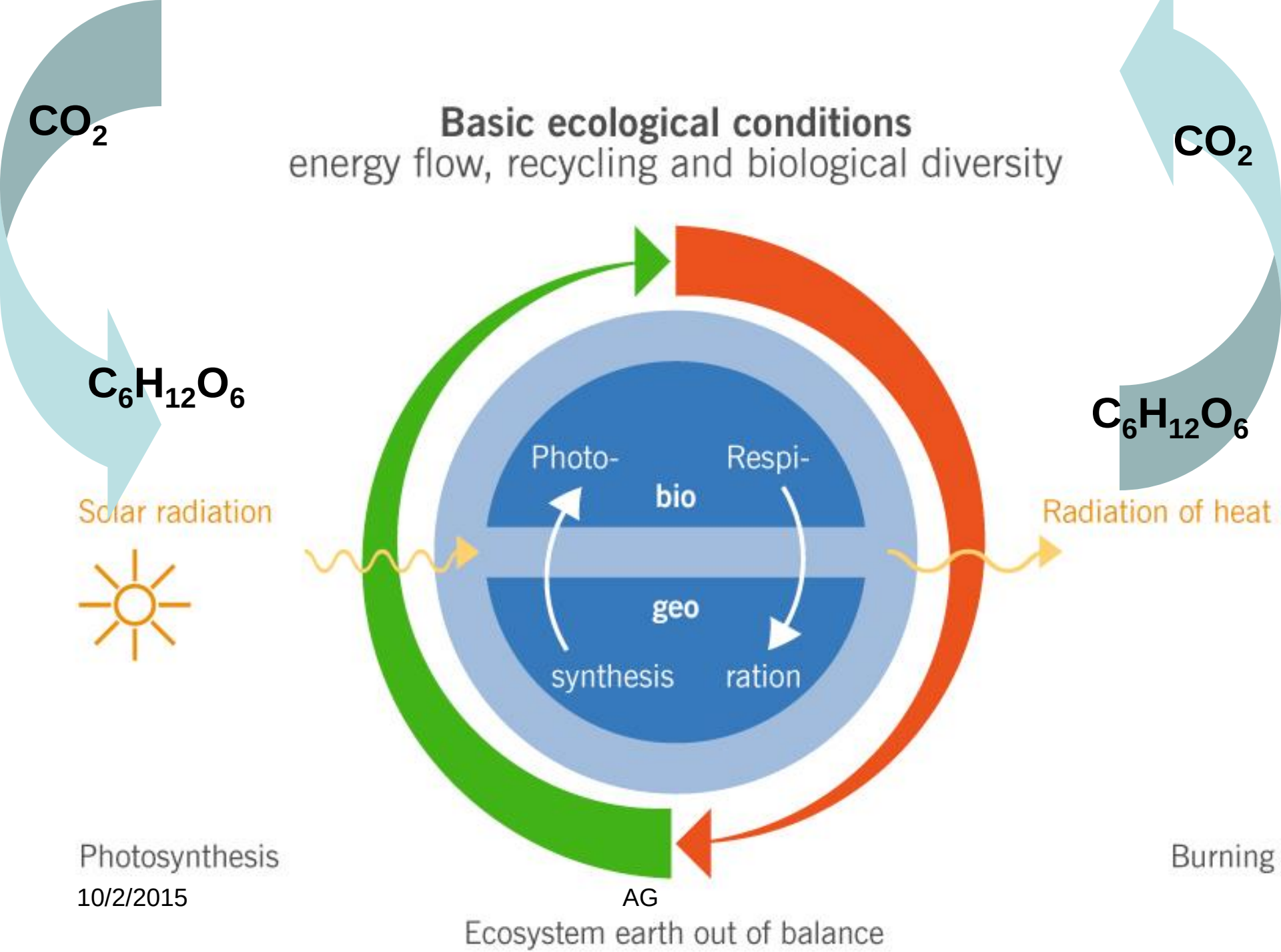
Resource Efficiency in Ecological Recycling Agriculture with Dairy Production

Artur Granstedt, Sweden



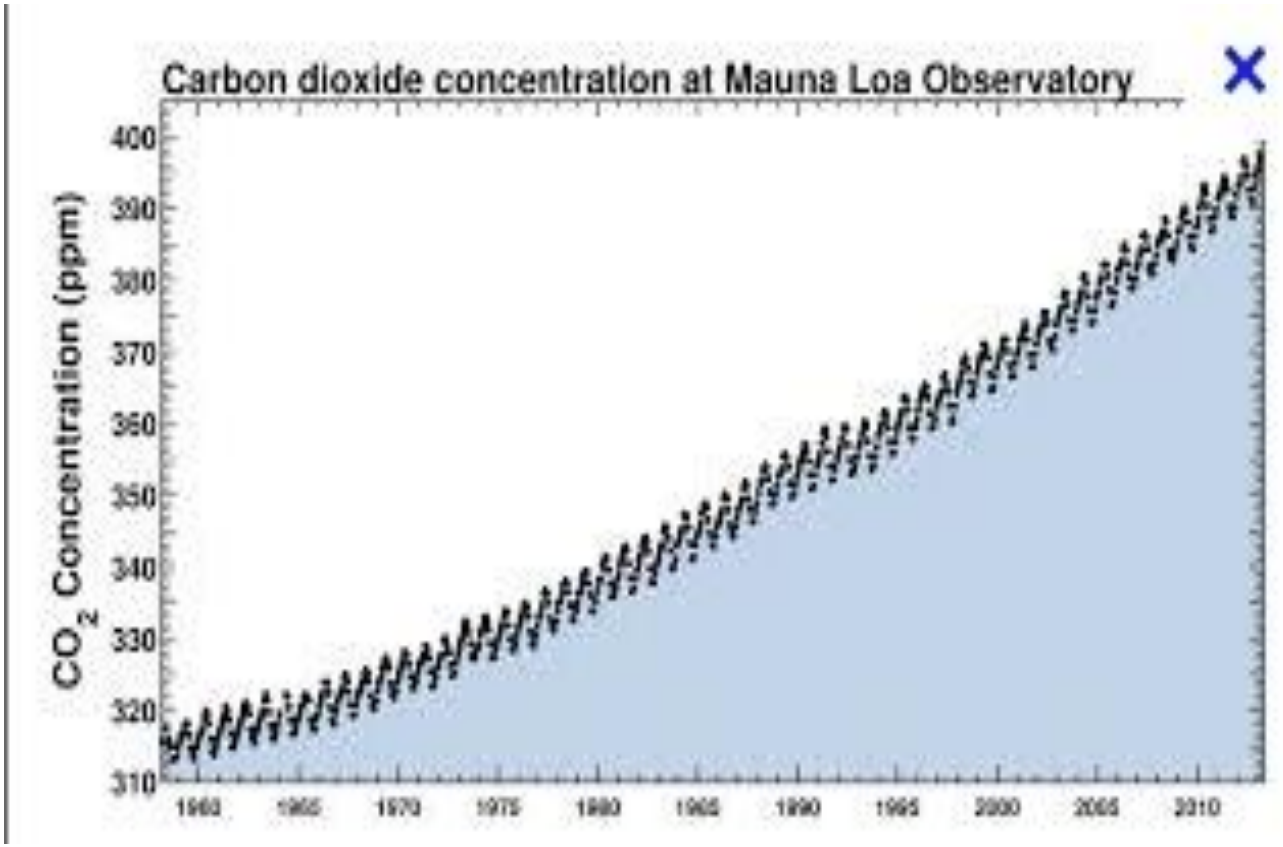
BERAS implementation
Baltic Ecological Recycling Agriculture and Society

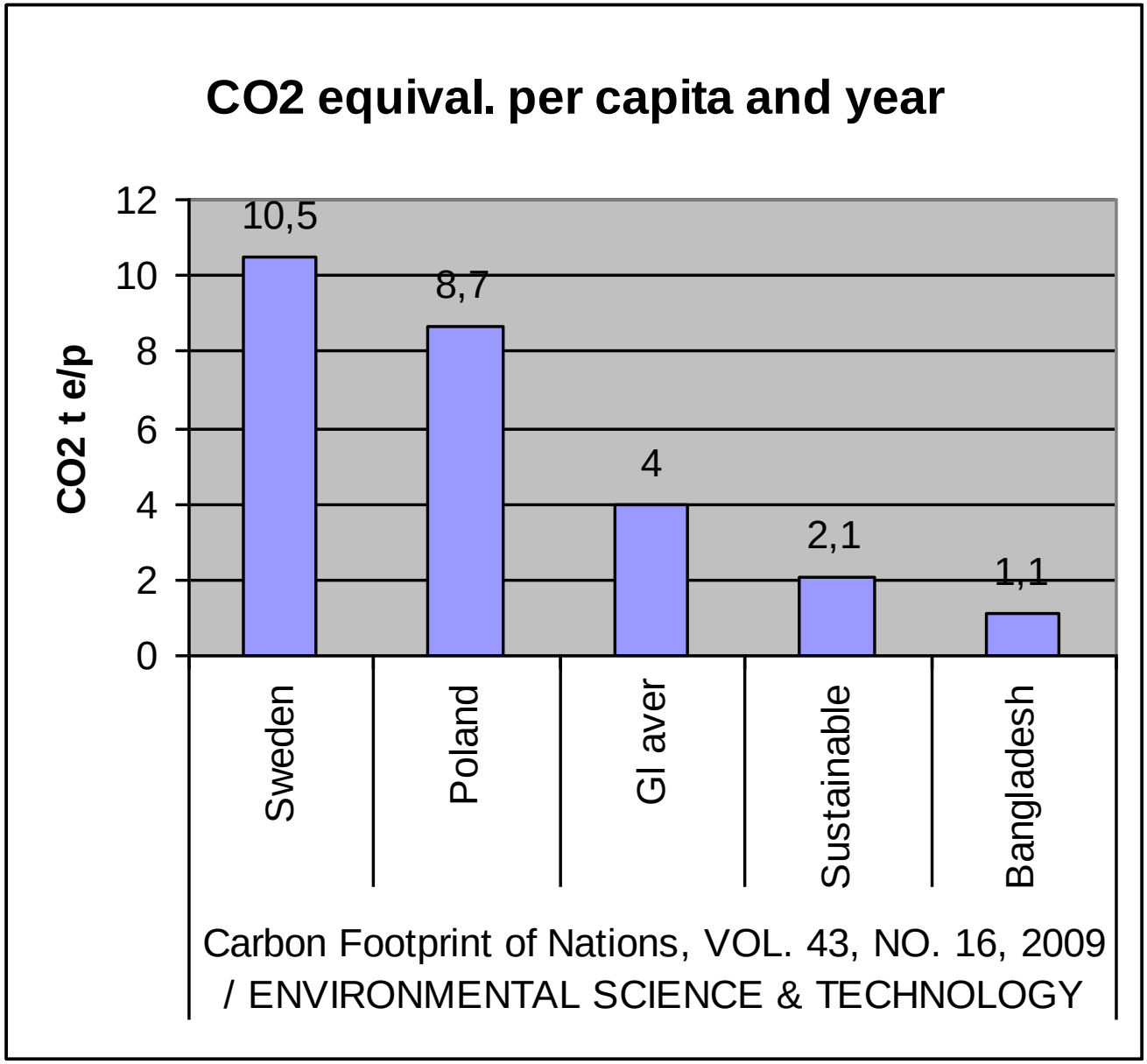
BERAS International
Artur.Granstedt@beras.eu



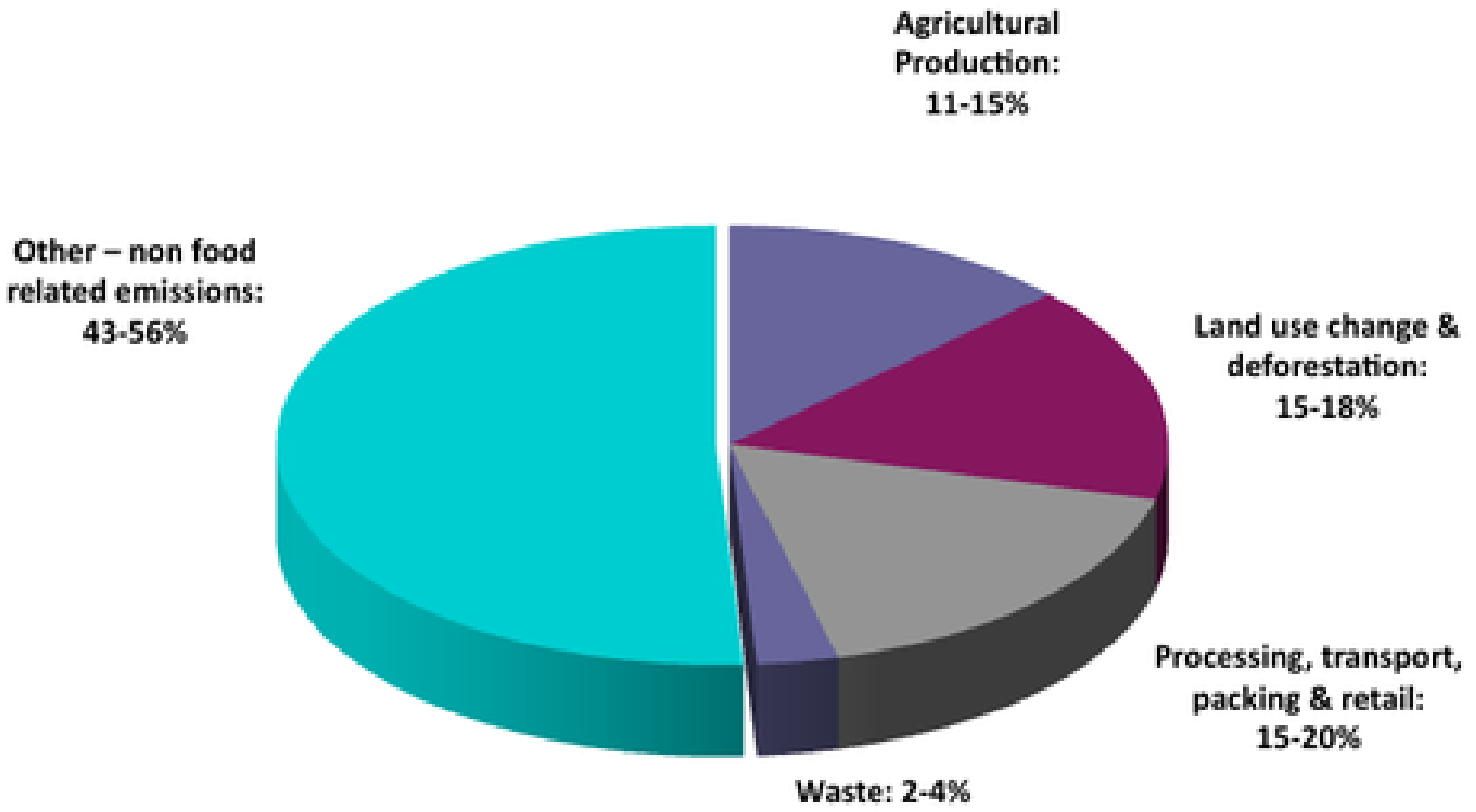
Ecosystem earth out of balance

Ch. D. Keeling mobilized enough resources so he could, starting 1958, measure the CO_2 in the atmosphere on Mauna Loa observatory in Hawaii




CO2 equival. per capita and year
CO2 t e/p
12
10
8
6
4
2
0
10,5
8,7
4
2,1
1,1
Sweden
Poland
GI aver
Sustainable
Bangladesh
Carbon Footprint of Nations, VOL. 43, NO. 16, 2009
/ ENVIRONMENTAL SCIENCE & TECHNOLOGY

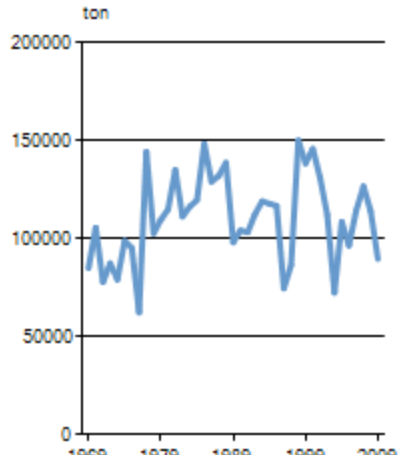
Food and climate change

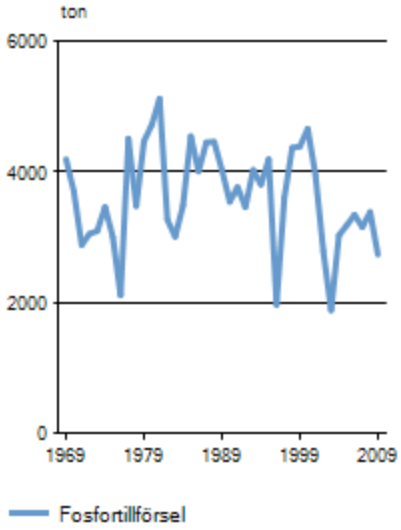


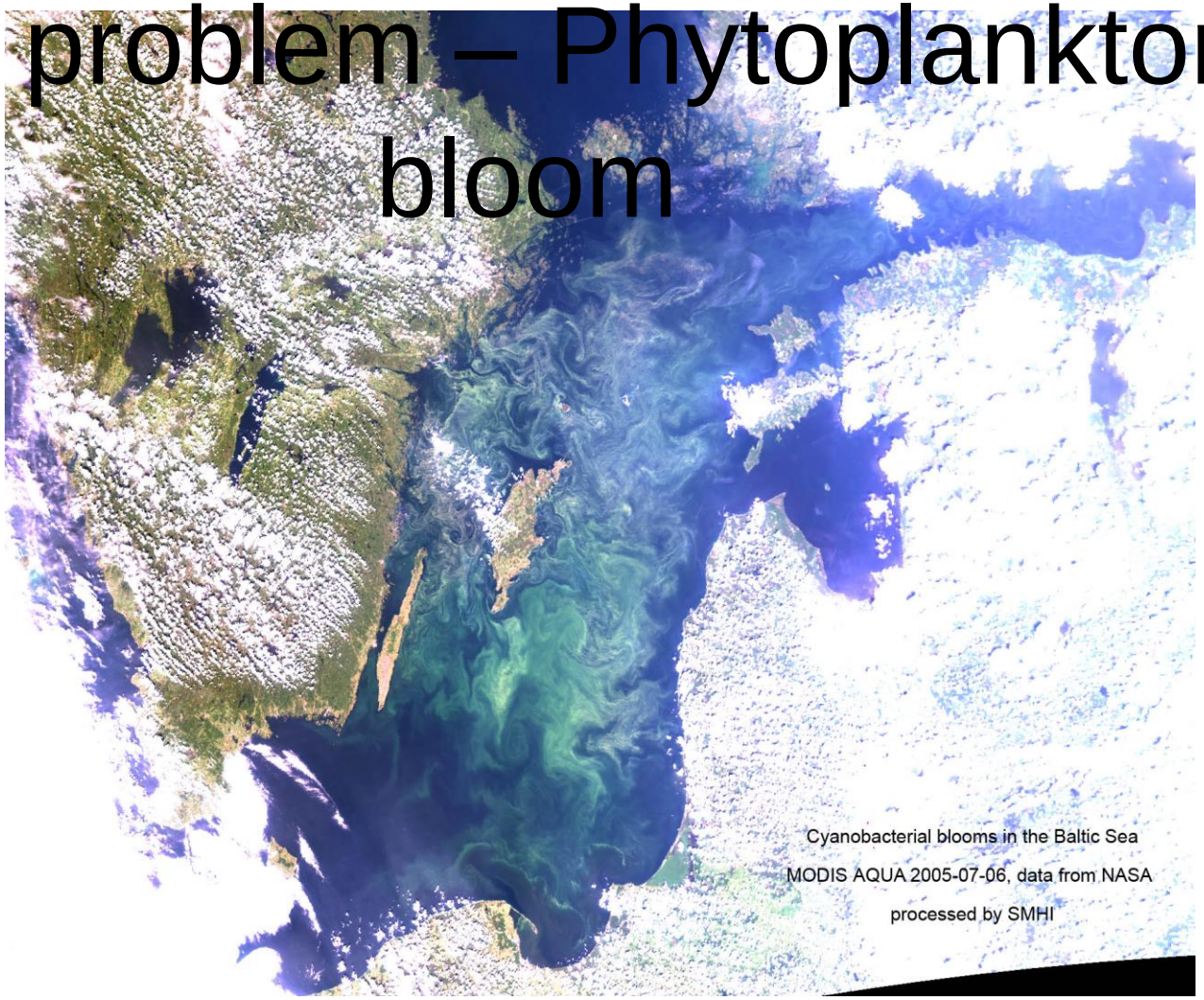
The United Nations Conference on Trade and Development (**UNCTAD**), 2011
Bellarby et al, 2008

The nitrogen and phosphorus surplus to the sea

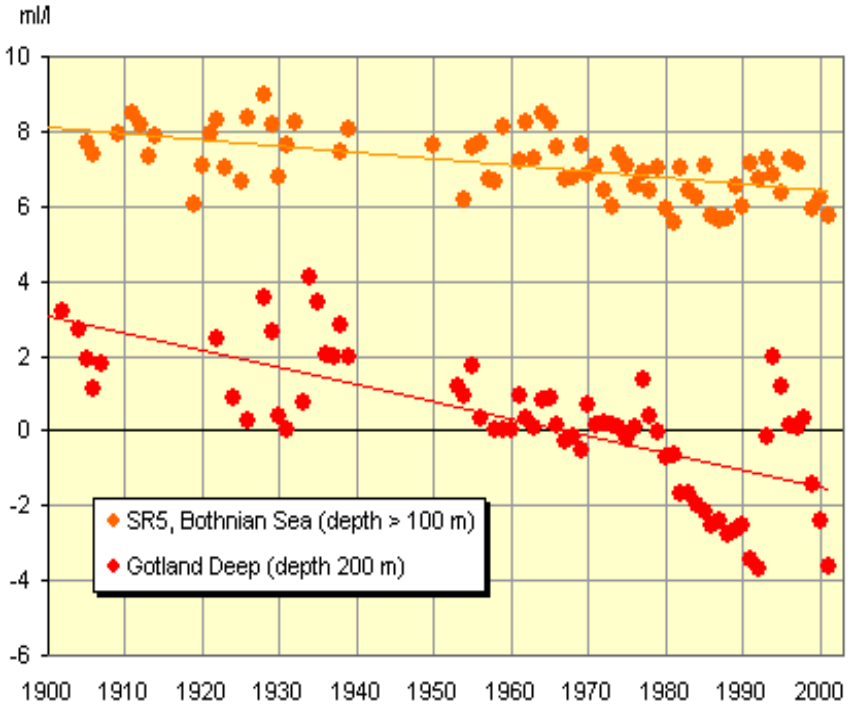
problem – Phytoplankton bloom

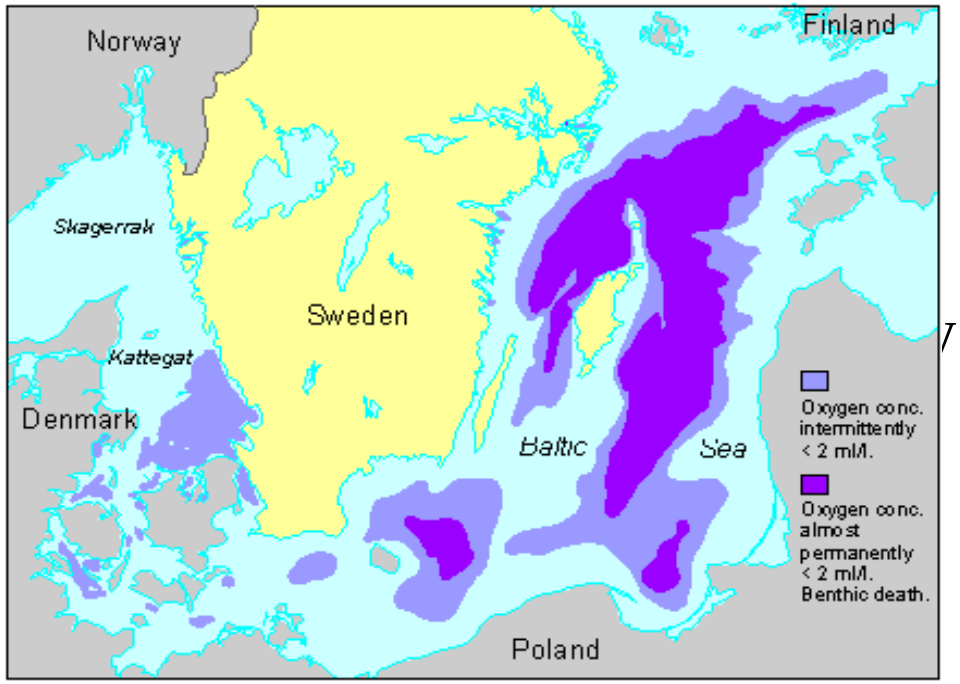






. Decreasing oxygen and increasing dead sea bottoms

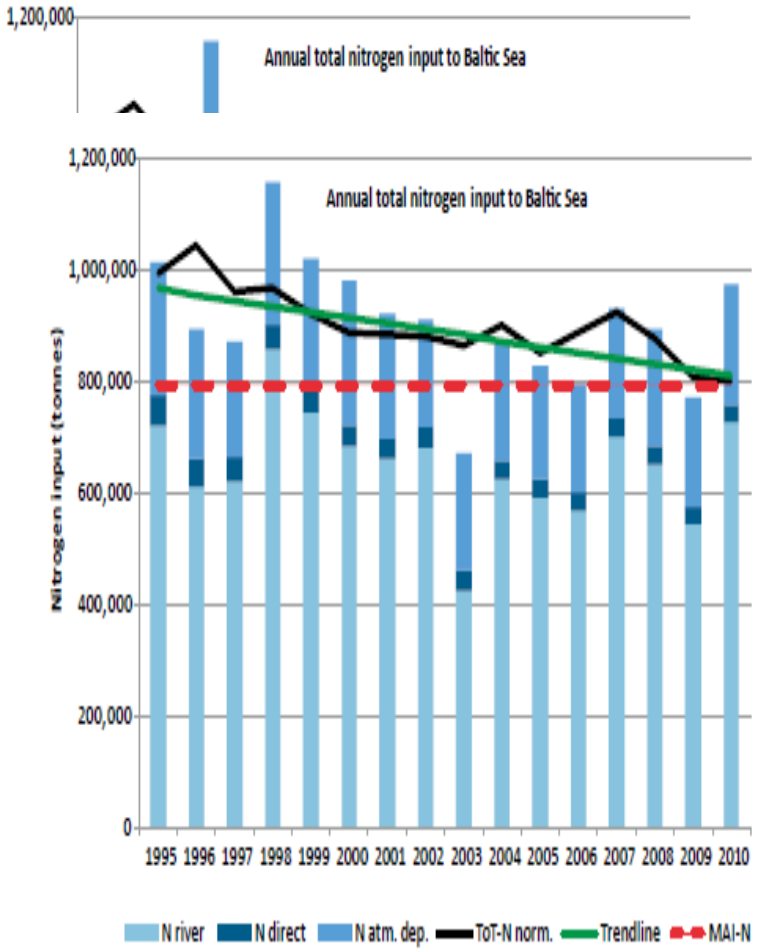


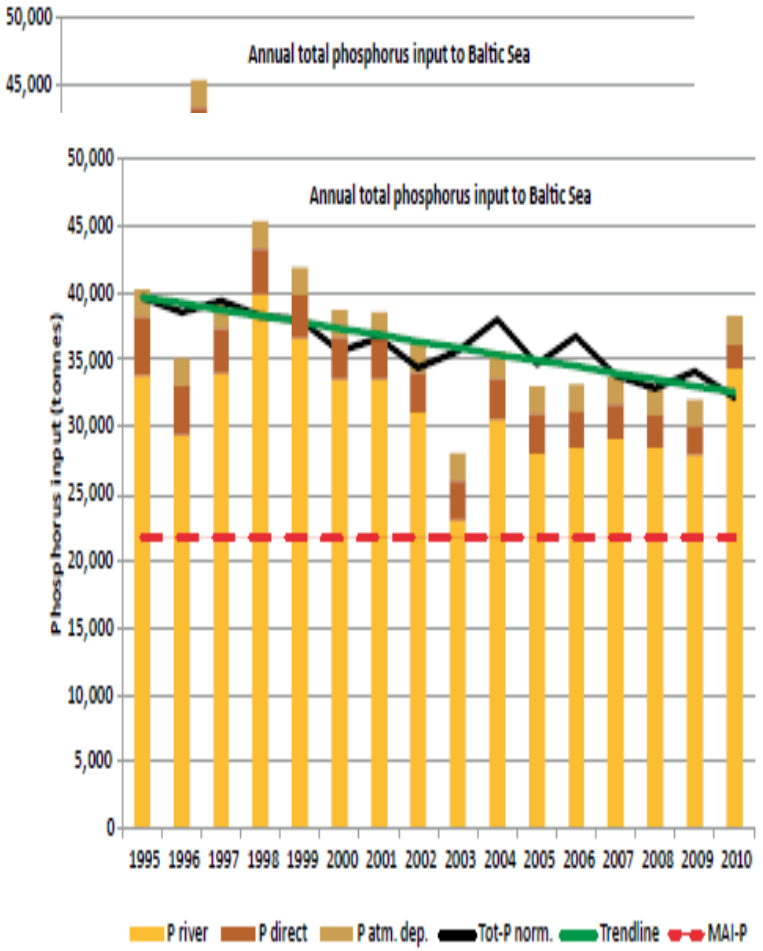


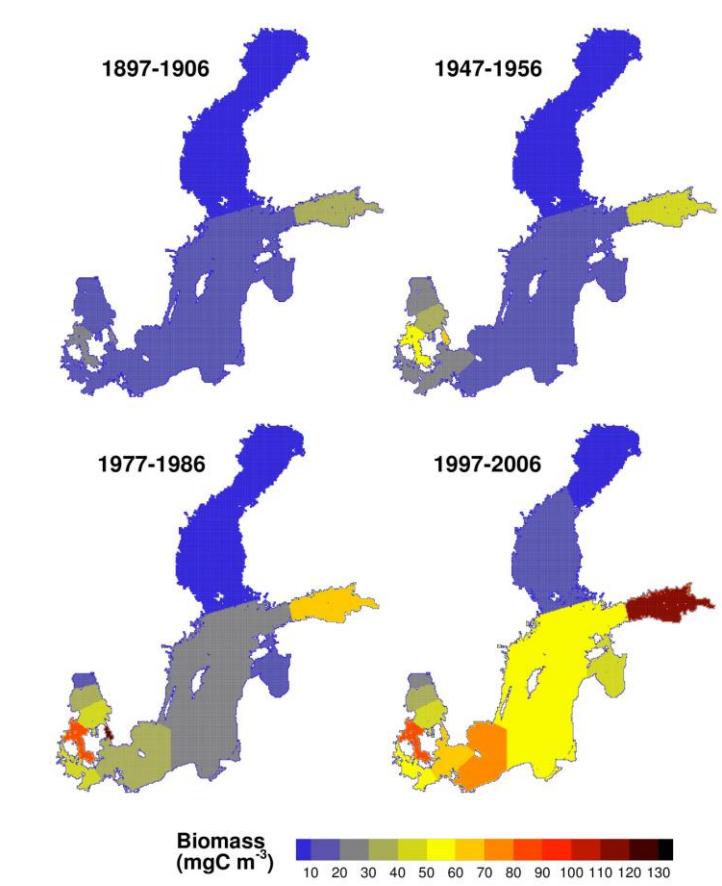
Source: Swedish Environmental Protection Agency.
www.internat.naturvardsverket.se/documents/pollutants/overgod/eutro/havsyree.html

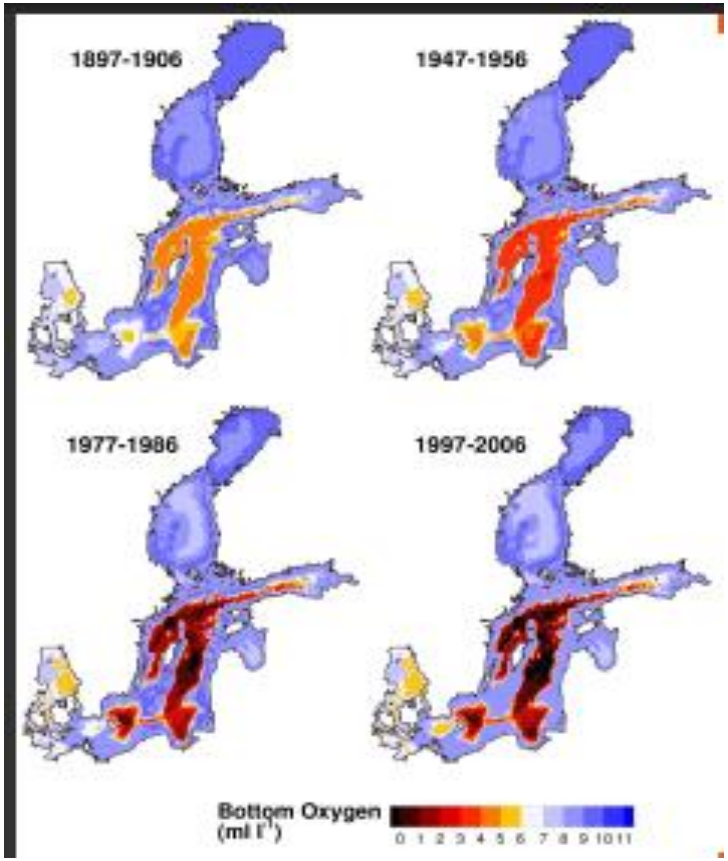
HELCOM, 2015. Updated Fifth Baltic Sea pollution load compilation (PLC-5.5). Baltic Sea EnvironmentProceedings No. 15.

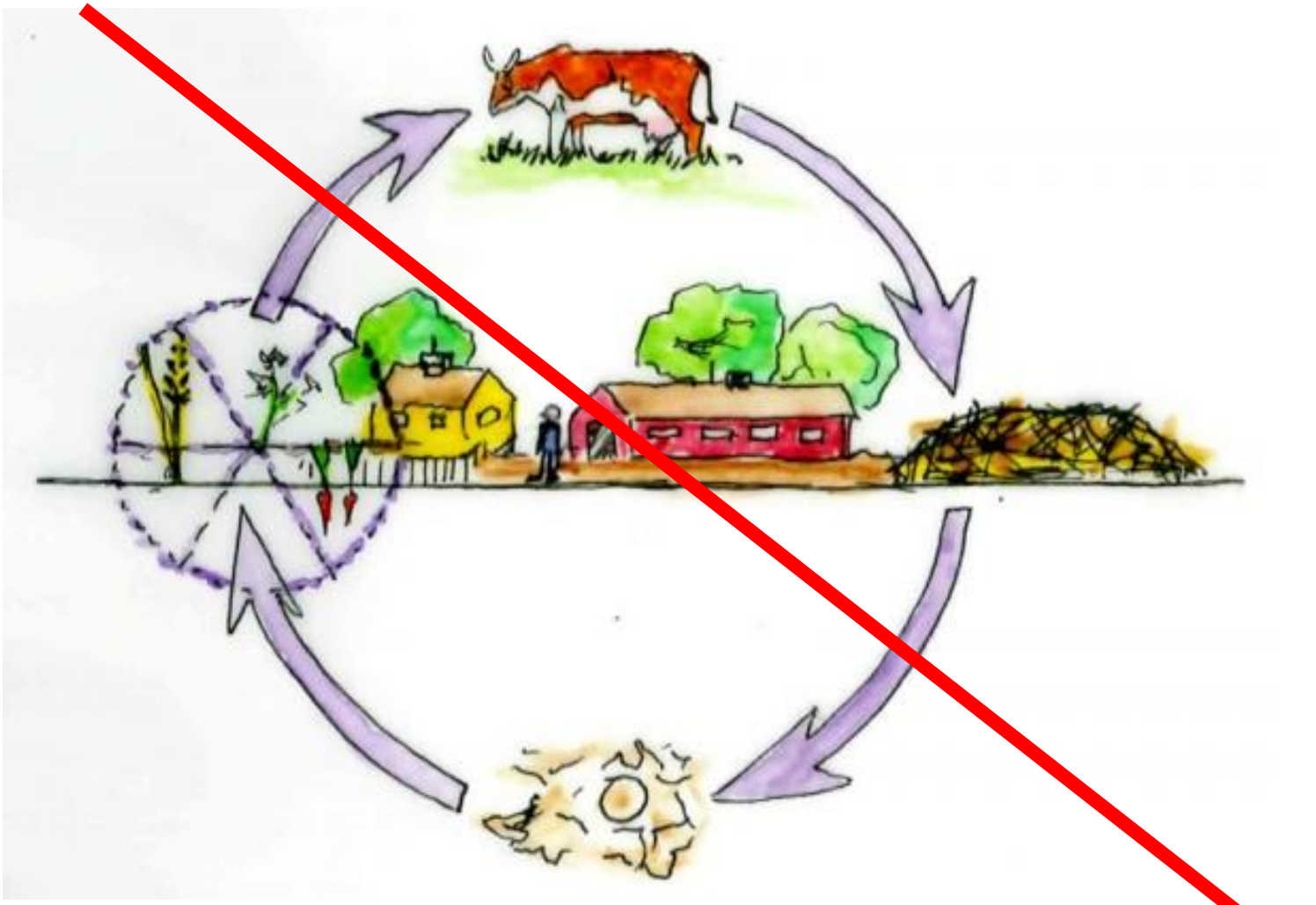
During the period 1994-2010, total flow normalized waterborne nitrogen input to the Baltic Sea was reduced by 17%.

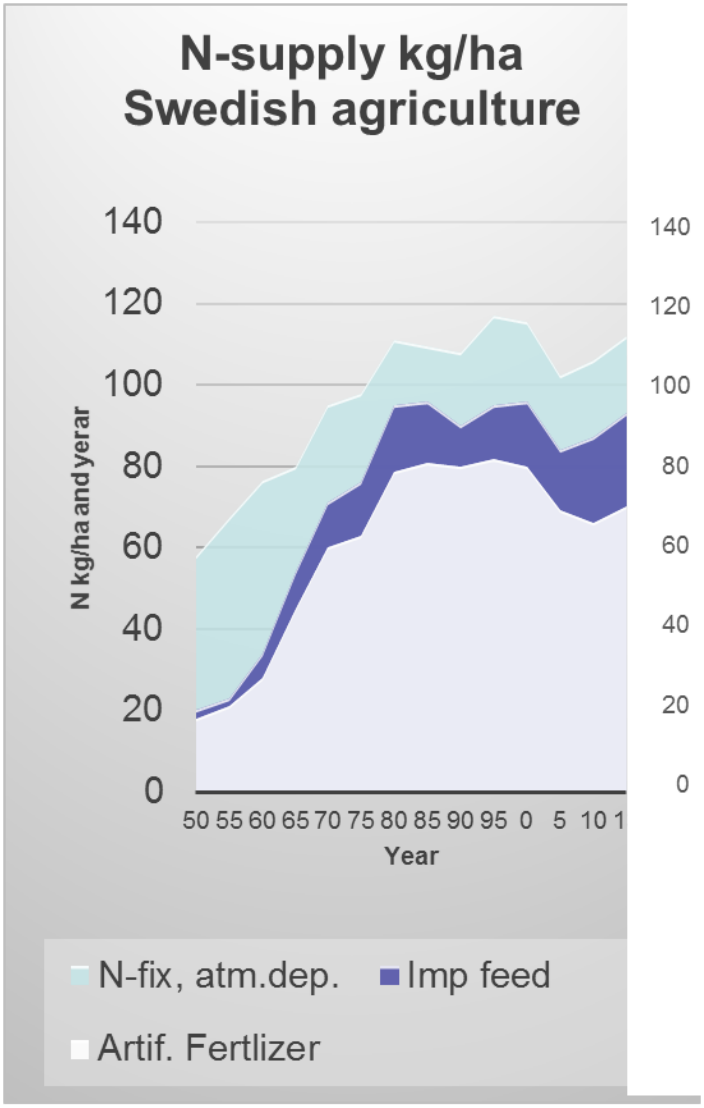


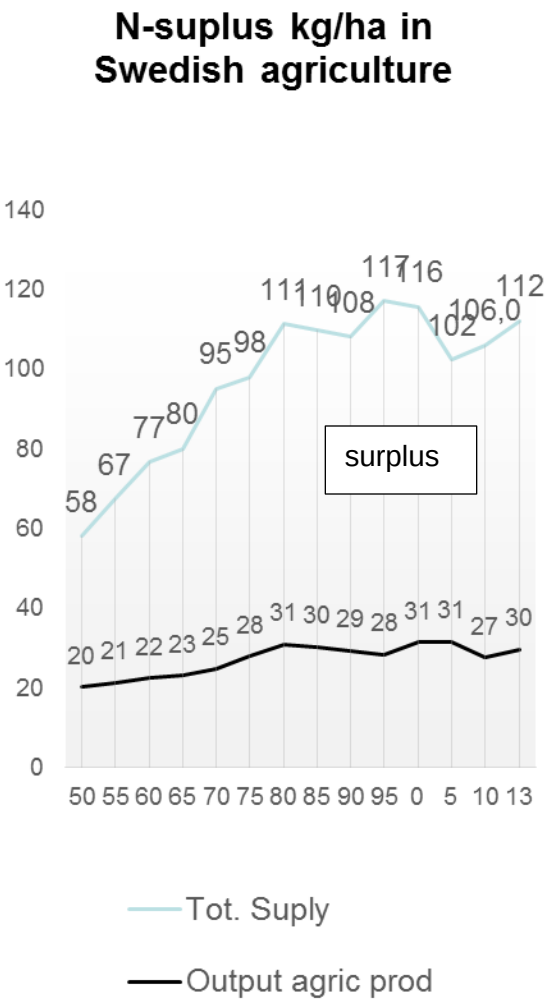


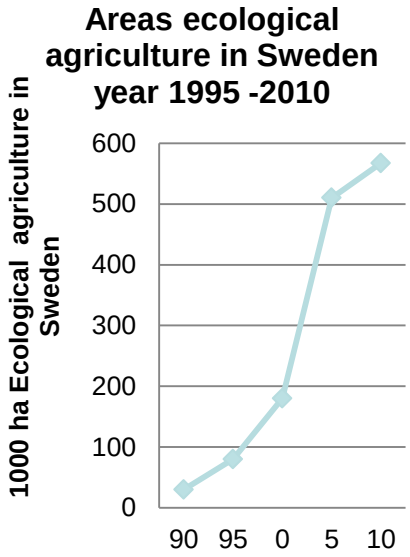

1897-1906
1947-1956
1977-1986
1997-2006
Biomass
(mgC m-3)
10 20 30 40 50 60 70 80 90 100 110 120 130


1897-1906
1947-1956
1977-1986
1997-2006
Bottom Oxygen
(ml l-1)
0 1 2 3 4 5 6 7 8 9 10 11

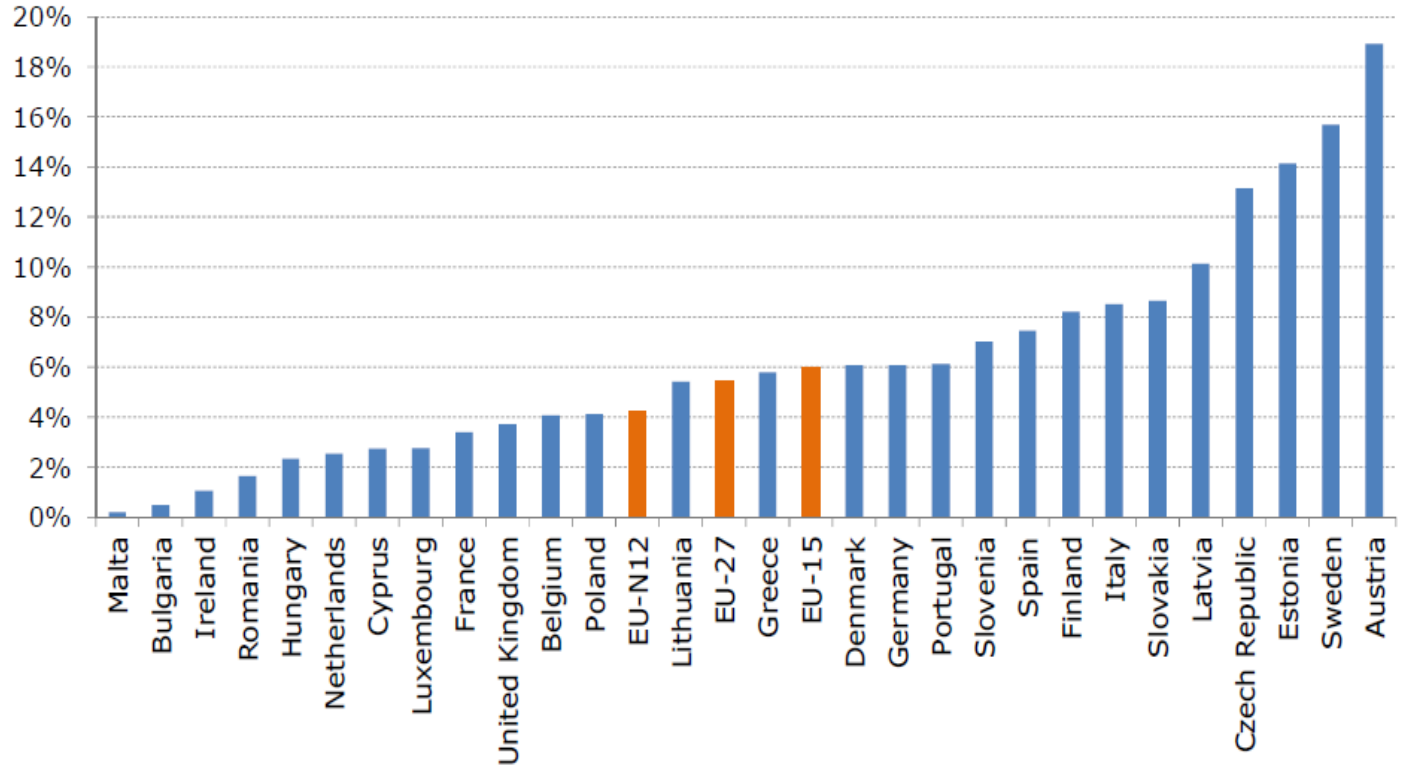



N-supply kg/ha
Swedish agriculture
N kg/ha and yerar
140
120
100
80
60
40
20
0
50 55 60 65 70 75 80 85 90 95 0 5 10 1
Year
N-fix, atm.dep.
Imp feed
Artif. Fertlizer


N-suplus kg/ha in
Swedish agriculture
140
120
100
80
60
40
20
0
58
67
77
80
95
98
111
110
108
117
116
102
106,0
112
surplus
20 21 22 23 25 28 31 30 29 28 31 31 27 30
50 55 60 65 70 75 80 85 90 95 0 5 10 13
Tot. Suply
Output agric prod

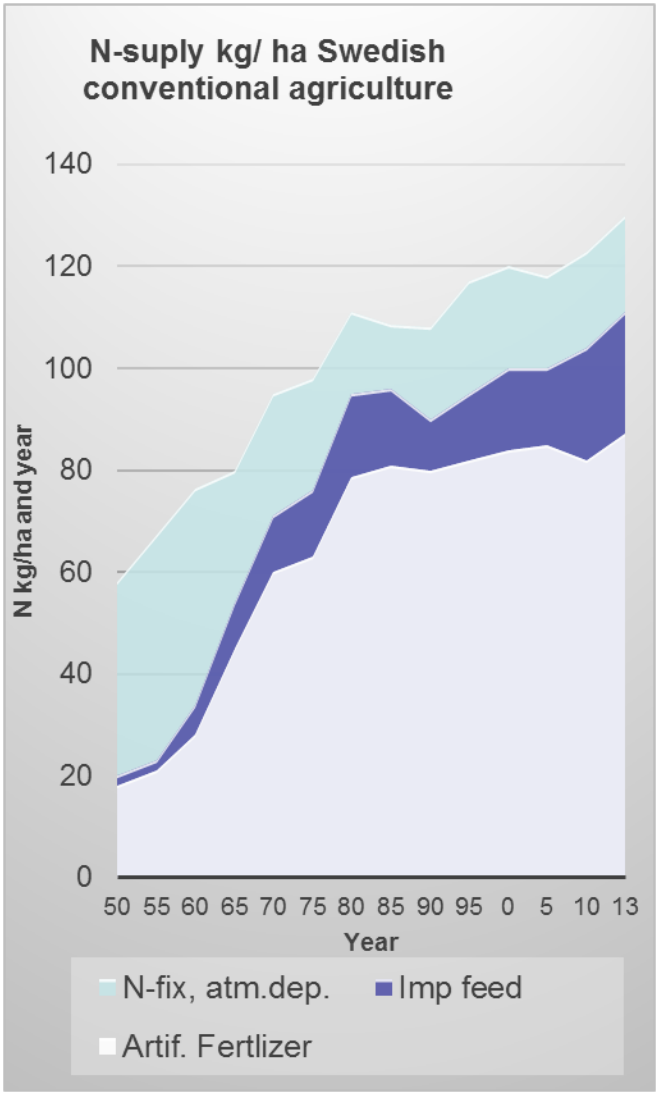

Areas ecological
agriculture in Sweden
year 1995 -2010
1000 ha Ecological agriculture in
Sweden
600
500
400
300
200
100
0
90 95 0 5 10

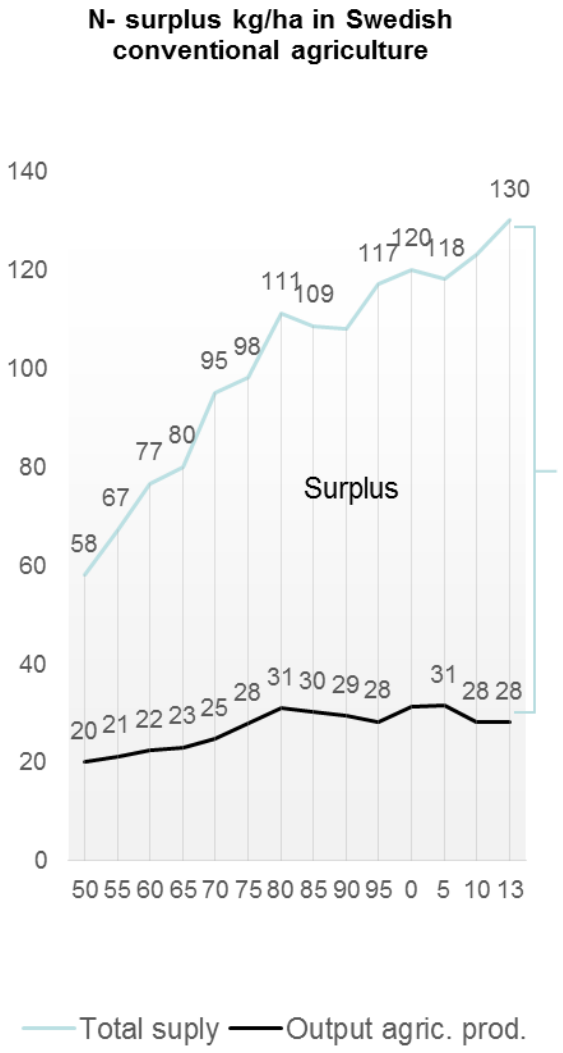
Graph 4. Share of the organic area in the UAA in the EU Member States, 2011



Source: Eurostat data on the basis of Council Regulation (EC) No 834/2007 on organic production (online data code: food_in_porg1) and land use statistics (online data code: apro_cpp_luse). Estimated data for organic production for IE, CY and LU. Estimated data for land use statistics for BE, EL, ES and IT.

Facts and figures on organic agriculture in the European Union, 2013

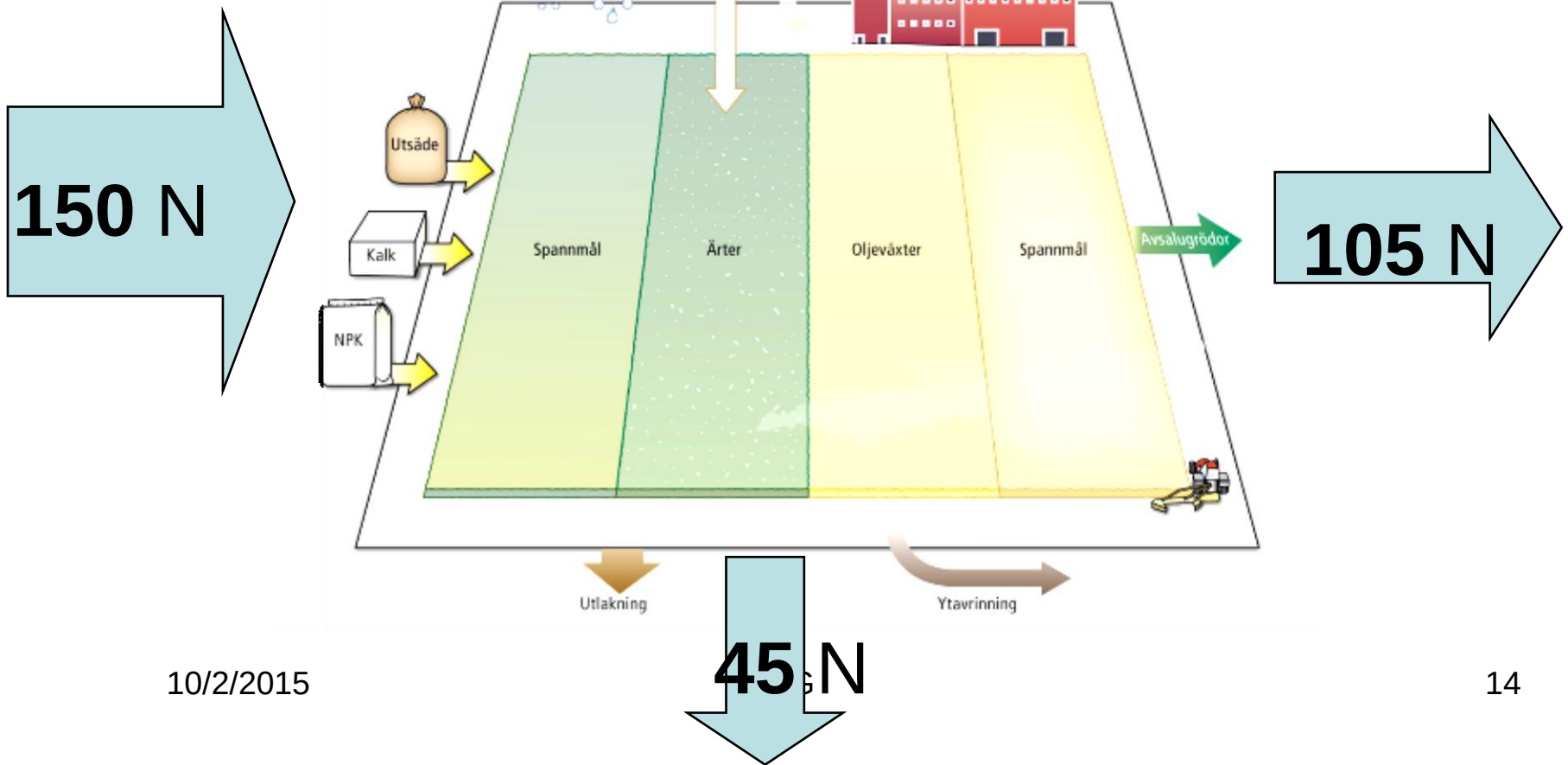

N-suply kg/ ha Swedish conventional agriculture
N kg/ha and year
140
120
100
80
60
40
20
0
50 55 60 65 70 75 80 85 90 95 0 5 10 13
Year
N-fix, atm.dep.
Imp feed
Artif. Fertlizer


N- surplus kg/ha in Swedish conventional agriculture
140
120
100
80
60
40
20
0
Surplus
58 67 77 80 95 98 111 109 117 120 118 130
20 21 22 23 25 28 31 30 29 28 31 28 28
50 55 60 65 70 75 80 85 90 95 0 5 10 13
Total suply
Output agric. prod.

Specialized crop farm

Input, output and surplus of Nitrogen kg/ha and year

(Average 563 farms 01-06,data from Swedish board of agriculture report 2008:25)



Specialized animal farm

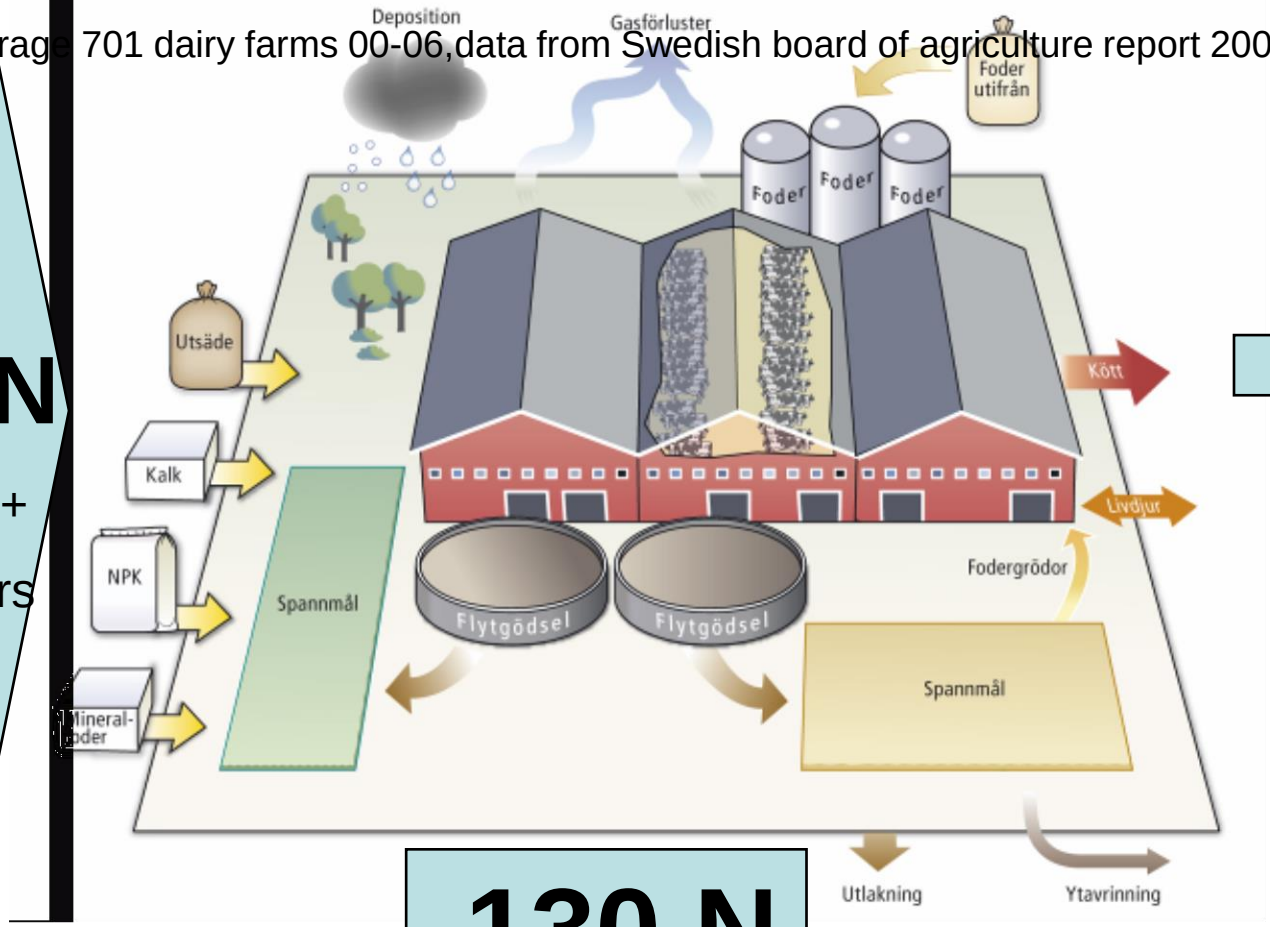
Input, output and surplus of Nitrogen kg/ha and year

(Average 701 dairy farms 00-06,data from Swedish board of agriculture report 2008:25)

200 N

Fodder +

Fertilizers



70 N

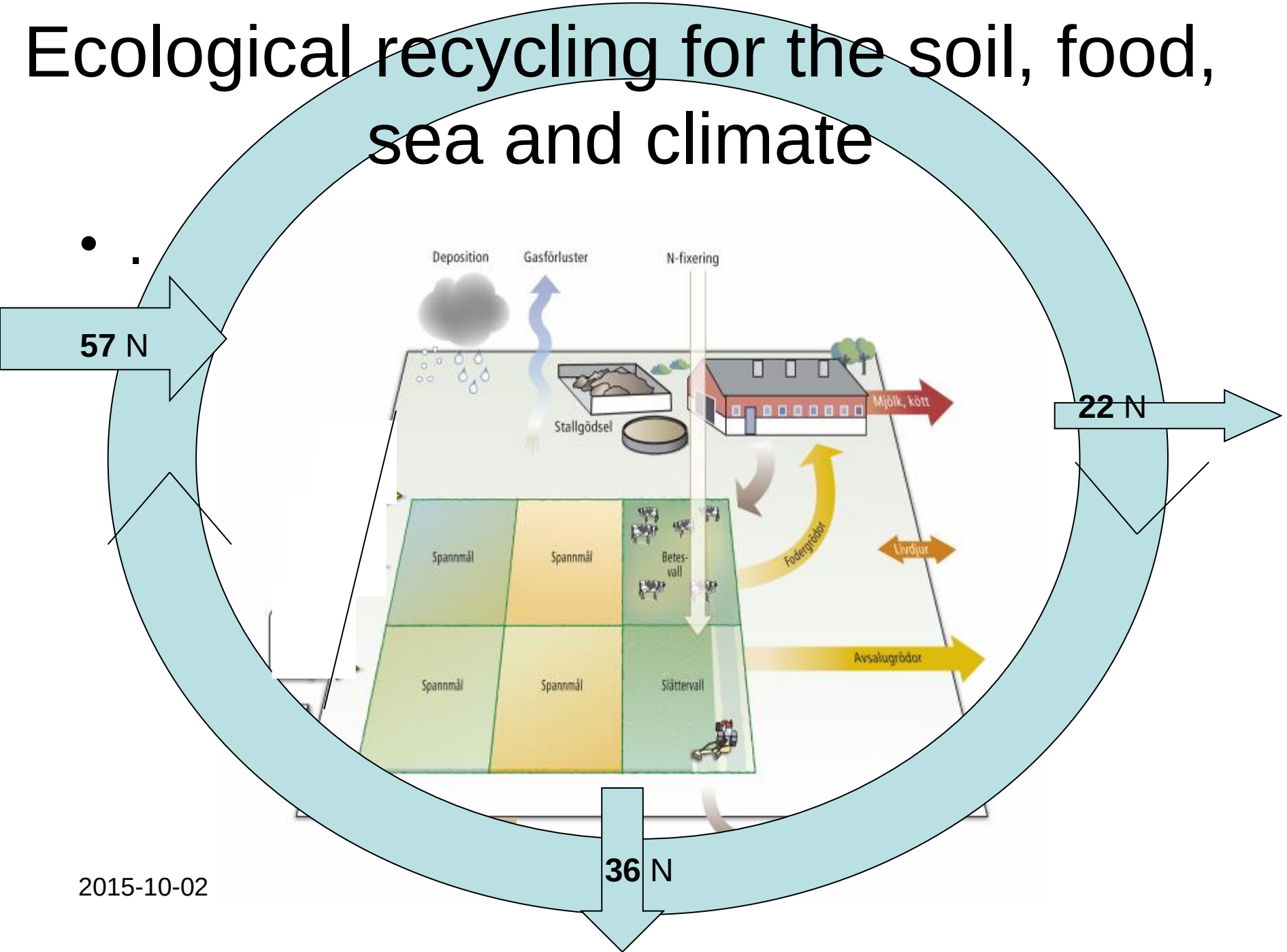
(Milk and meat)

130 N

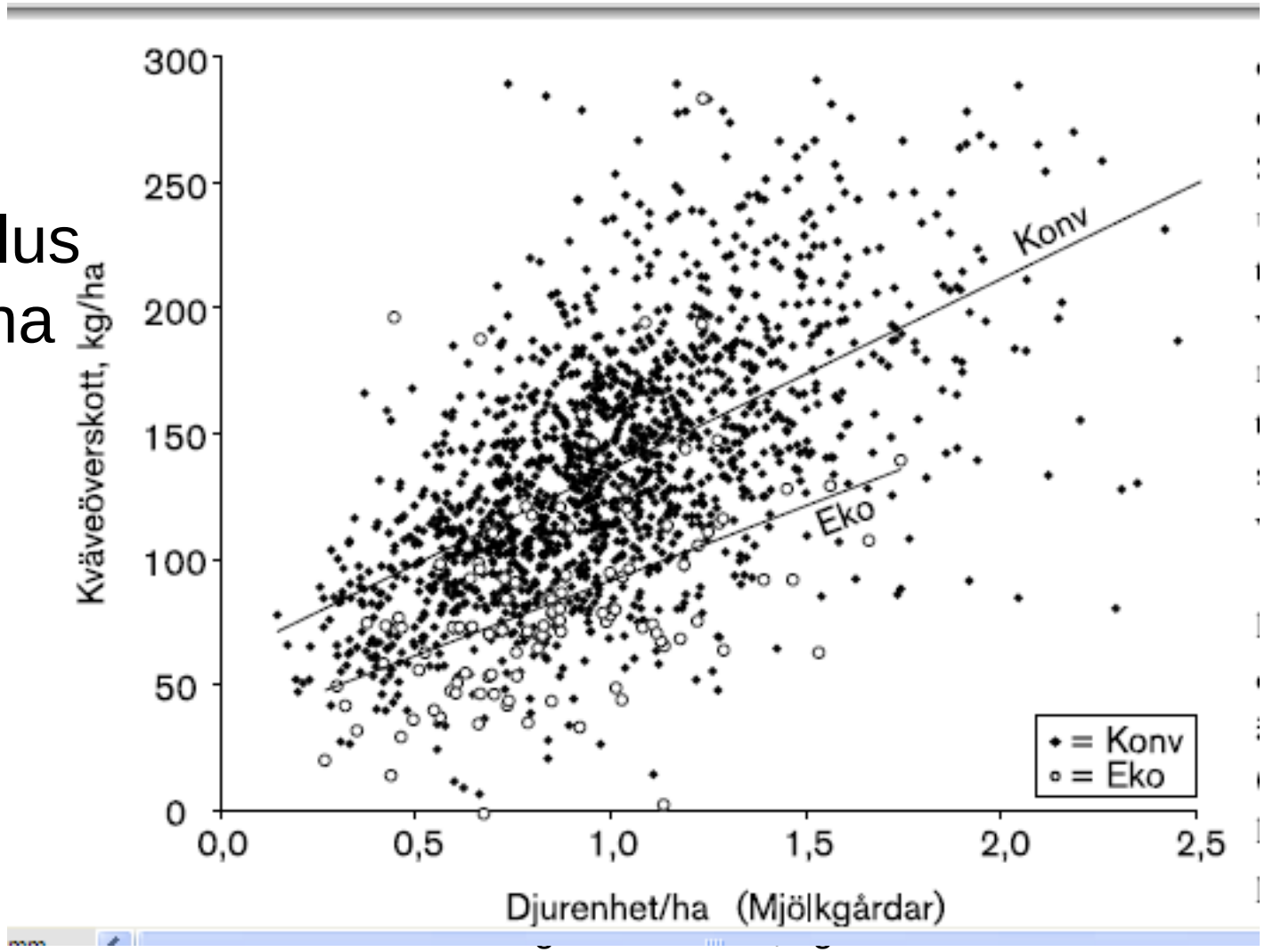
3 P

Ecological recycling for the soil, food, sea and climate

- .



N surplus kg/ha

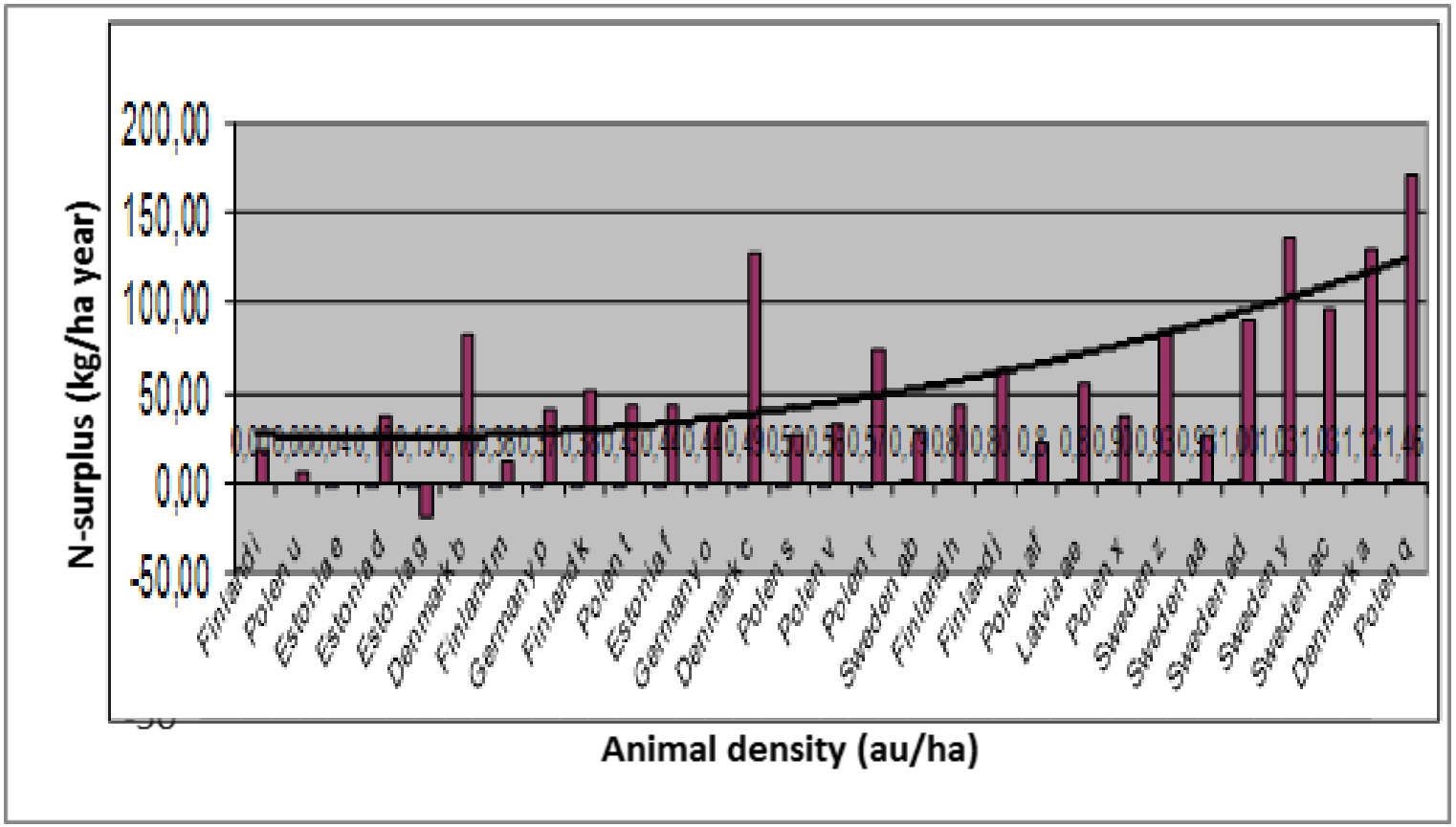


Anim. Units /ha

	Number of farms	N	P	K
Ecological production	**107**	**84**	**2,3**	**8,3**
Conventional production	**1517**	**136**	**4,0**	**11,7**

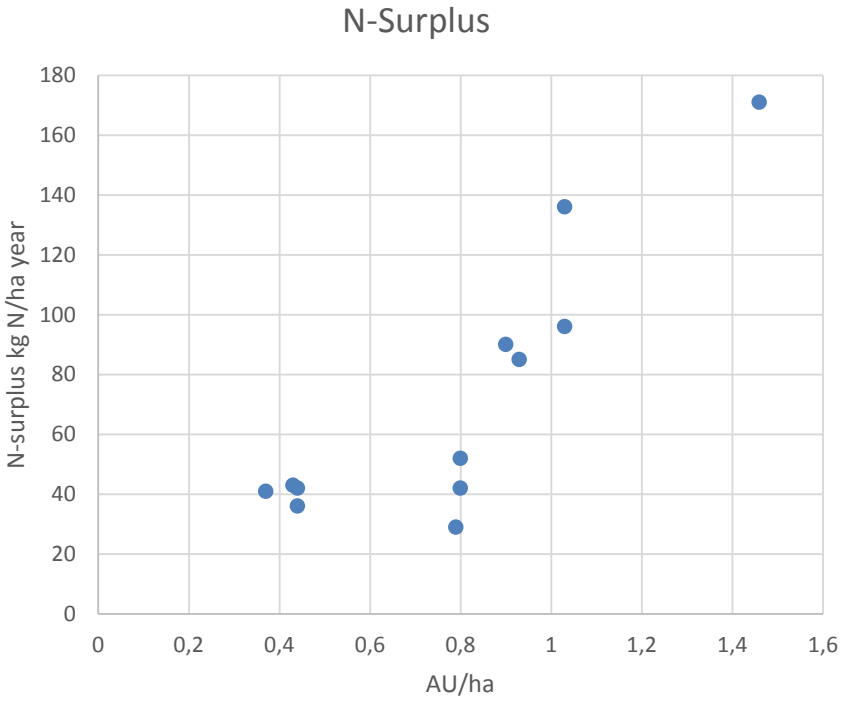
(Wivstad et al, SLU, 2008)

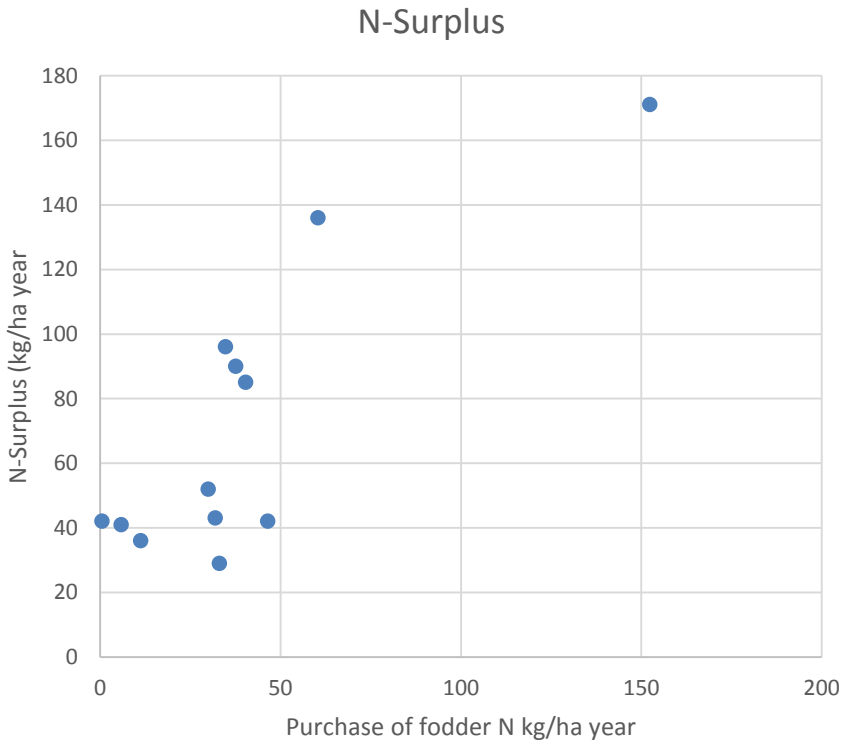
Animal density and nitrogen surplus 29 BERAS implementation farms 2010-2013



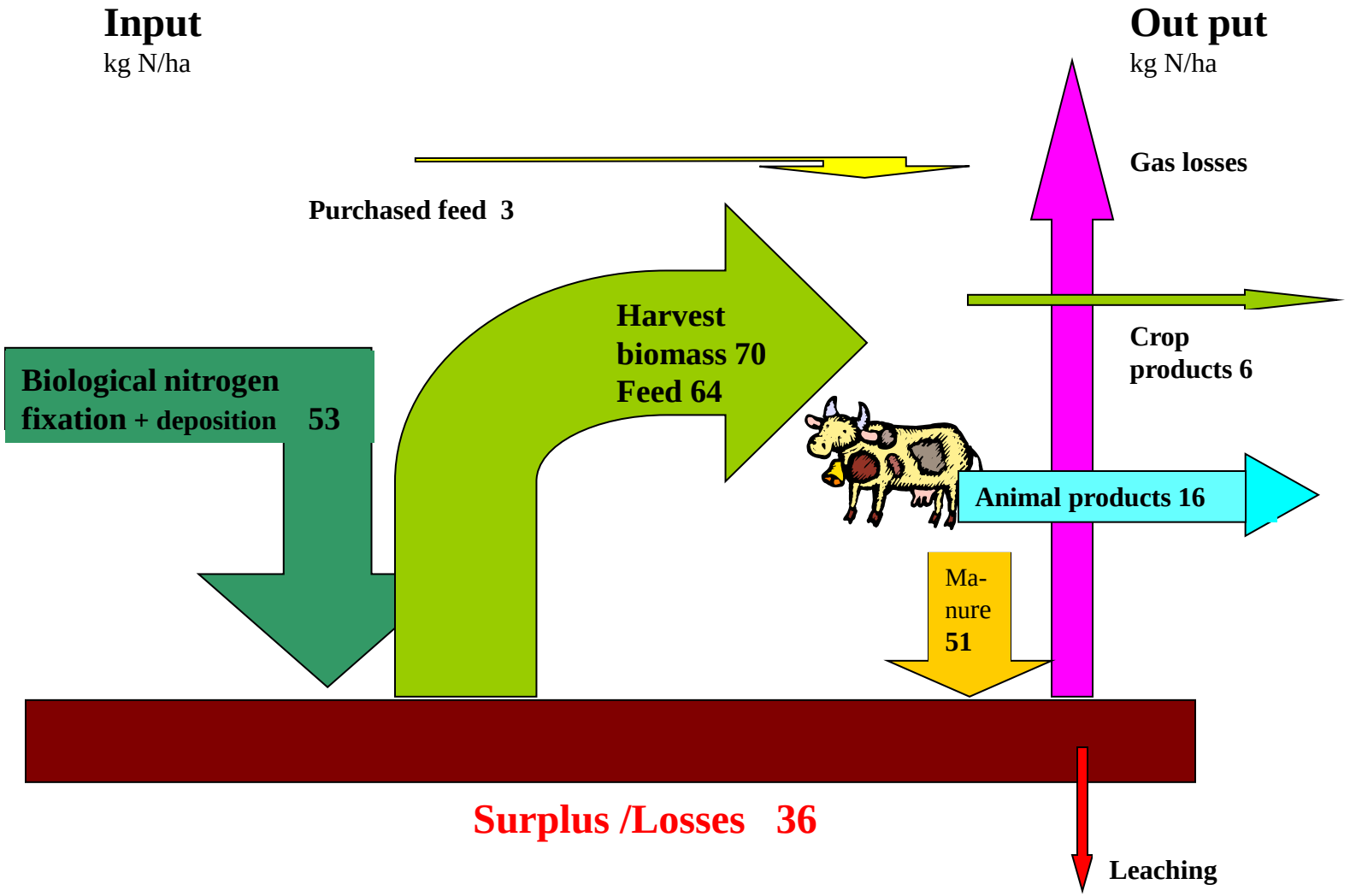
Granstedt and Seuri, 2013, Ecological Recycling Agriculture. BERAS Implementation report 3. www.beras.eu

Animal density (purchase of fodder) BERAS-implementation dairy farms and nitrogen surplus





Integration of crop and animal production: Ecological Recycling Agriculture (ERA)



Nitrogen balance kg N/ha and year
Yttereneby-Skilleby (an ERA-farm)

Ley with Leguminous species

was the sunlight driven natural resource used to create a multiple doubled food production during 150 years before the introduction of artificial fertilizers and chemicals

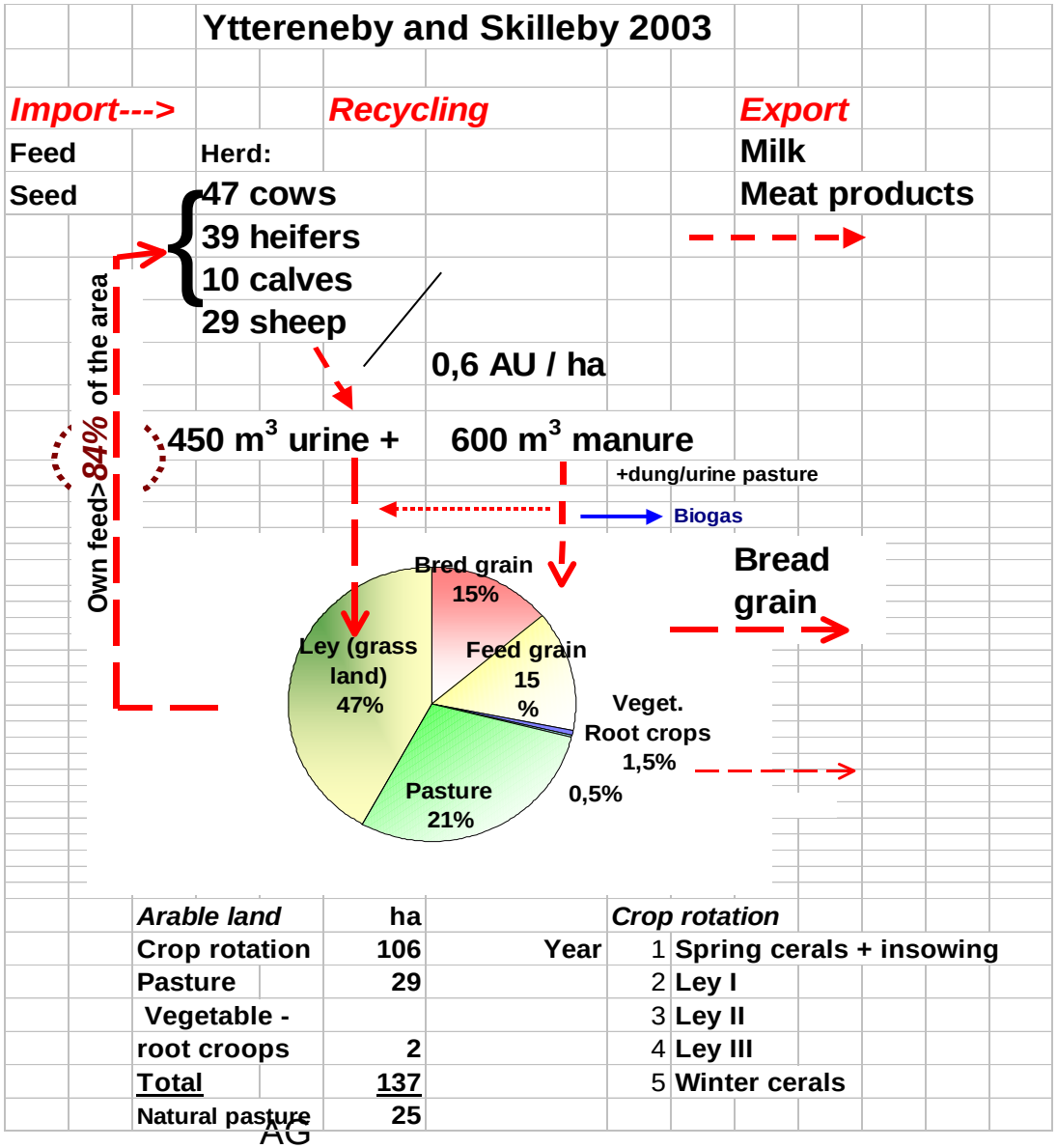
- Energy from the sun
- Nitrogen and carbon from the atmosphere
- Minerals and water from the ground

AG

Example of Ecological Recycling Agriculture / ERA

The prototype farm Yttereneby – Skilleby in Järna)

- The animal density is adjusted to the farm's feed production capacity. In this case fodder crops on 84 % and crops for sale on 16 % of the farm area and with a animal density of 0,6 AU/ha (= average for Sweden)



Arable land	ha		*Crop rotation*	
Crop rotation	106	Year	1	Spring cerals + insowing
Pasture	29		2	Ley I
Vegetable -			3	Ley II
root croops	2		4	Ley III
Total	137		5	Winter cerals
Natural pasture	25			

2015-10-02

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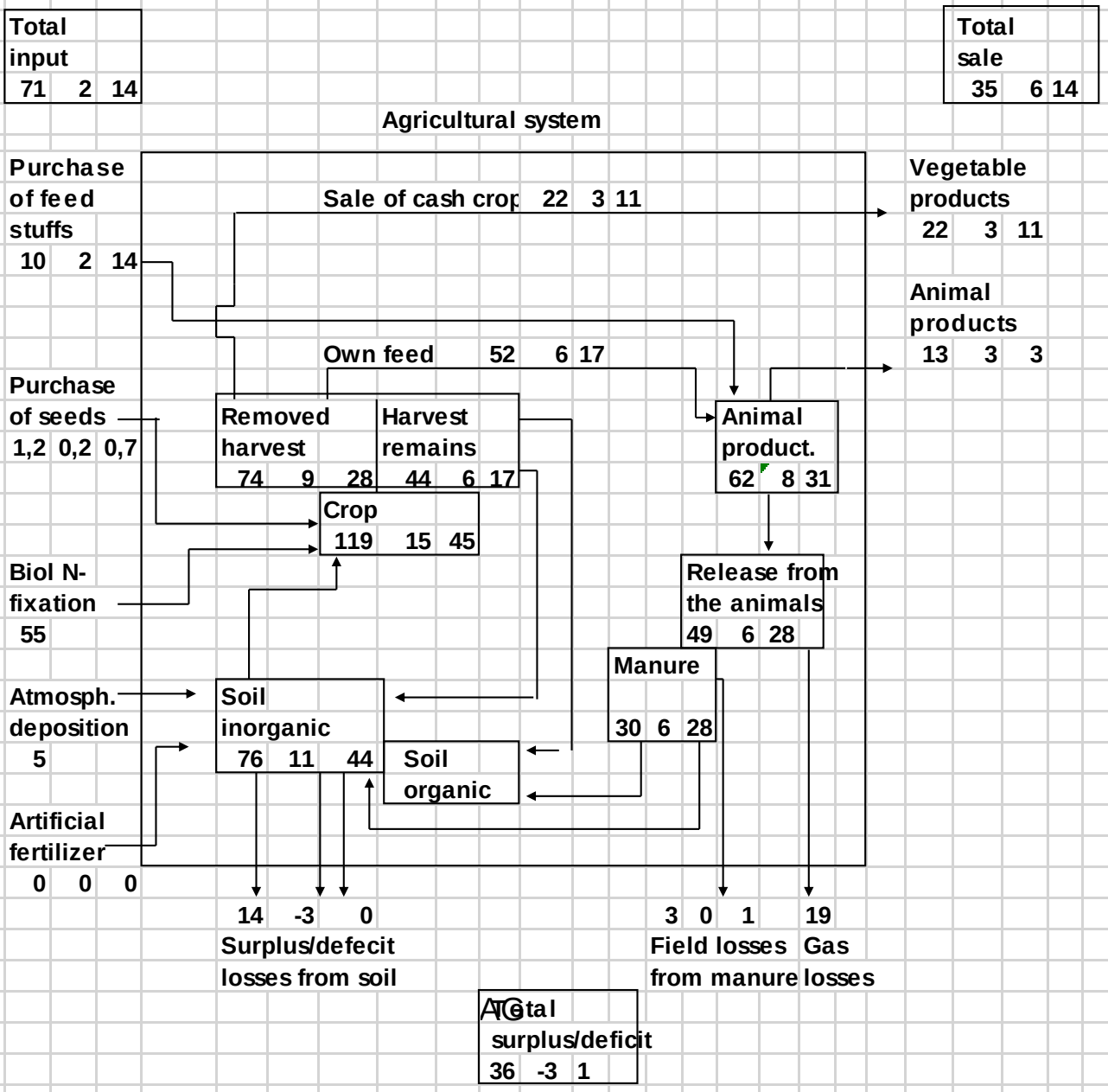
Network of Learning Centres and Sustainable Food Societies around the Baltic Sea

- 167 ha farm land
- Diverse crop rotation
- Vegetables and potatoes
- 95 cows (30 lactating)
- 50 Pigs

Professional cheese making

Flow of N/P/K kg ha^{-1} in the agricultural-ecosystem Fredeburg year 2011

Areal 96 ha. Farmer: Alfons Weisler-Trapp



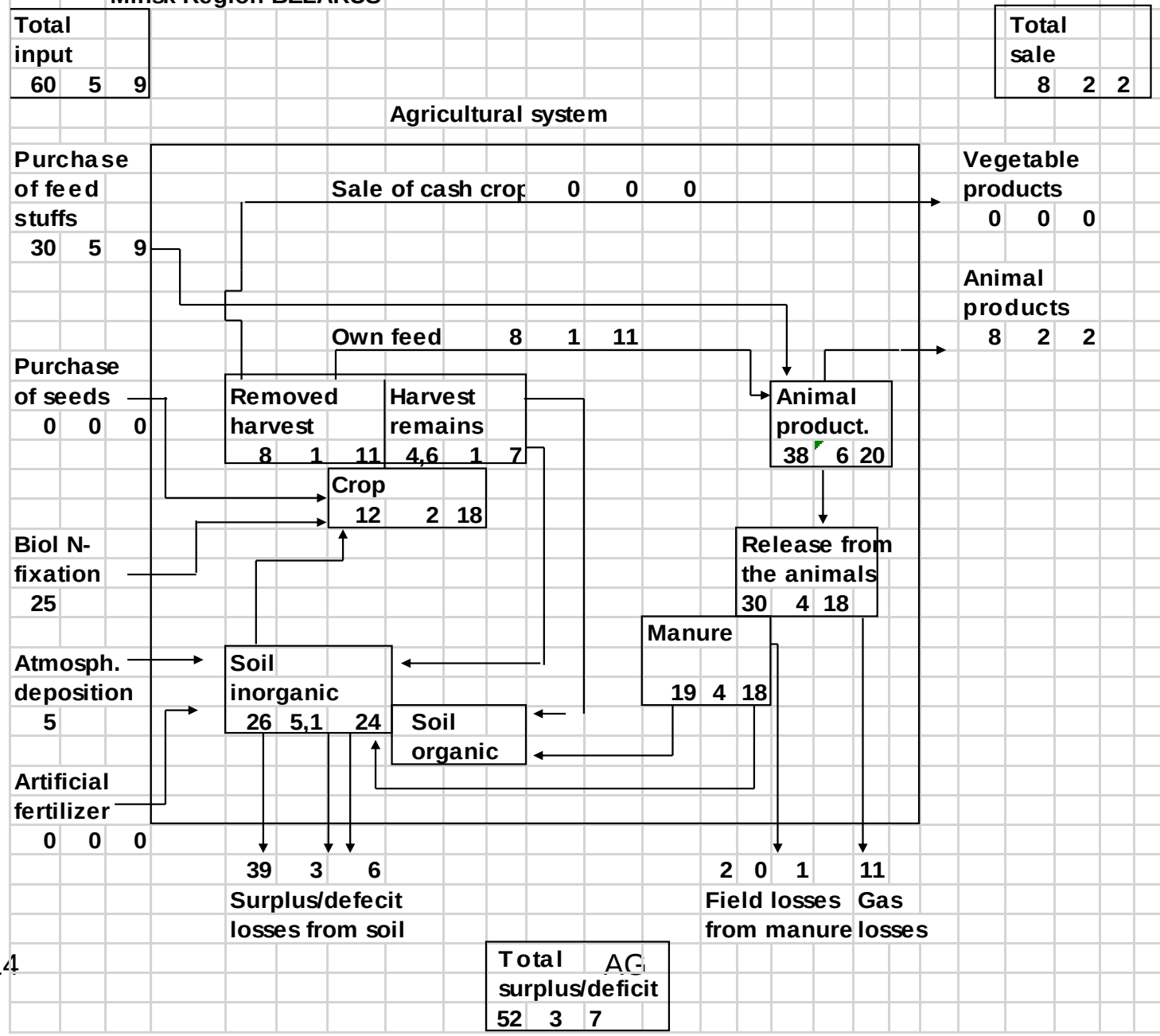
2015-10-02

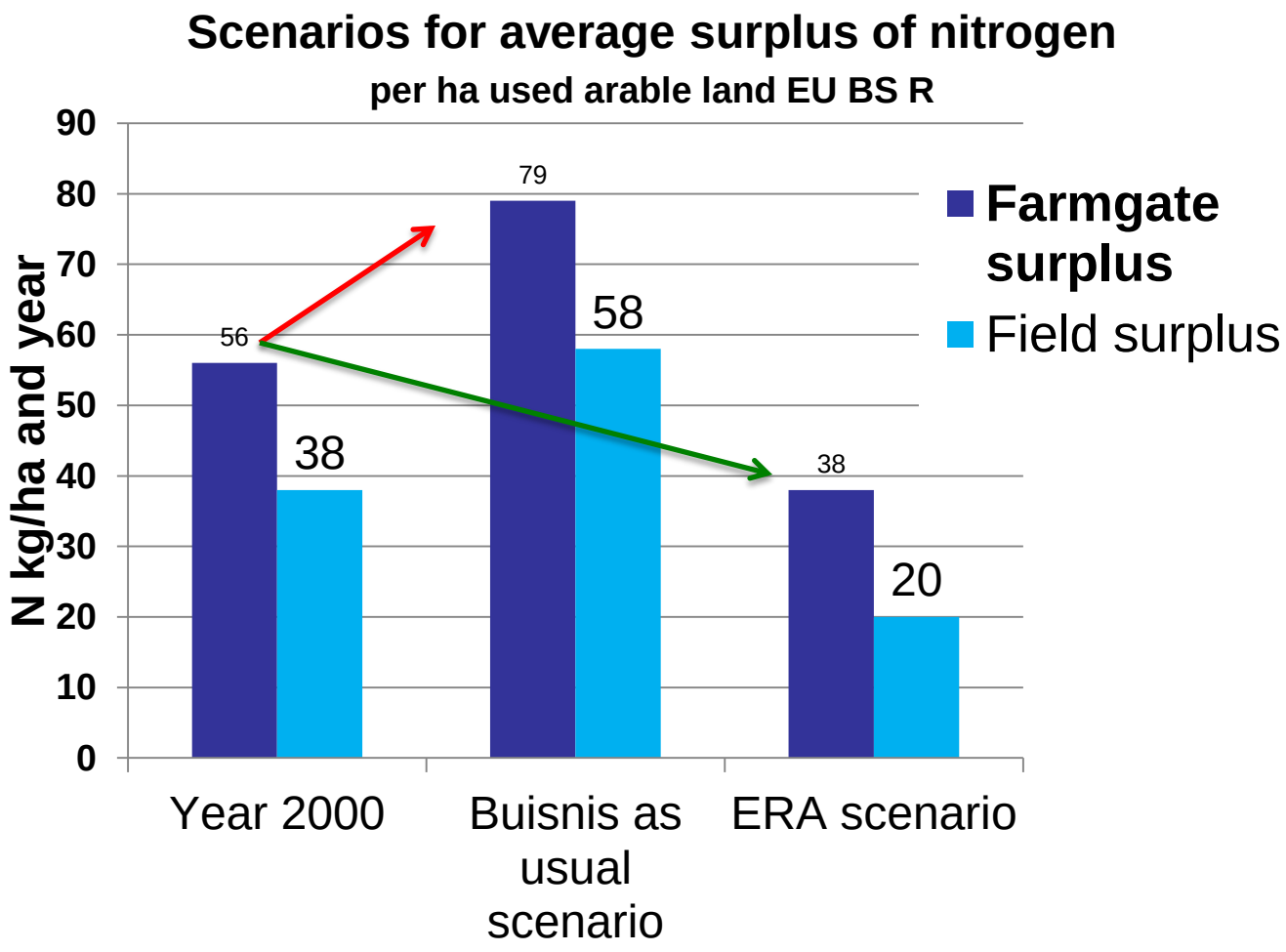
DAK-farm , 80 ha

Dimitry Krylov

Dzerzhinsk district

Minsk Region BELARUS



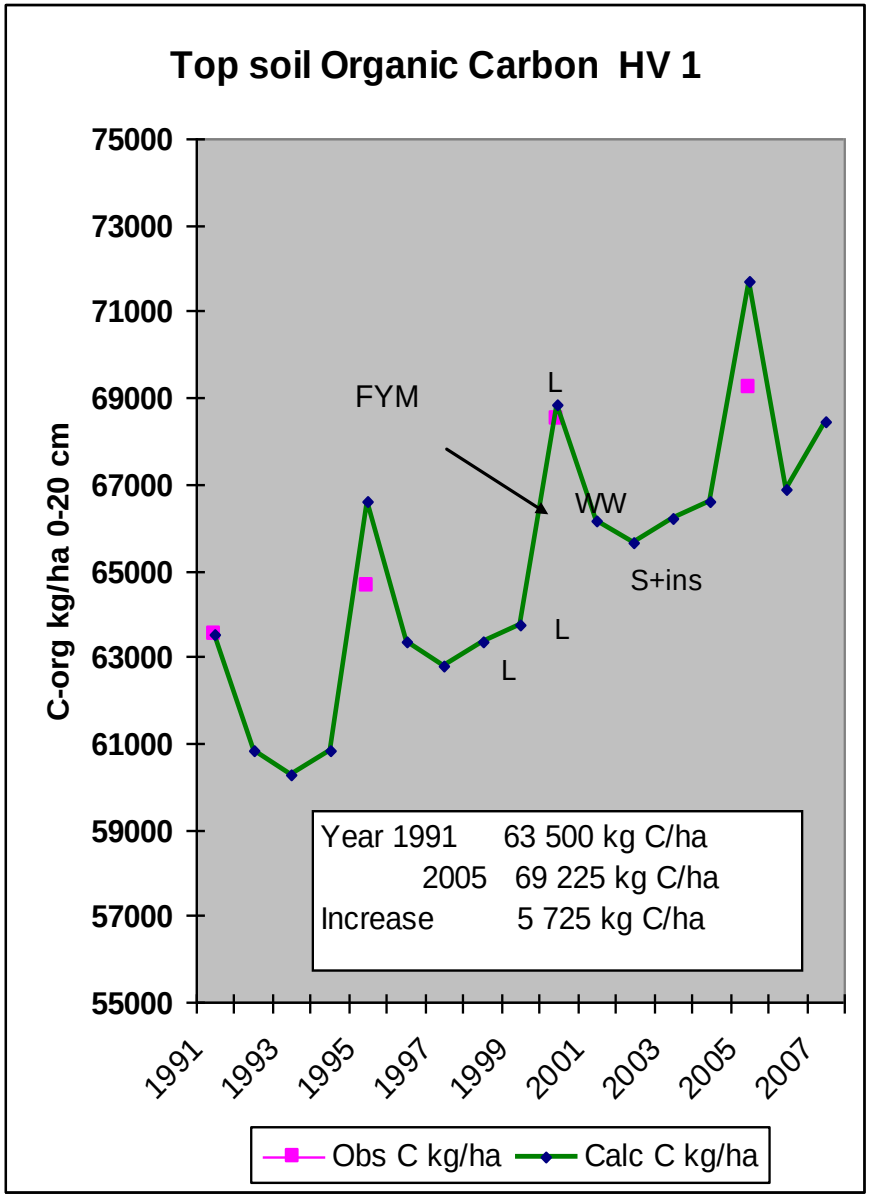


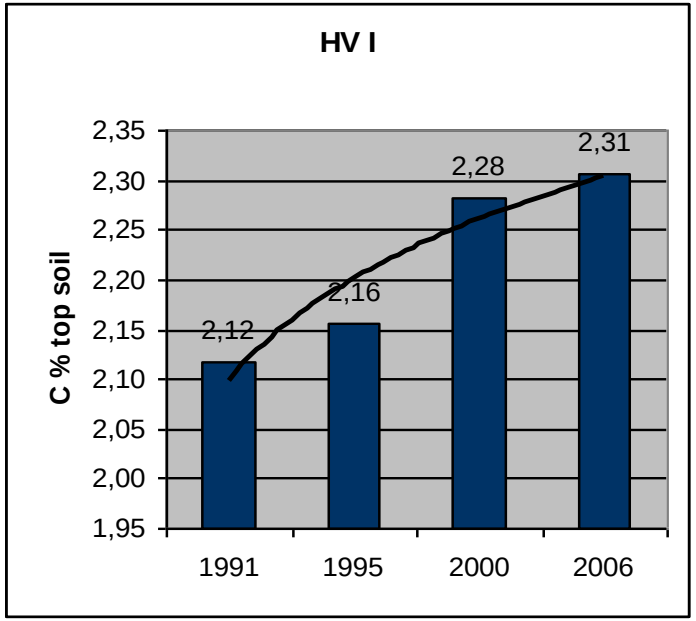
Granstedt et al 2008
Biological Agriculure an d Horticulture

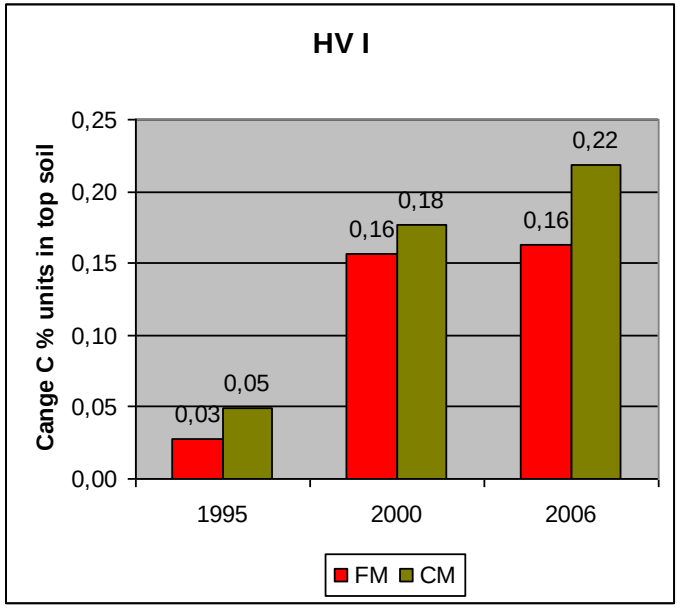
Long term manure experiment

Experimental plan from 1991

Main plot	Treatments winter wheat
F1	Not composted manure 12.5 ton (0 from 1995)
F2	25 ton
F3	50 ton
K1	Composted manure 12.5 ton (0 from 1995)
K2	25 ton
K3	50 ton
Subplot (split plot) +	BD preparation each plot each year
-	Without BD preparation


Top soil Organic Carbon HV 1
C-org kg/ha 0-20 cm
75000
73000
71000
69000
67000
65000
63000
61000
59000
57000
55000
1991
1993
1995
1997
1999
2001
2003
2005
2007
FYM
L
WW
S+ins
L
L
Year 1991 63 500 kg C/ha
2005 69 225 kg C/ha
Increase 5 725 kg C/ha
Obs C kg/ha
Calc C kg/ha

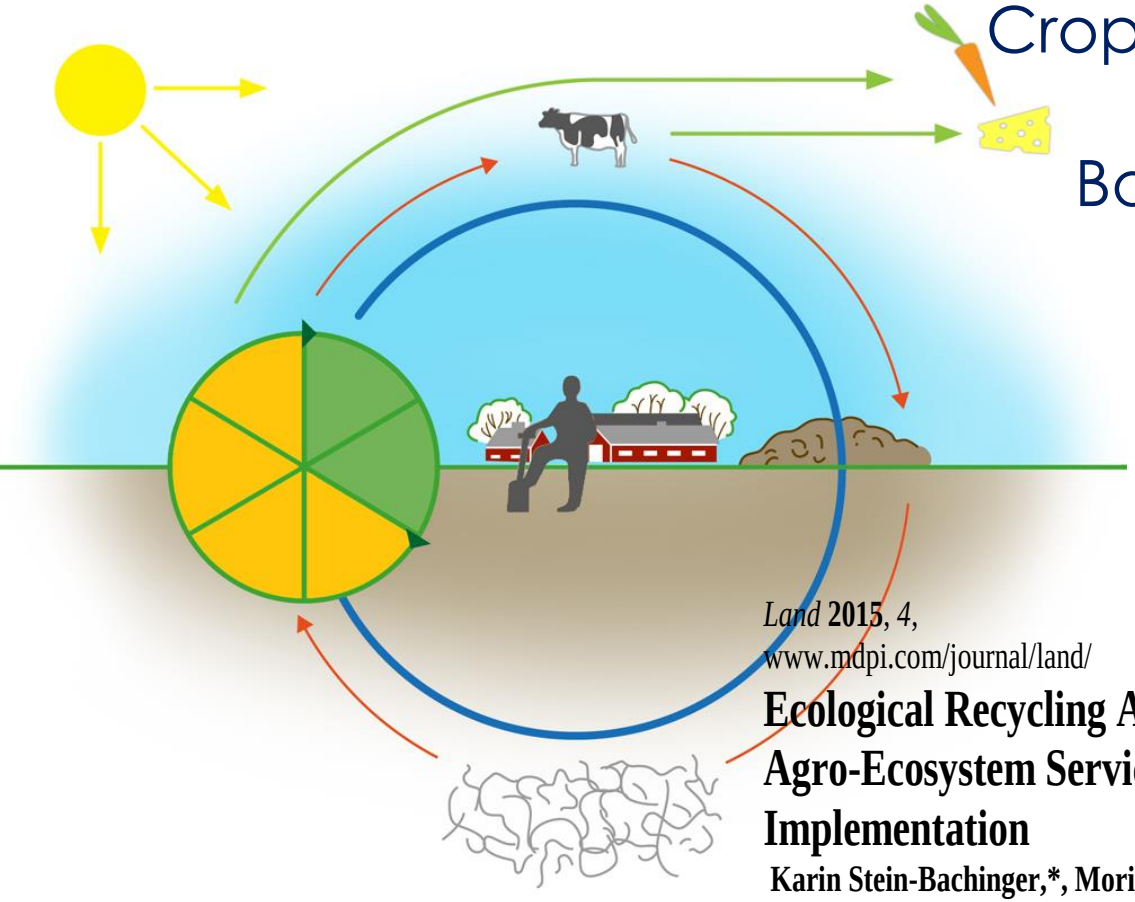

HV I
C % top soil
2,35
2,30
2,25
2,20
2,15
2,10
2,05
2,00
1,95
2,12
2,16
2,28
2,31
1991
1995
2000
2006


HV I
Cange C % units in top soil
0,25
0,20
0,15
0,10
0,05
0,00
0,03
0,05
0,16
0,18
0,16
0,22
1995
2000
2006
FM
CM

BERAS International
Building Ecological Recycling Agriculture and Societies

Ecological Recycling Agriculture

www.beras.eu



Crop rotation with N- fixation legumes ley

Balance Animal and crop production

Manure management

Soil improvement

Land **2015**, *4*,
www.mdpi.com/journal/land/

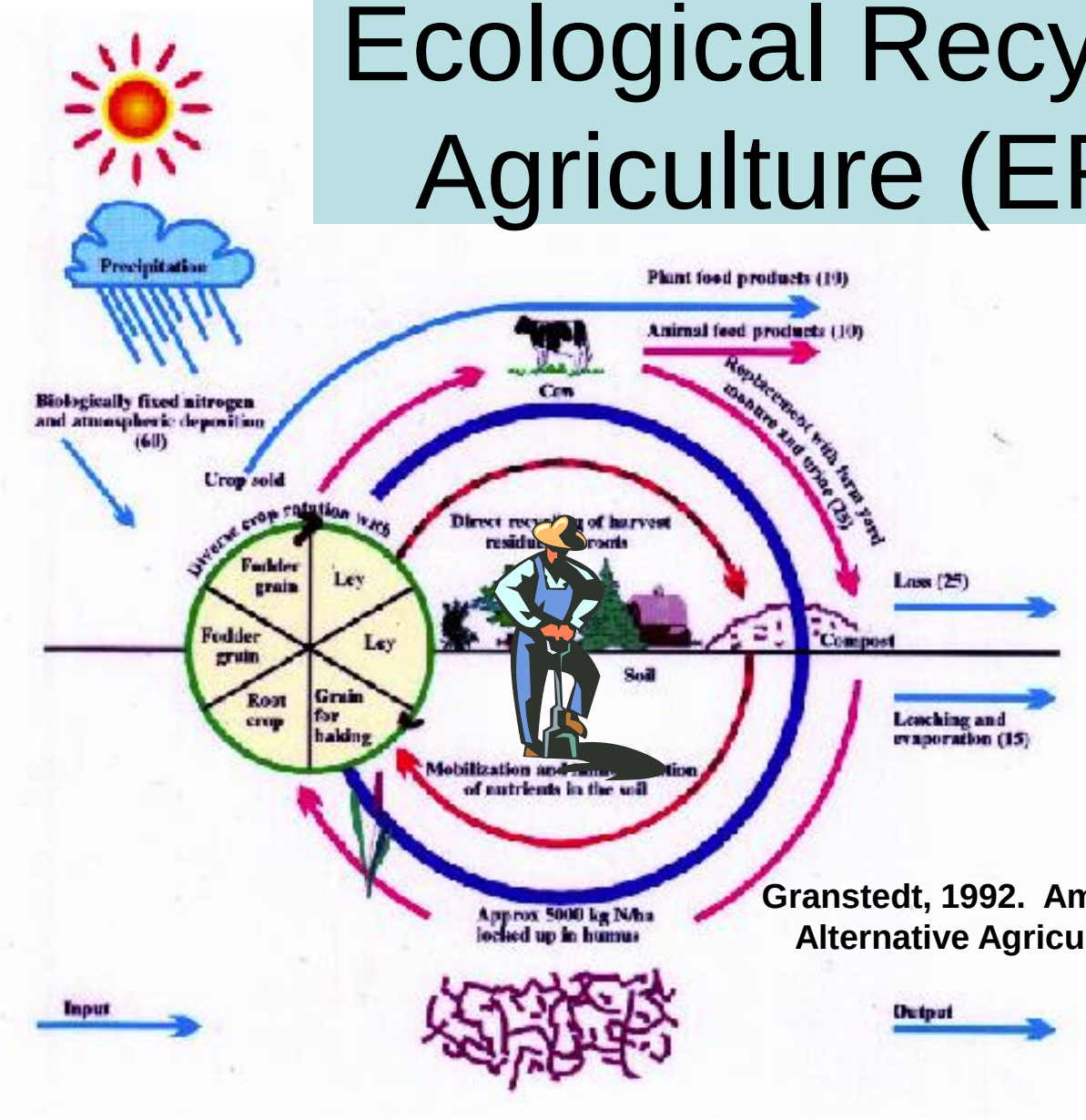
Ecological Recycling Agriculture to Enhance Agro-Ecosystem Services in the Baltic Sea Region: Guidelines for Implementation

Karin Stein-Bachinger,*, Moritz Reckling1, Johann Bachinger1, Johannes Hufnagel1, Wijnand Koker and Artur Granstedt

- **An ecological recycling agriculture based on integrated crop and animal production with effective recycling of nutrients and organic biomass and crop rotation with legume - grassland:**
  1. **conserve basic natural resources**
  2. **rebuild fertile soils**
  3. **reduce nutrient leaching with more than 50 %**
  4. **prevent negative human impacts on the climate from food production**
  5. **produce nutritionally quality food**
- **A conversion of agriculture around the Baltic Sea is the possible remedy for the sea**

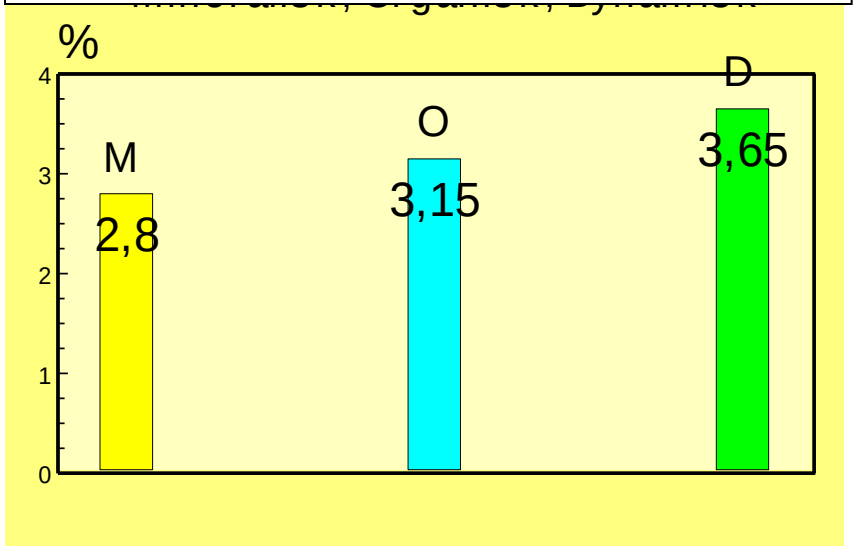
Explanation /discussions:

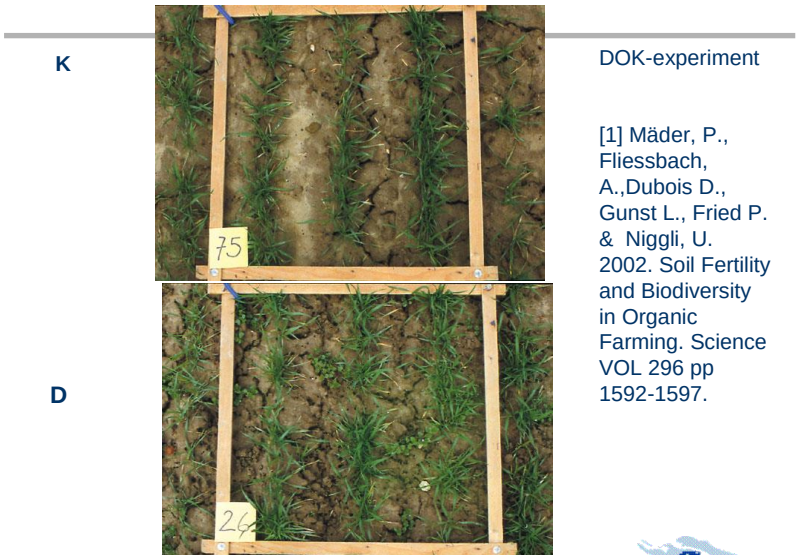
Ecological Recycling Agriculture (ERA)



Granstedt, 1992. American Journal of Alternative Agriculture, Washington

Humus content after 20 years in DOK trials comparing conventional, organic and biodynamic treatments





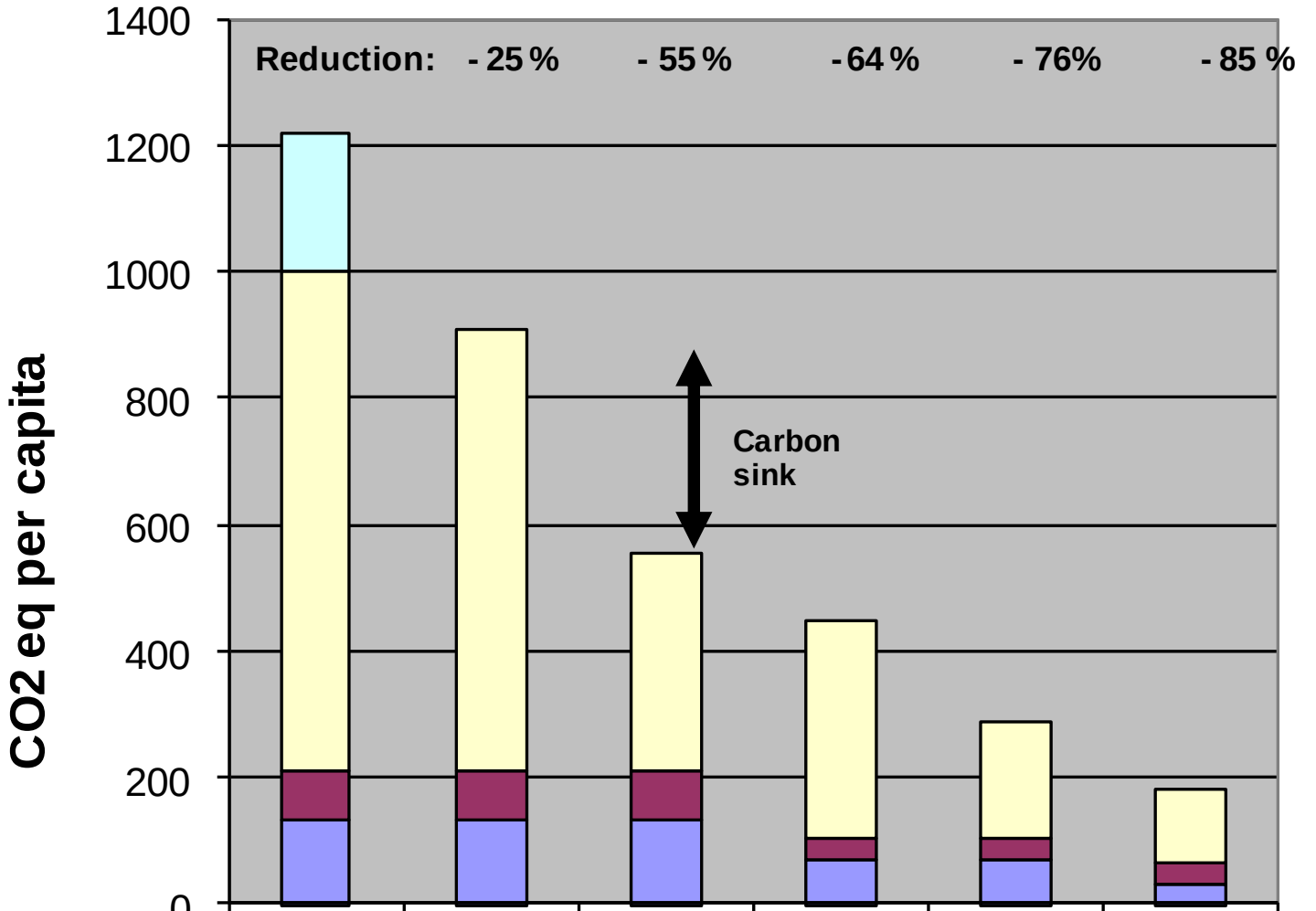
DOK-experiment

[1] Mäder, P., Fliessbach, A.,Dubois D., Gunst L., Fried P. & Niggli, U. 2002. Soil Fertility and Biodiversity in Organic Farming. Science VOL 296 pp 1592-1597.

Humus content after 20 years in DOK trials comparing conventional, organic and biodynamic treatments. In the Swiss DOK -trials comparing t biodynamic, organic and conventional treatments in FiBL the humus content was, after 20 years, in conventional farming 2,8 % (M), in organic farming with organic manure 3,15 % (O) and in biodynamic farming with biodynamic manure treatments and the use of biodynamic preparations 3,65 % (D). (Mäder, et al, 2002).

Mäder, P., Fliessbach, A.,Dubois D., Gunst L., Fried P. & Niggli, U. 2002. Soil Fertility and Biodiversity in Organic Farming. Science VOL 296 pp 1592-1597.

Basic food CO2 eq



	CONV	ERA	ERA.SOM	ERA.SOM.LOC	ERA.SOM.LOC.BG	ERA.SOM.LOC.BG.VEG
Land-use change	220					
Agriculture	790	699	344	344	188	120
Processing	80	80	80	35	35	30
Transports	130	130	130	66	66	31