Ecological Recycling Agriculture

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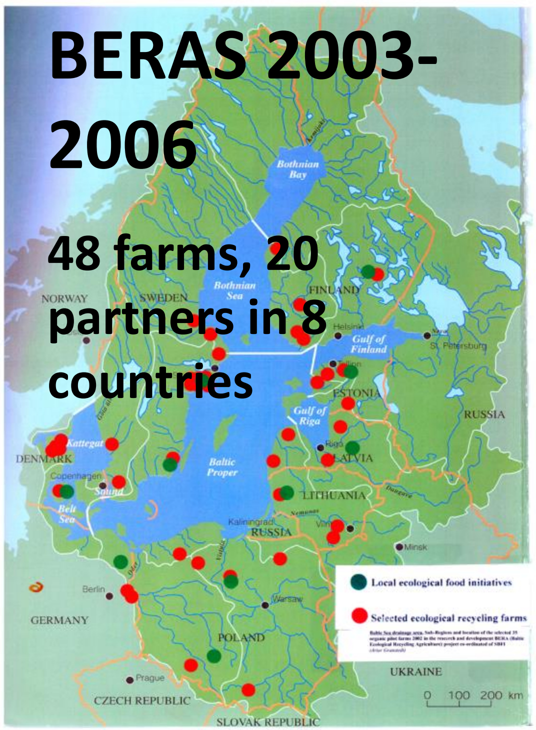
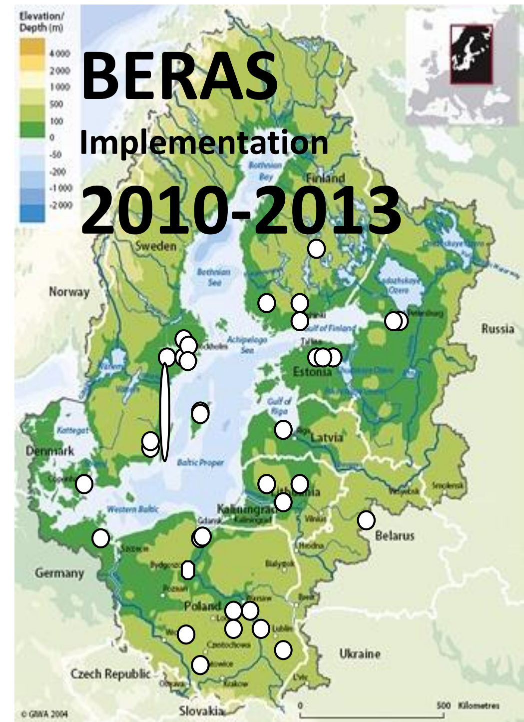


BERAS 2003-2006

48 farms, 20 partners in 8 countries

BERAS secretariat , Järna Sweden



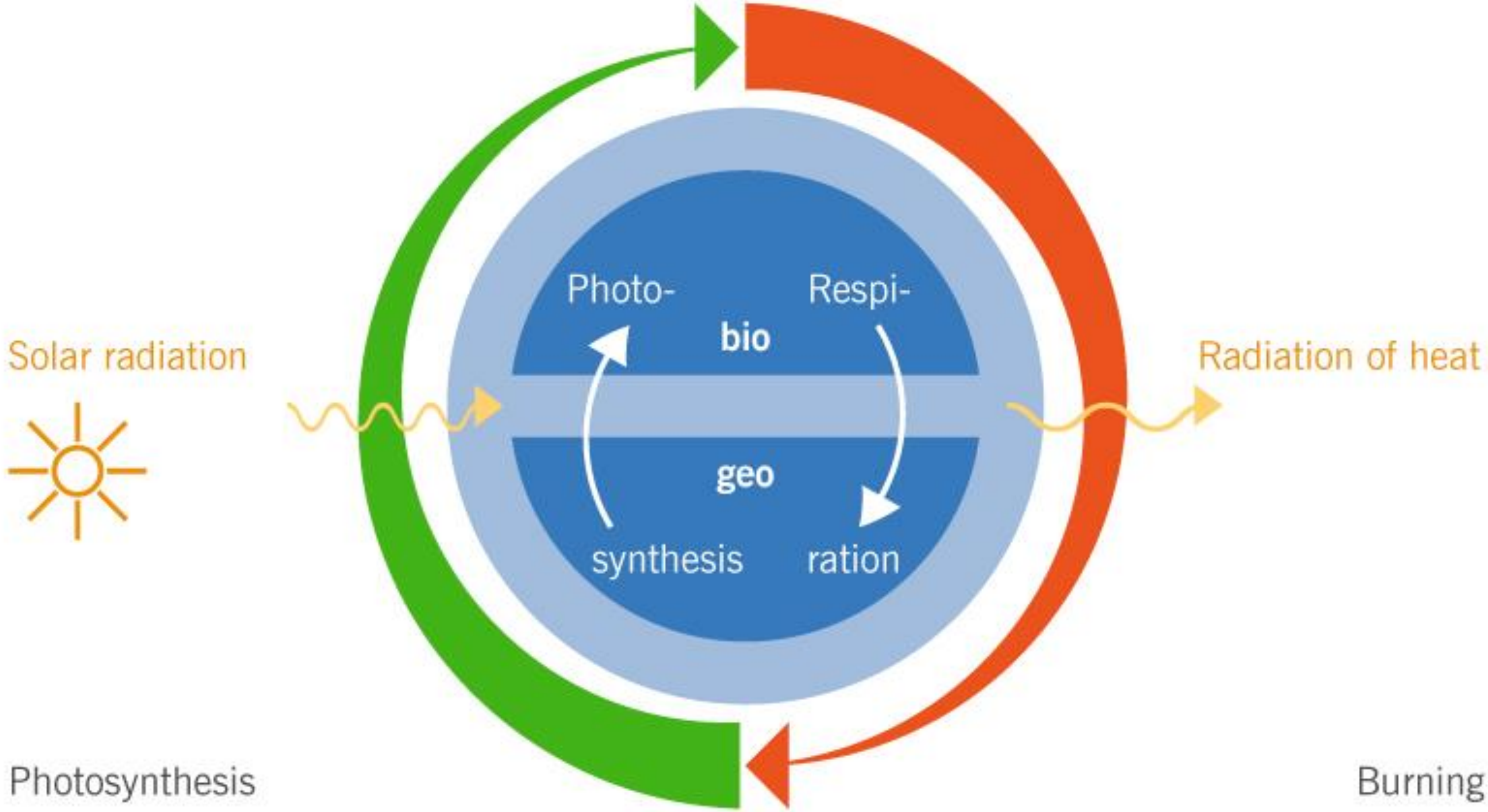
BERAS

Implementation

2010-2013

artur.granstedt@beras.eu

Basic ecological conditions
energy flow, recycling and biological diversity



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

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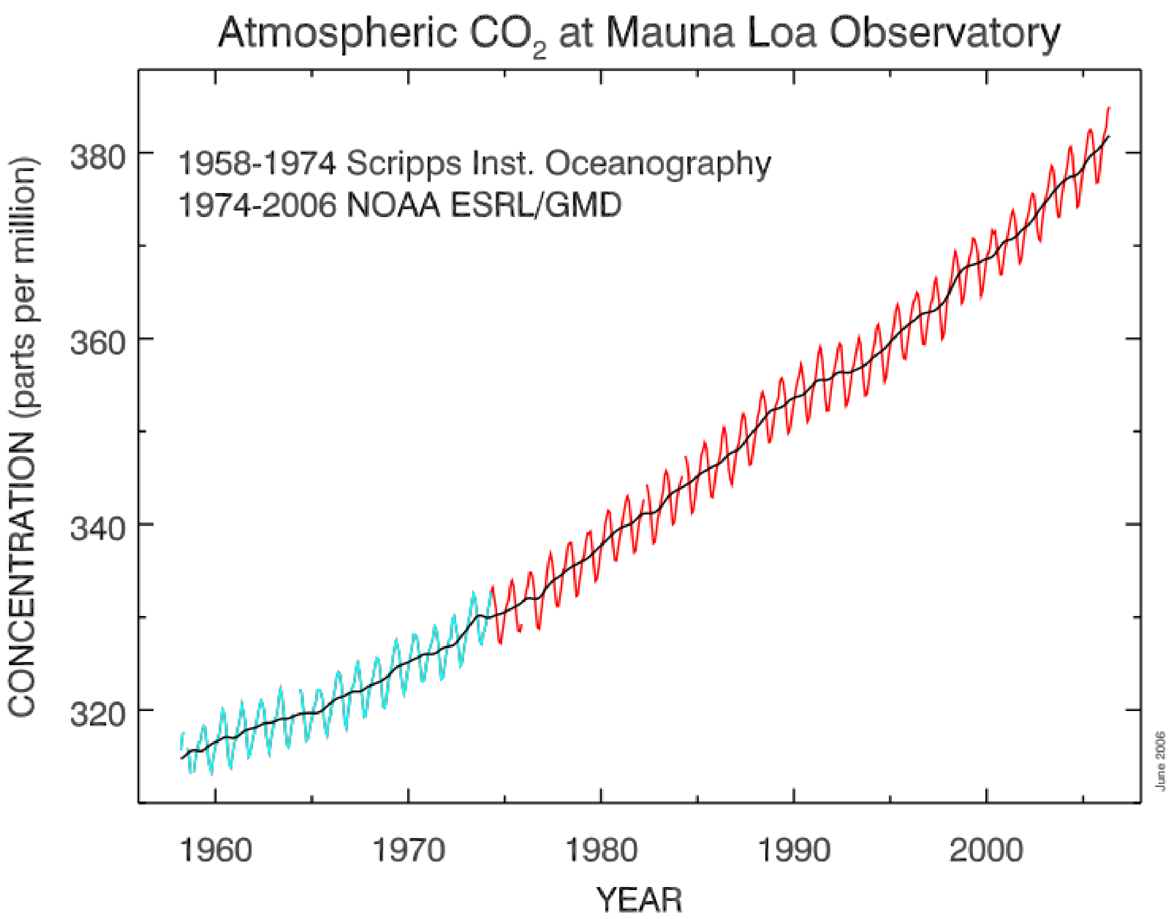
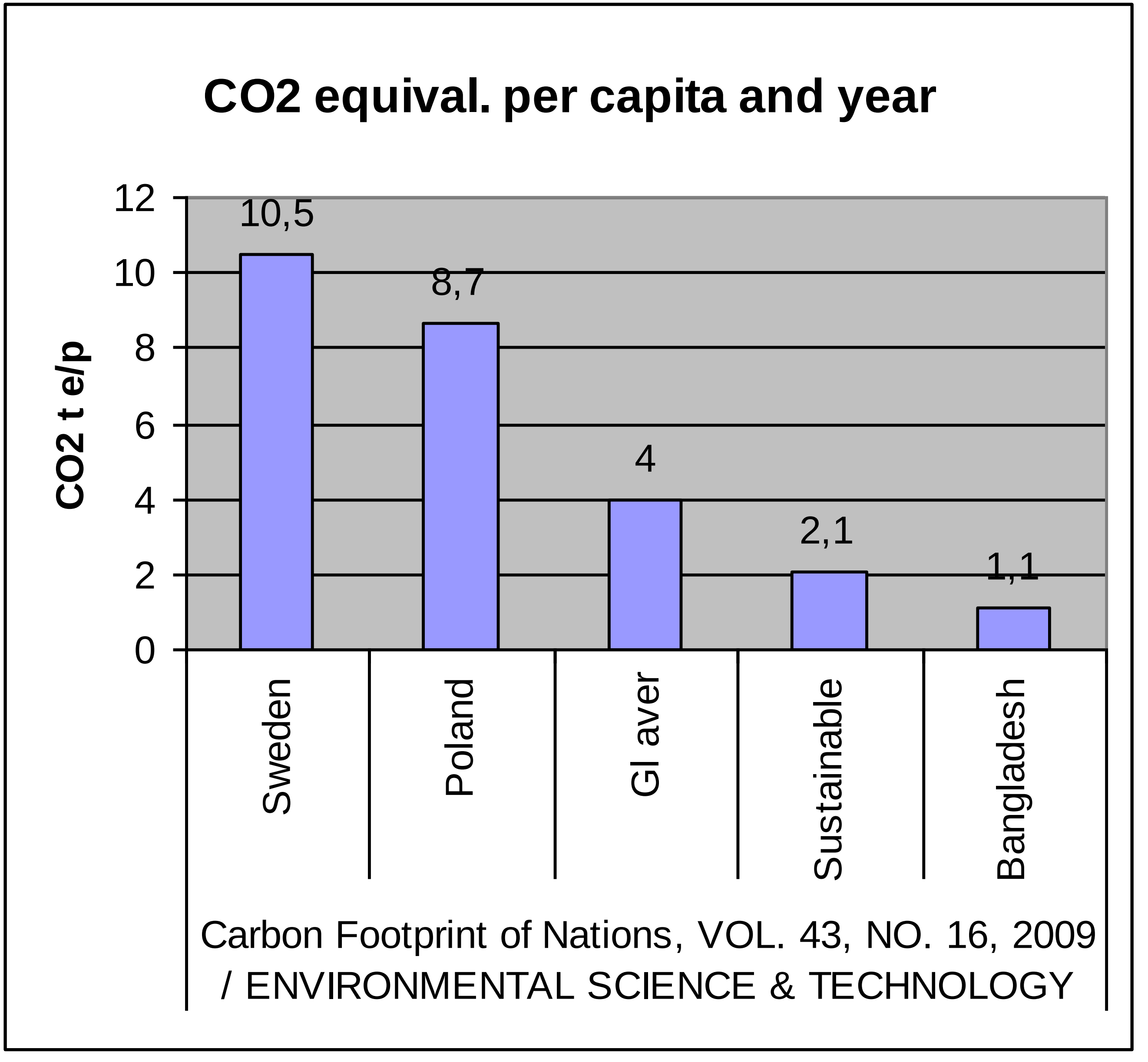



CO2 equival. per capita and year
CO2 t e/p
12
10
8
6
4
2
0
10,5
8,7
4
2,1
1,1
Sweden
Poland
Gl aver
Sustainable
Bangladesh
Carbon Footprint of Nations, VOL. 43, NO. 16, 2009
/ ENVIRONMENTAL SCIENCE & TECHNOLOGY

food

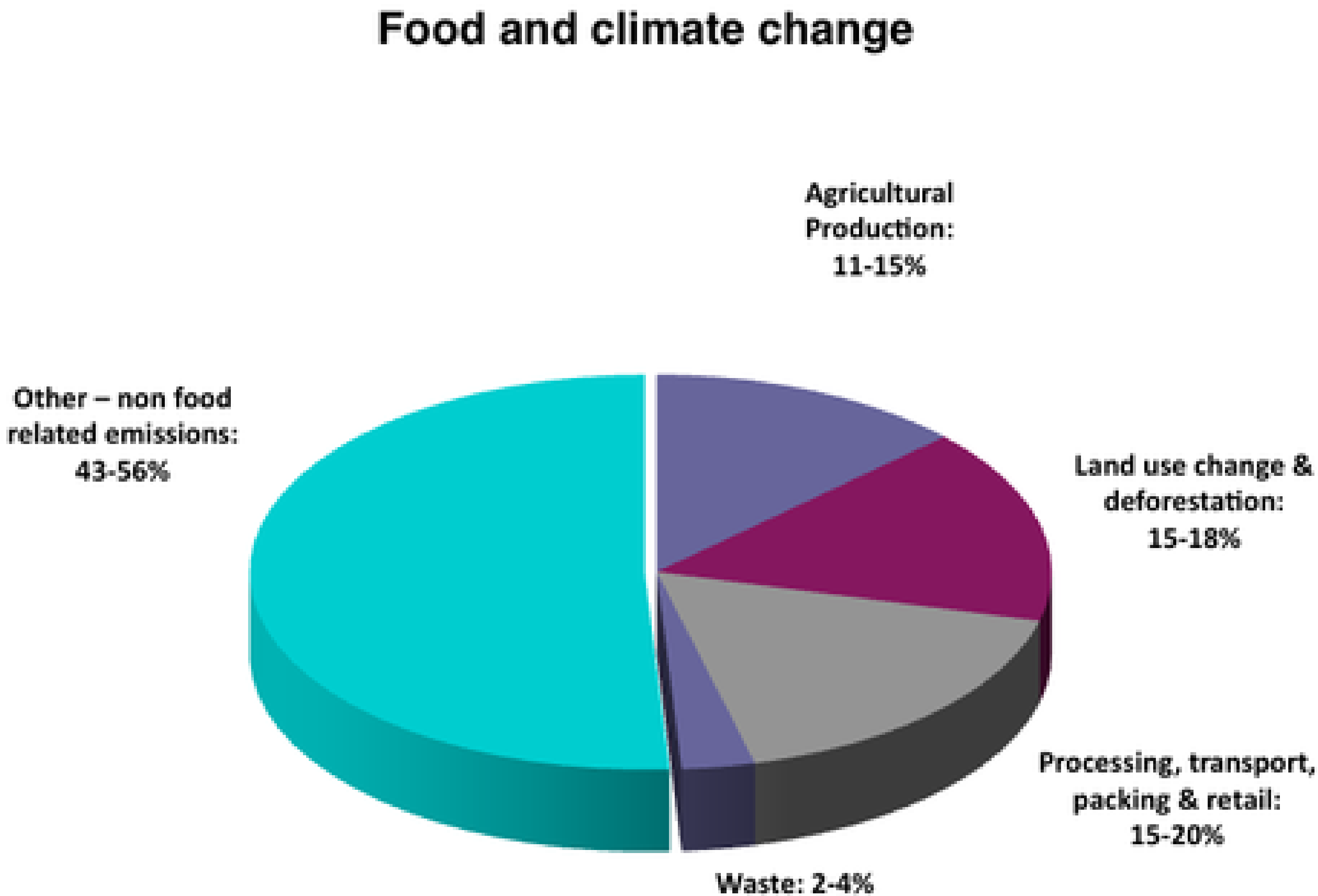
travel

Swedish Nature Protection Agency calculated in 2008

Annual 10,5 CO_2 t e/p

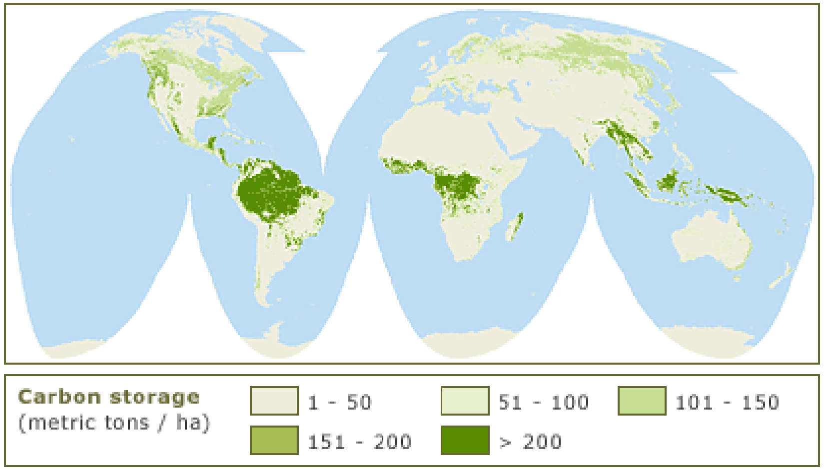
Goal: Reduce with 80 %

housing



The United Nations Conference on Trade and Development (**UNCTAD**), 2011

550
billion tons



13 billion ha land (30 %)

1.4 billion ha arable (0,2/Cap)

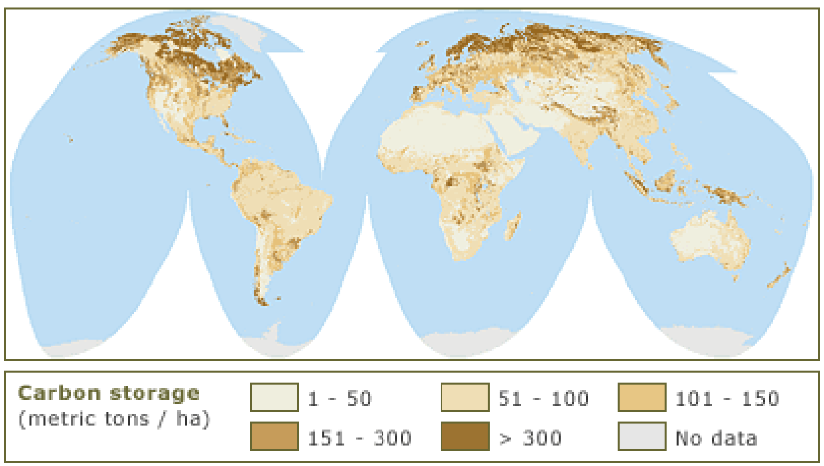
3,7 billion ha open, partly pasture, land (0,5/cap)

4,1 billion ha forest (0,6/Cap)

1600
Billion
tons

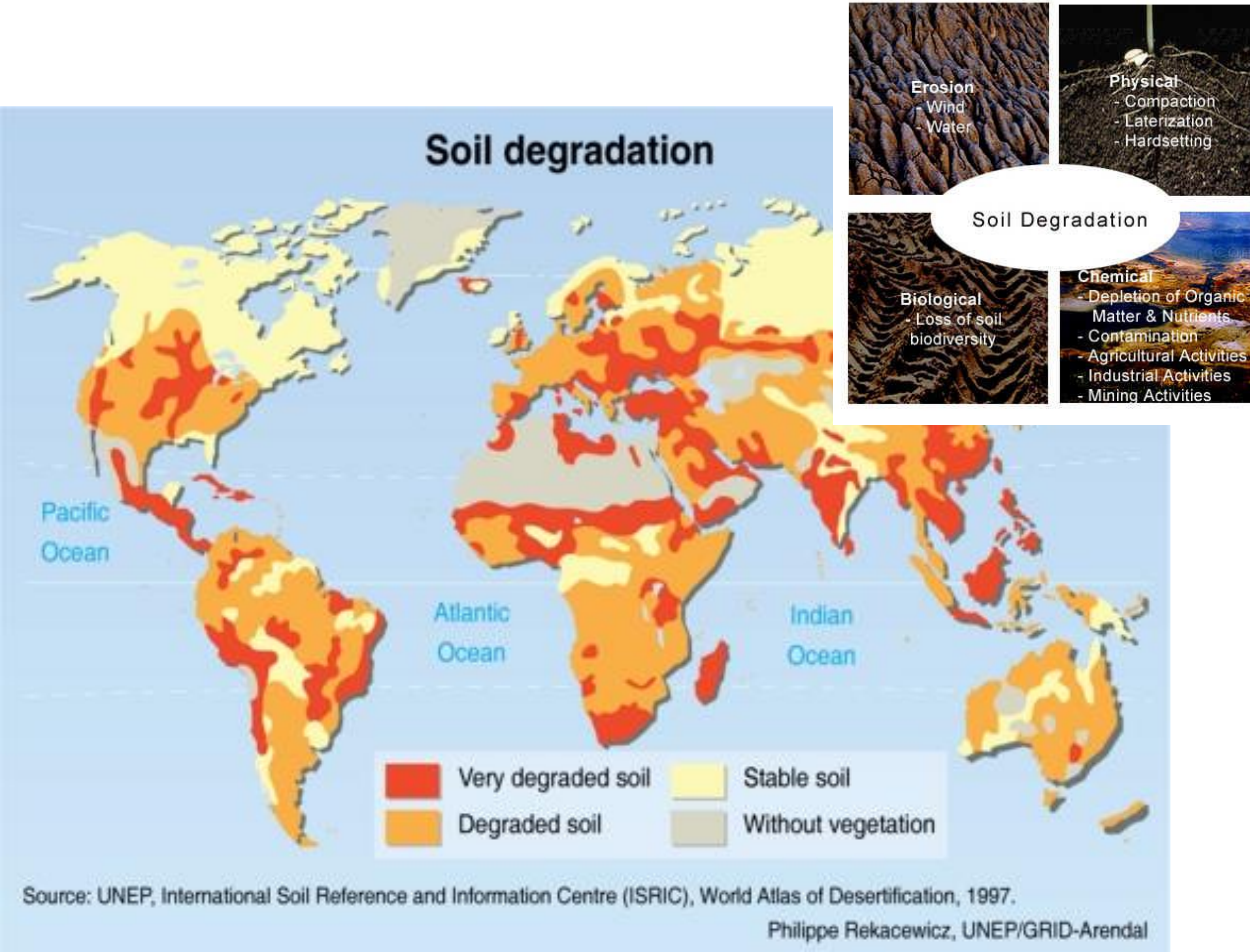
C

GLOBAL CARBON STORAGE IN SOILS

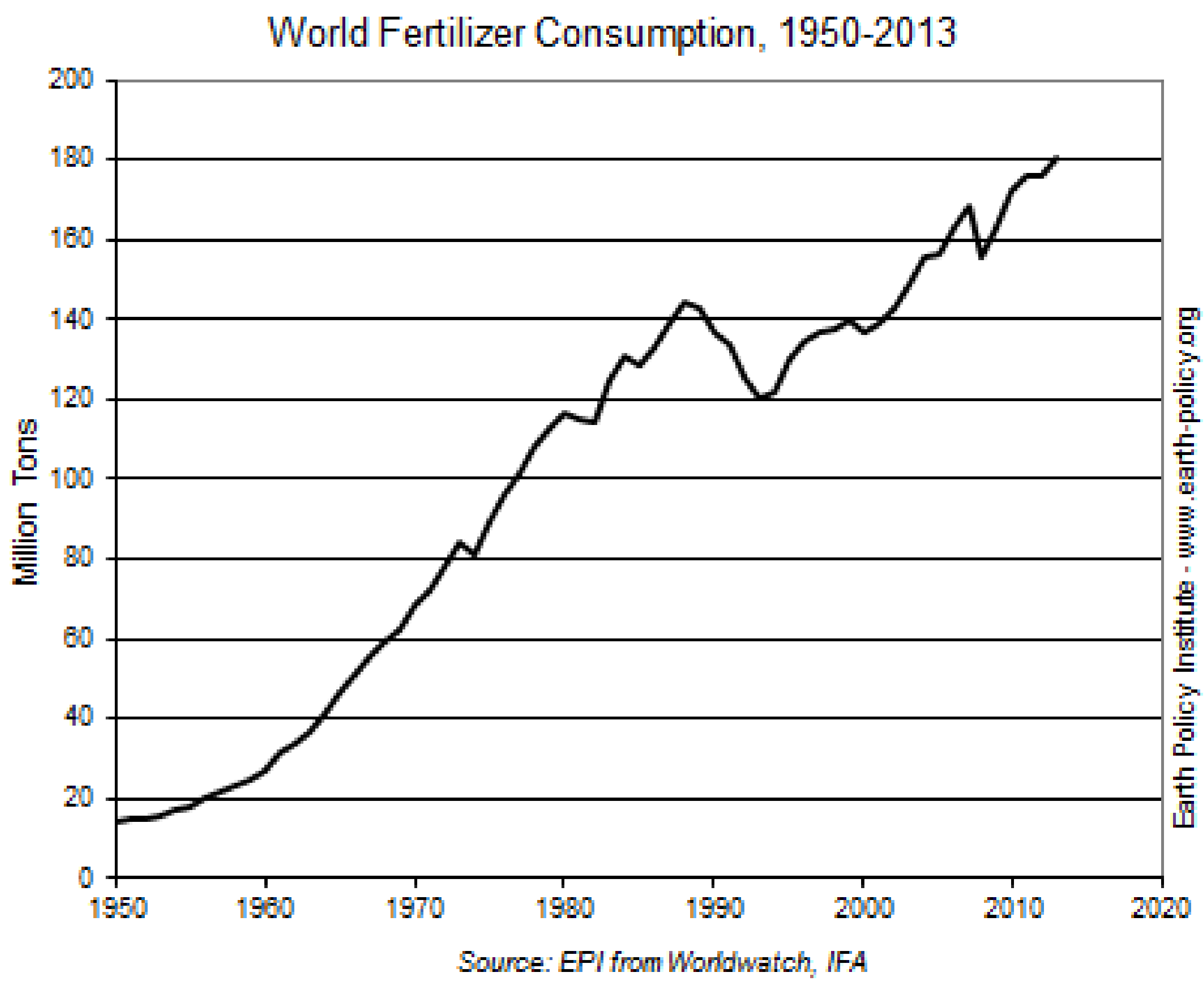


7 million ha arable land lost per year

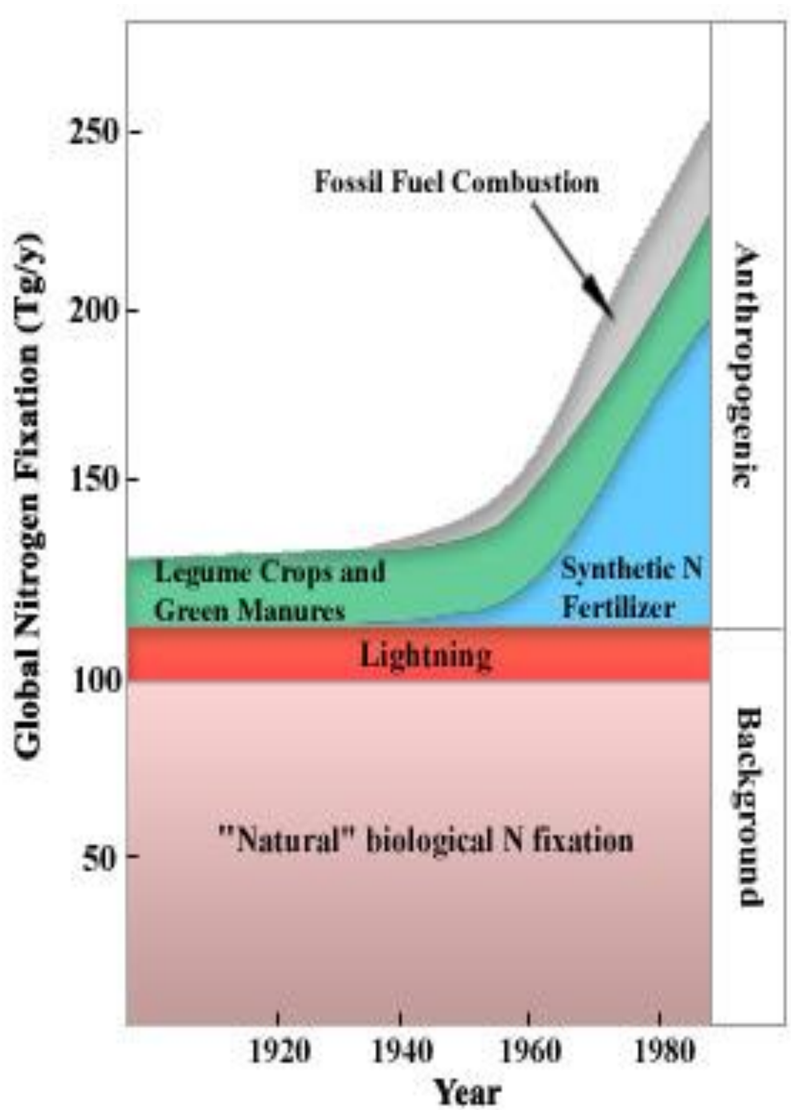
The amount of organic carbon in living organisms and in the soil, in tons/ha (World Resources Institute , 2000)


Soil degradation
Pacific
Ocean
Atlantic
Ocean
Indian
Ocean
Very degraded soil
Degraded soil
Stable soil
Without vegetation
Source: UNEP, International Soil Reference and Information Centre (ISRIC), World Atlas of Desertification, 1997.
Philippe Rekacewicz, UNEP/GRID-Arendal
Erosion
- Wind
- Water
Physical
- Compaction
- Laterization
- Hardsetting
Soil Degradation
Biological
- Loss of soil biodiversity
Chemical
- Depletion of Organic Matter & Nutrients
- Contamination
- Agricultural Activities
- Industrial Activities
- Mining Activities

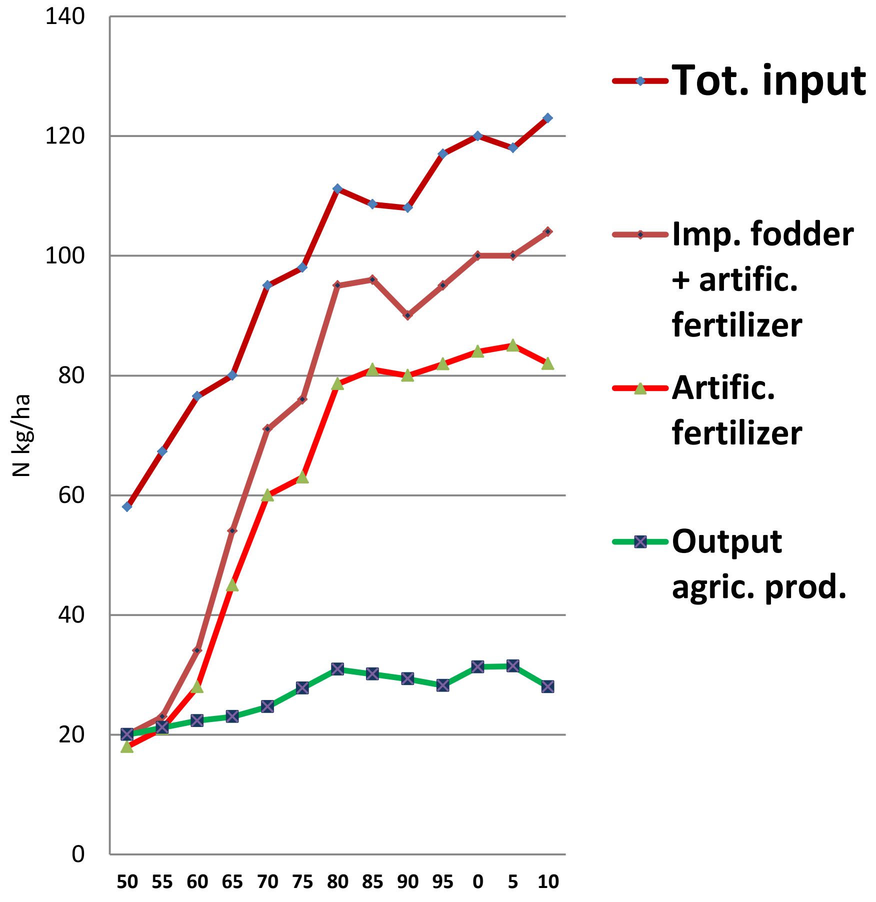
World fertilizer consumption



The Global Nitrogen Cascade



N-surplus kg/ha conventional Swedish Agriculture 1950 -2010



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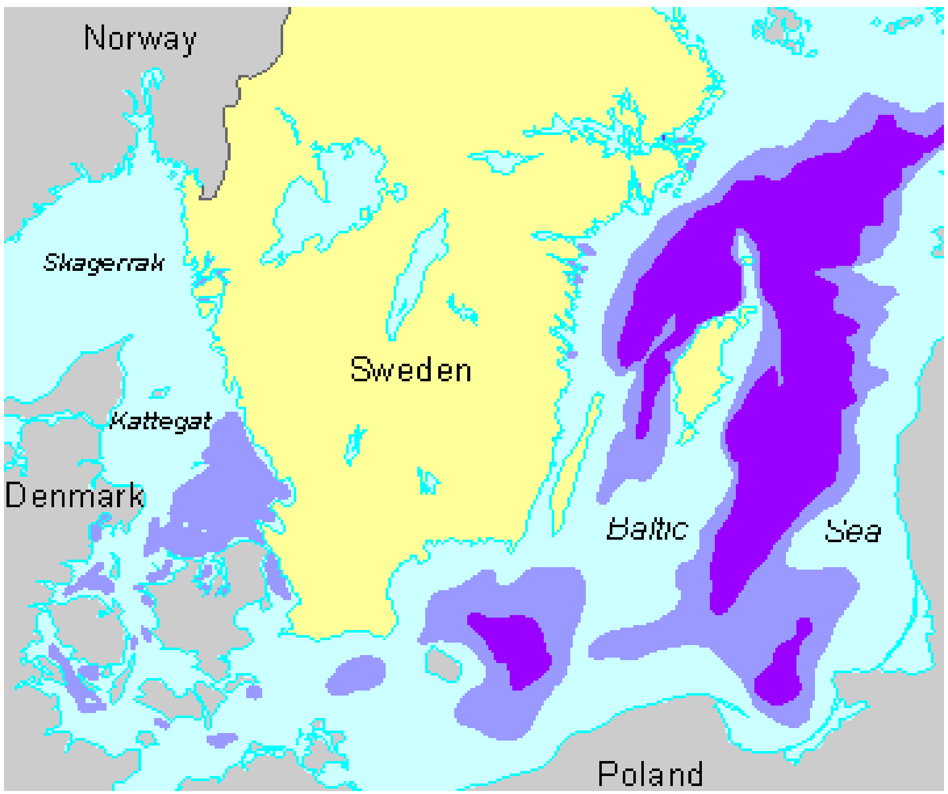
A decreasing level of oxygen results in dead sea bottoms



The concentration of oxygen periodically beneath 2 ml/l

The concentration of oxygen mostly beneath 2 ml/l = dead or dying

Ocean 'dead zones'

A new global study of Earth's oceans shows a marked increase in the number of "dead zones" – areas of seafloor with too little oxygen to sustain most marine life.

WHY DEAD ZONES OCCUR

1 Pollutants from the burning of fossil fuels rise into the atmosphere and fall back to Earth as rain

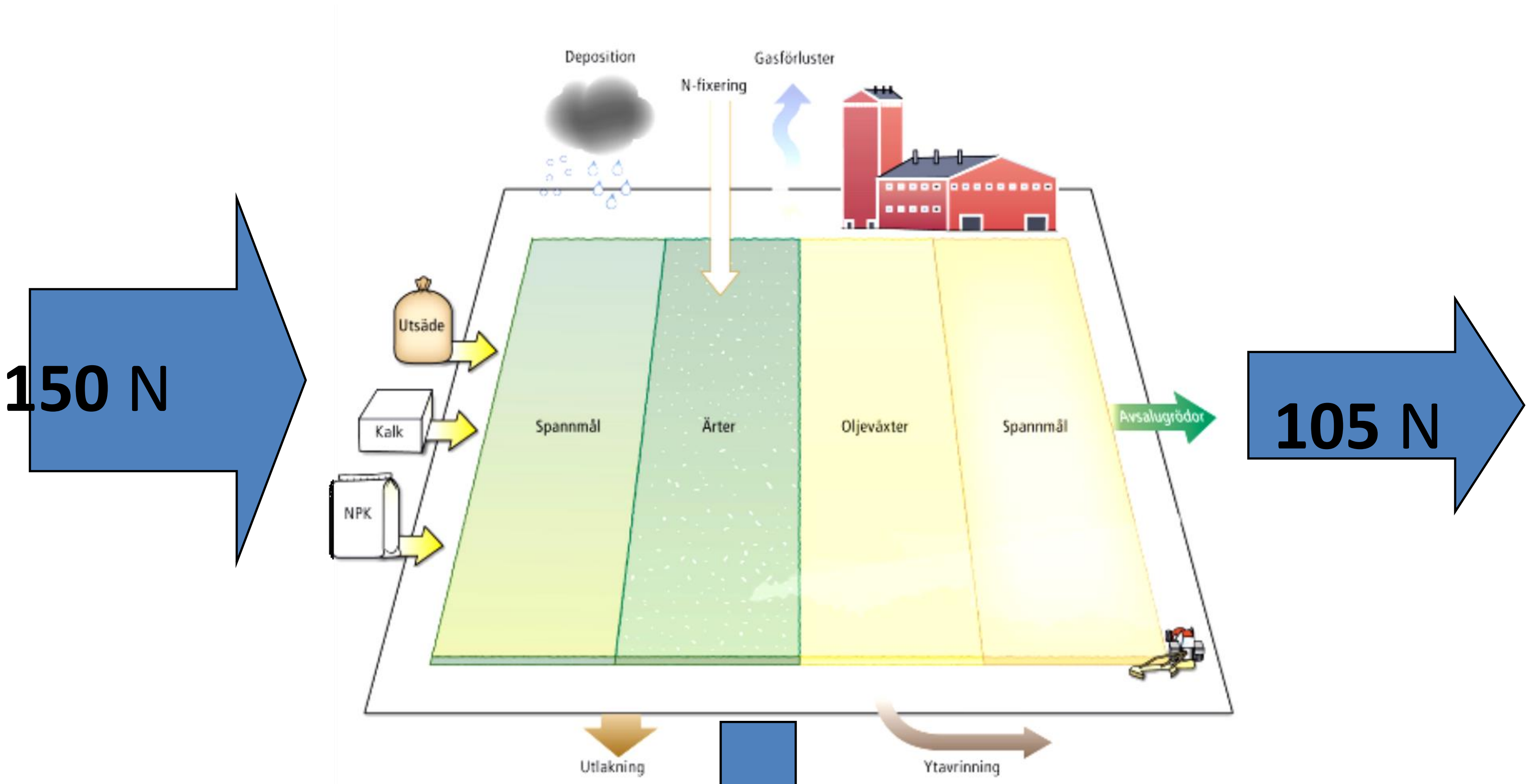
2 Excess nutrients from farm fertilizers and burning fossil fuels – primarily nitrogen and phosphorus – cause a rapid growth of algae in coastal waters

3 When the microscopic algae dies it falls to the ocean floor where it provides a rich food source for bacteria

Specialized crop farm

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

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



Specialized animal farm

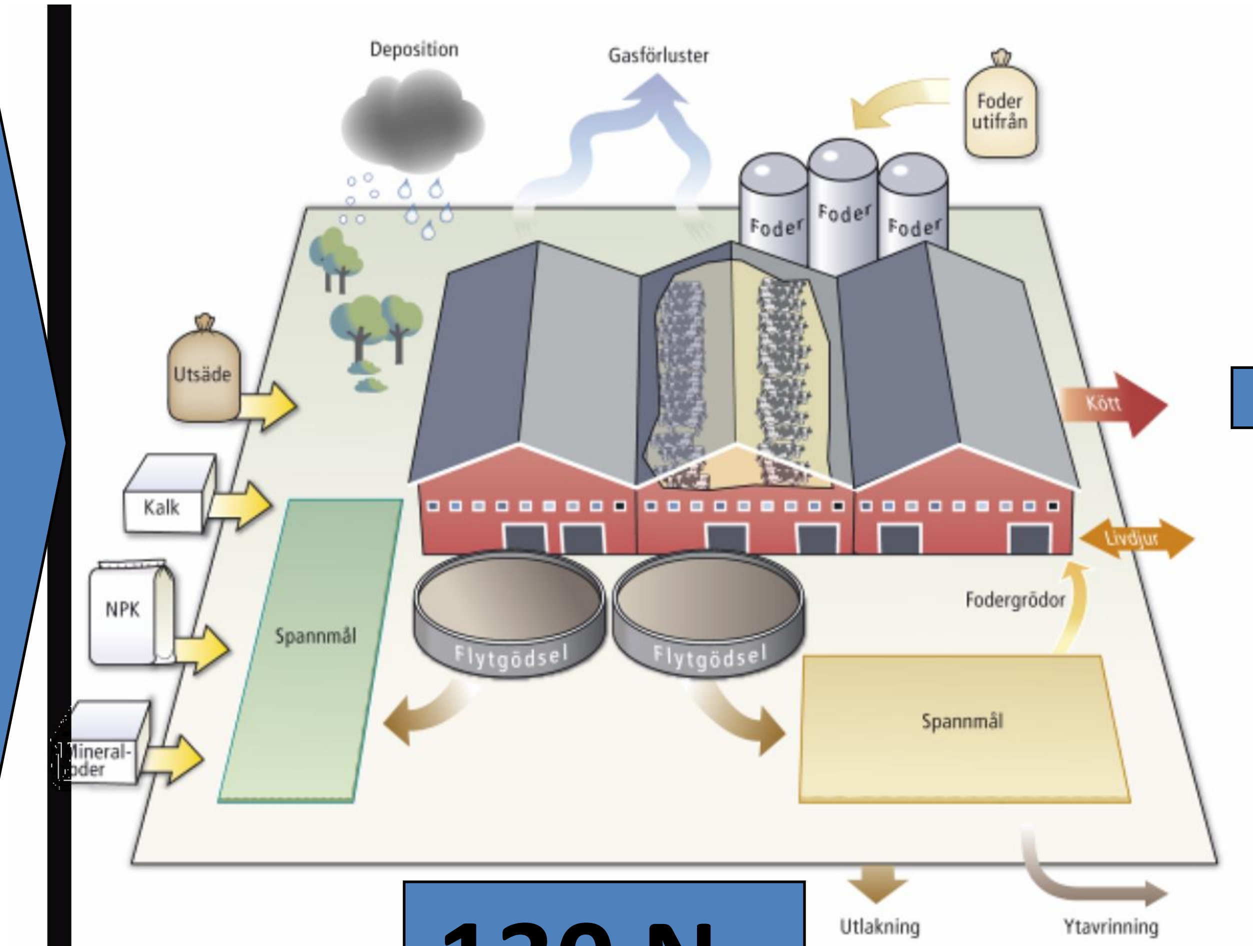
Input, output and surplus of Nitrogen kg/ha and year

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

200 N

Fodder +

Fertilizers



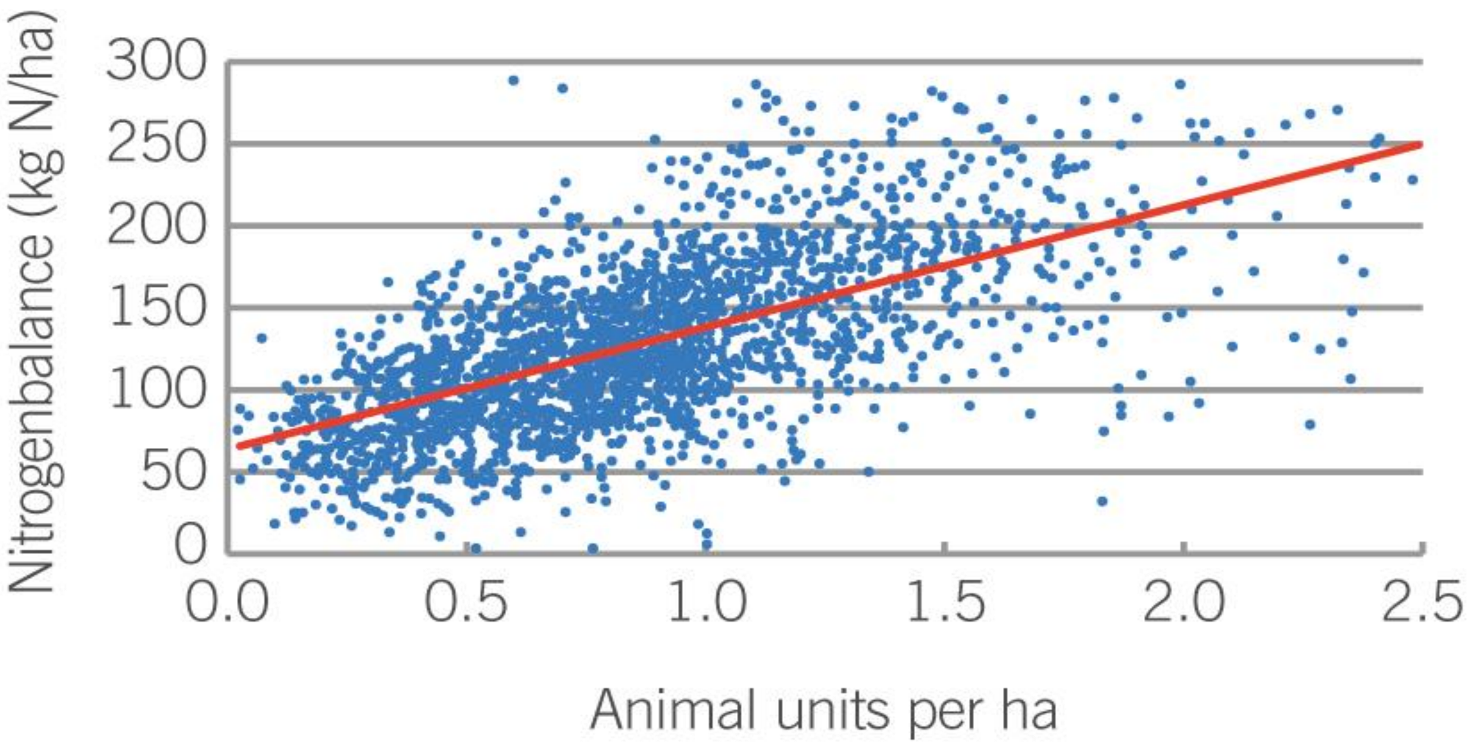
70 N

(Milk and meat)

130 N

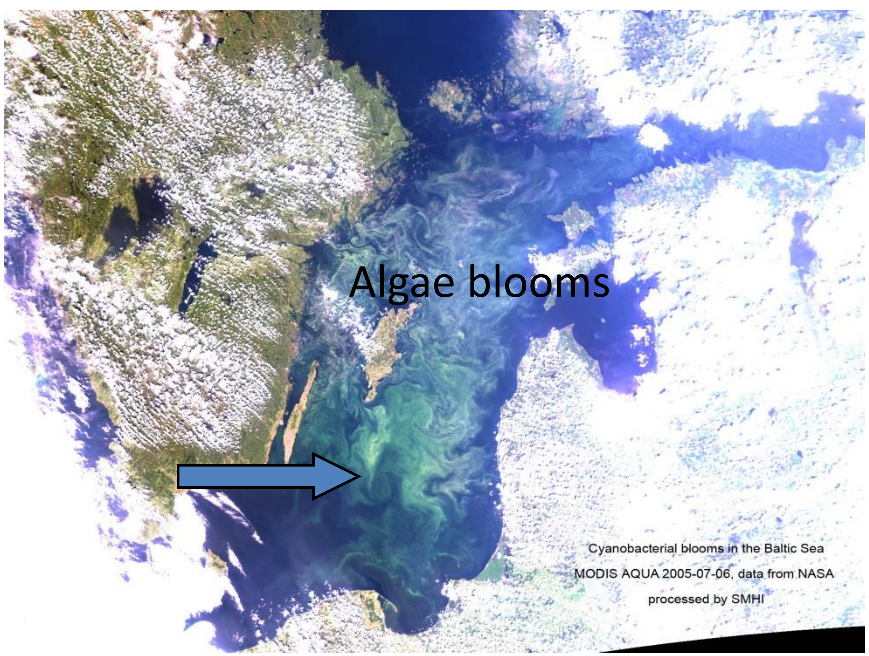
4 P

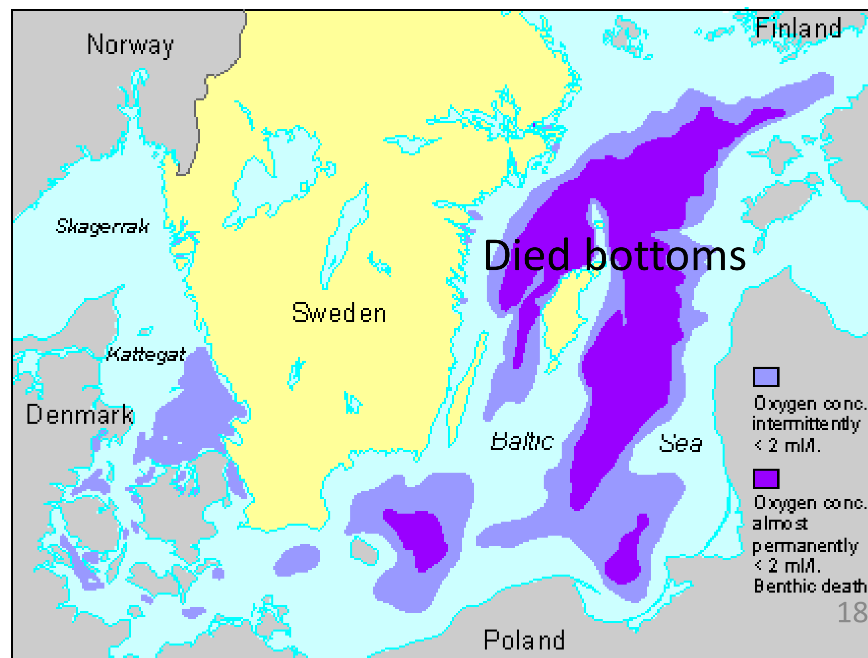
Nitrogen surplus as a function of the animal density

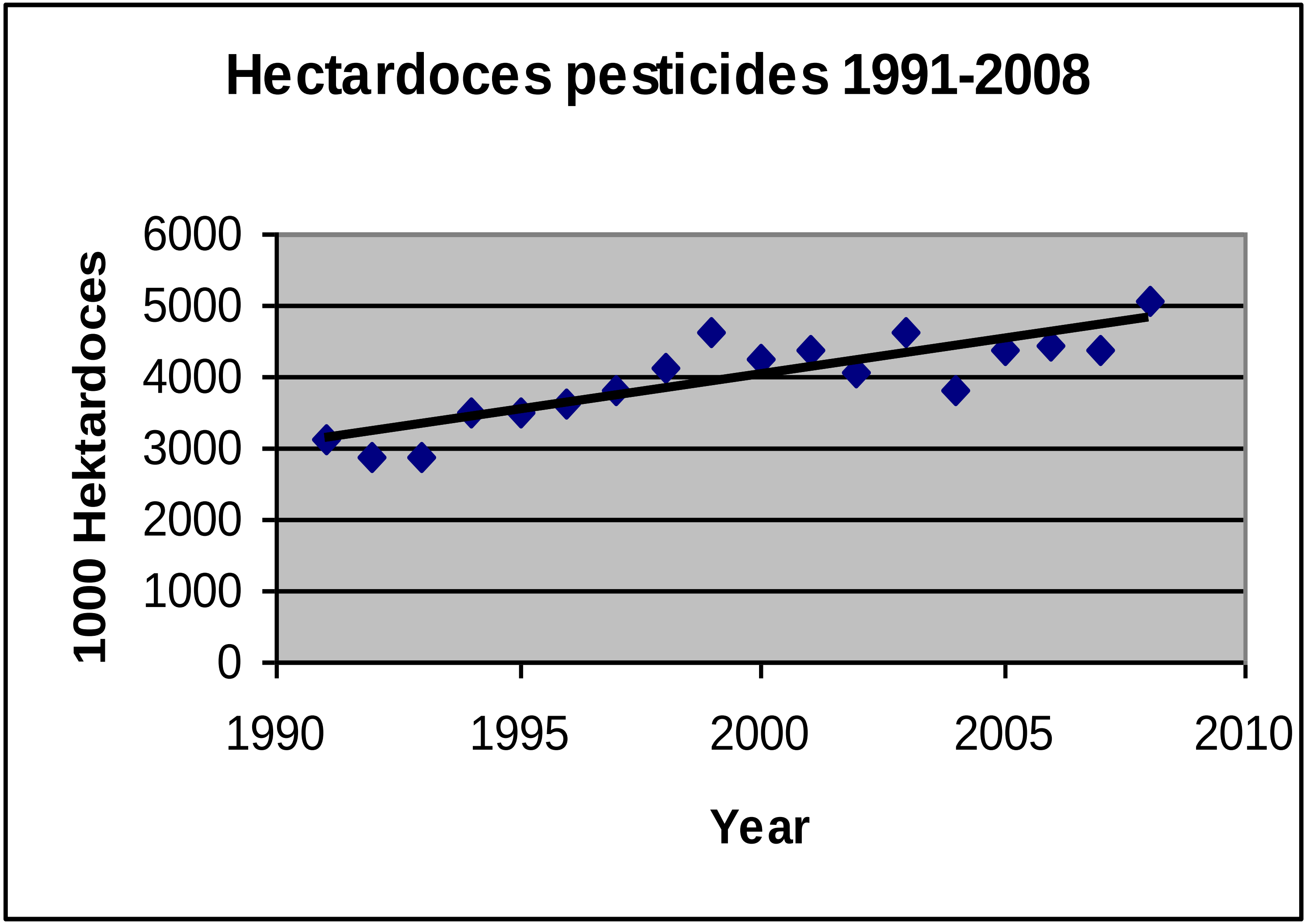


701 dairy farms, Swedish border of agriculture report 2008:25

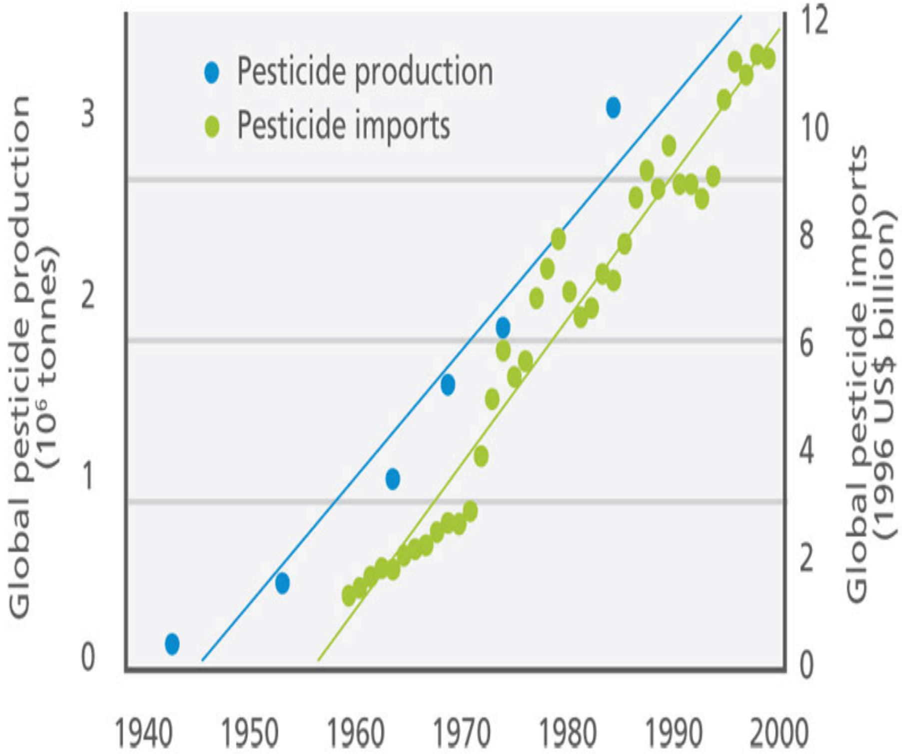
Linear flow of nutrients





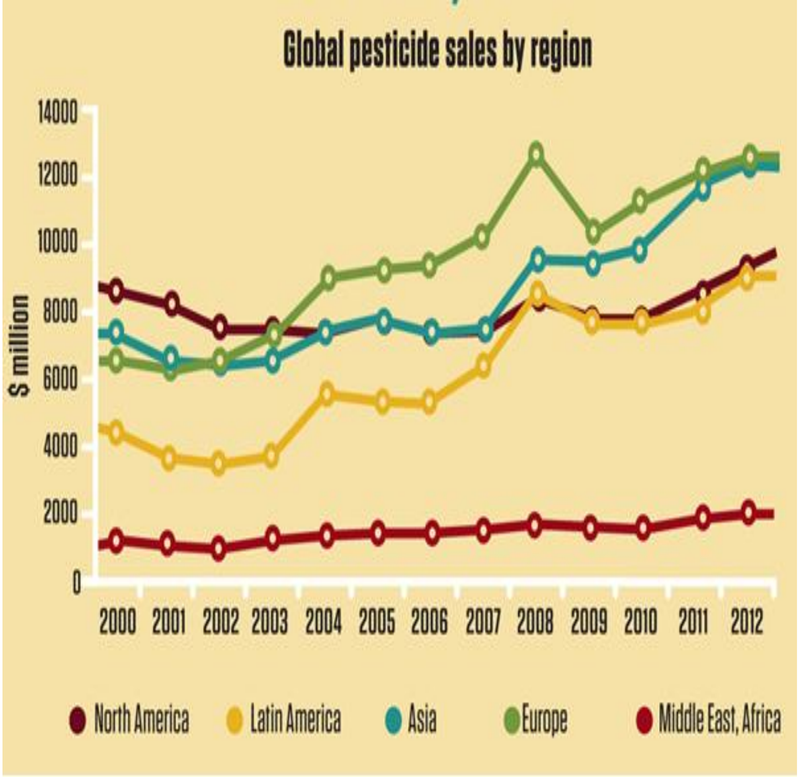


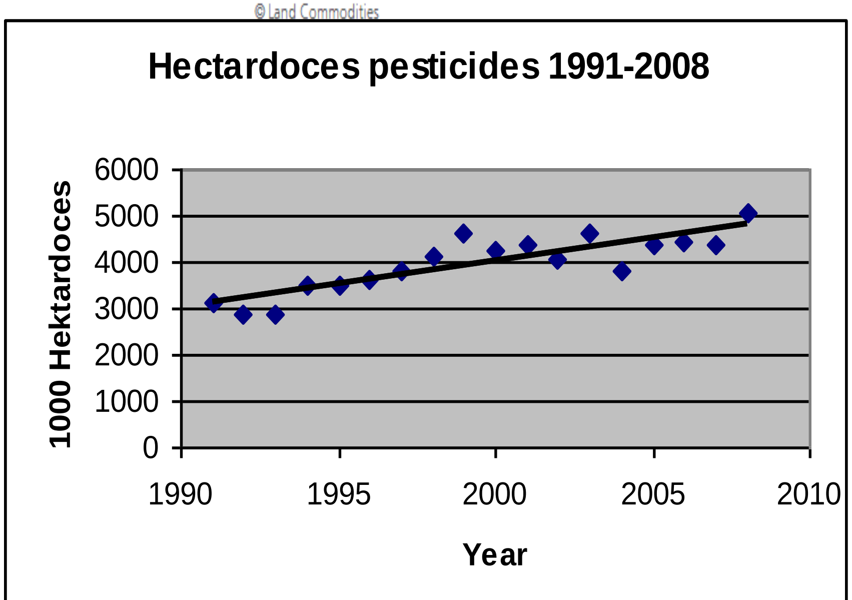
Pesticide usage has increased with more than 60% since 1990. Source: Jordbrukstatististisk årsbok, 2010. SCB. Sveriges officiella Statistik.



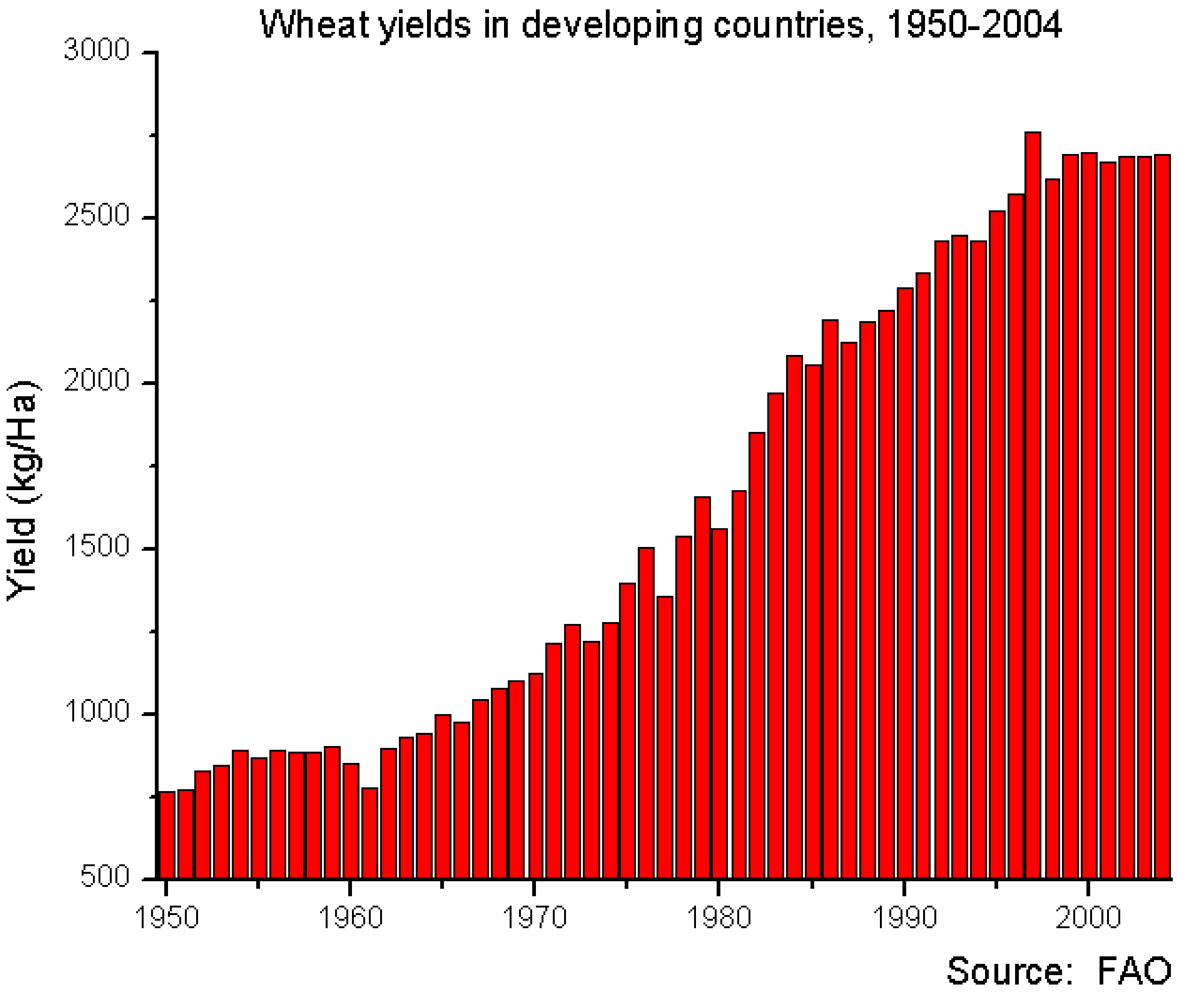
Source: Land Commodities Research

© Land Commodities



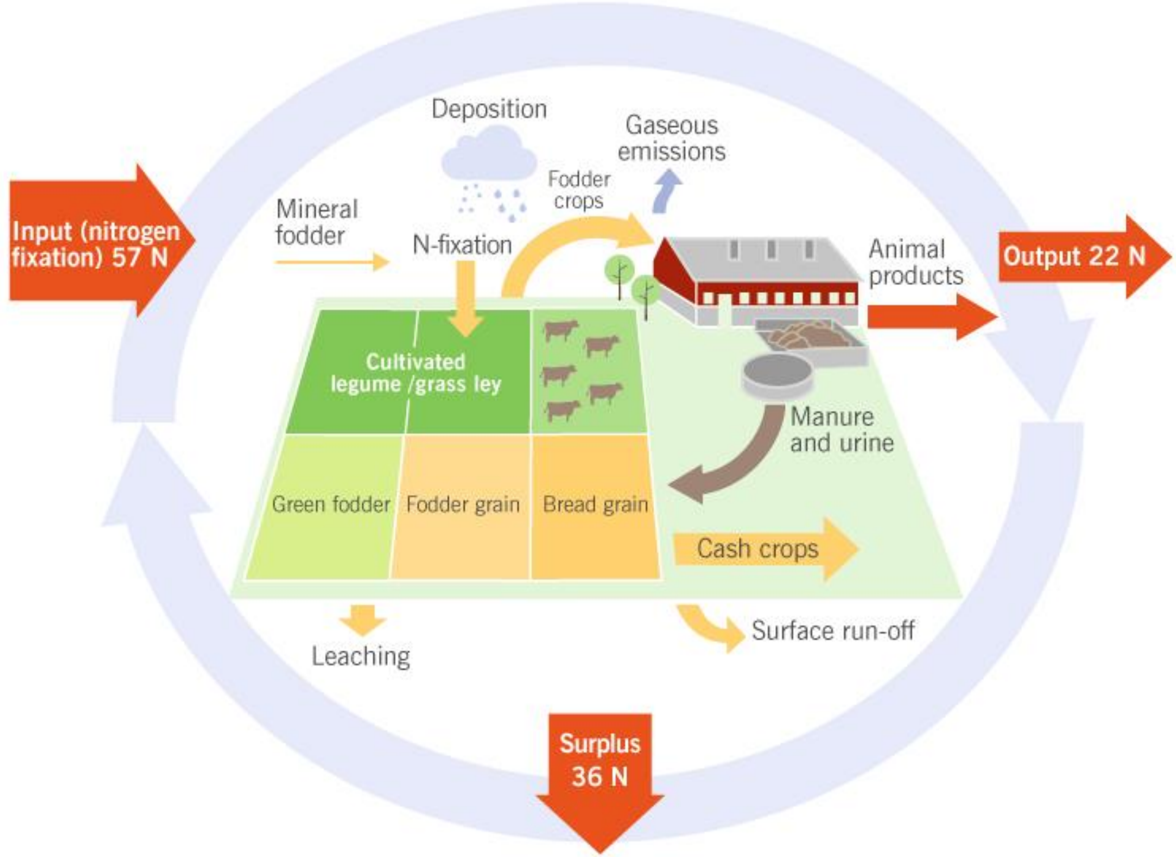


Despite increased use of pesticides, artificial fertilizers and GMO no more increased yields



Ecological Recycling Agriculture (ERA)

57



22

Losses

36

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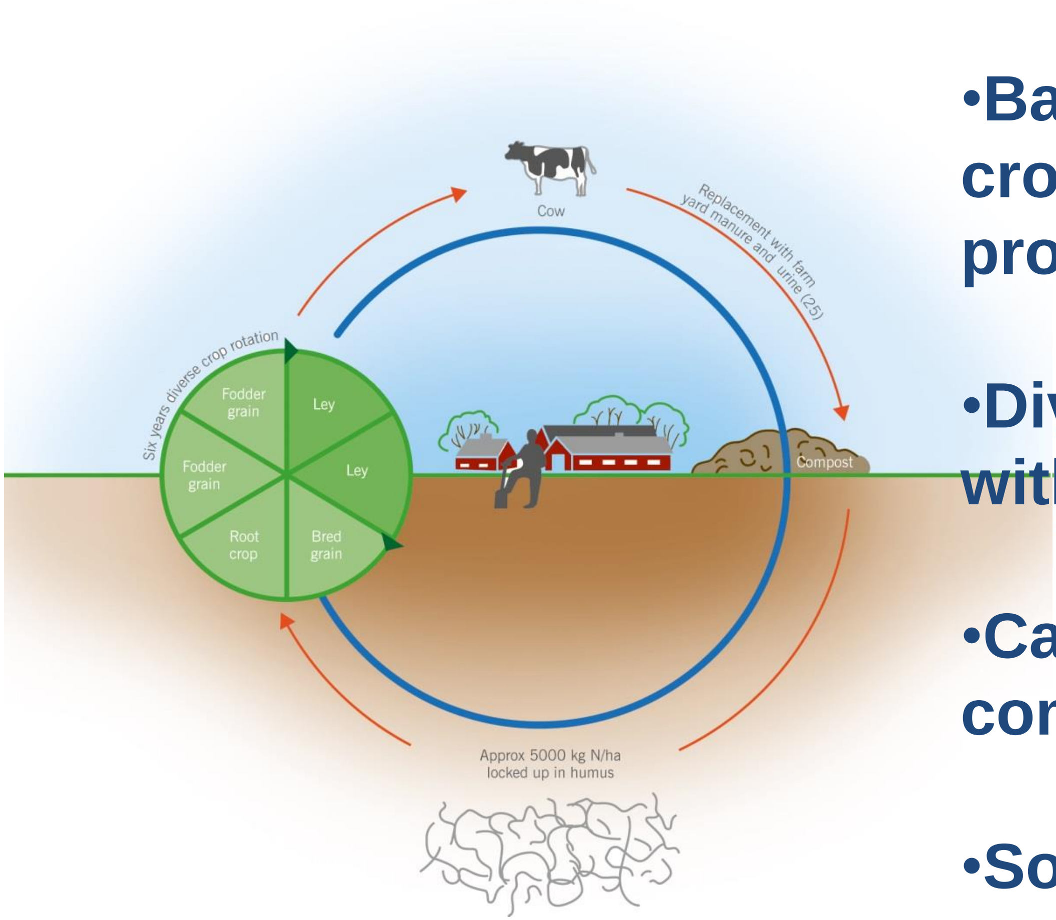
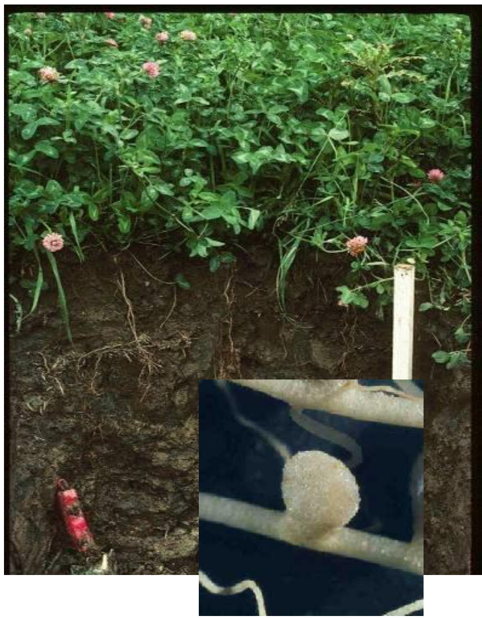
Ecological Recycling Agriculture



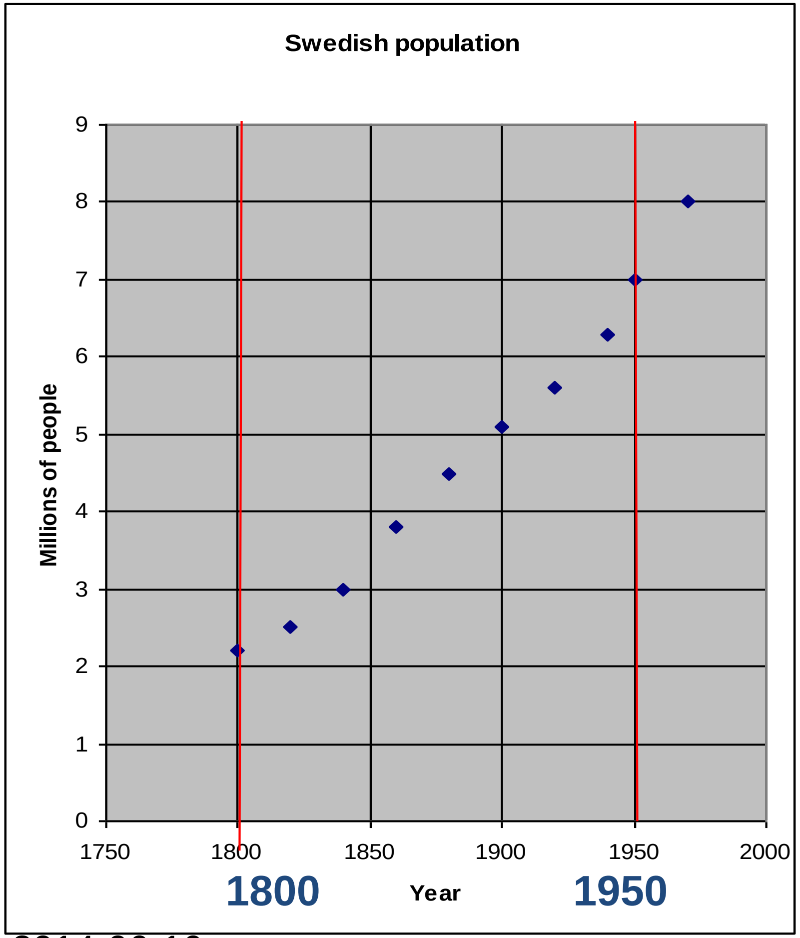
- •Balanced integration of crop and animal production
- •Diverse crop rotation with >30 % N-fix legumes
- •Carful manure composting management
- •Soil fertility management

Balance between

- ley with Leguminous species and consuming plants
- between fodder production and the animal production



Lack of food – in the end of 18th centaury



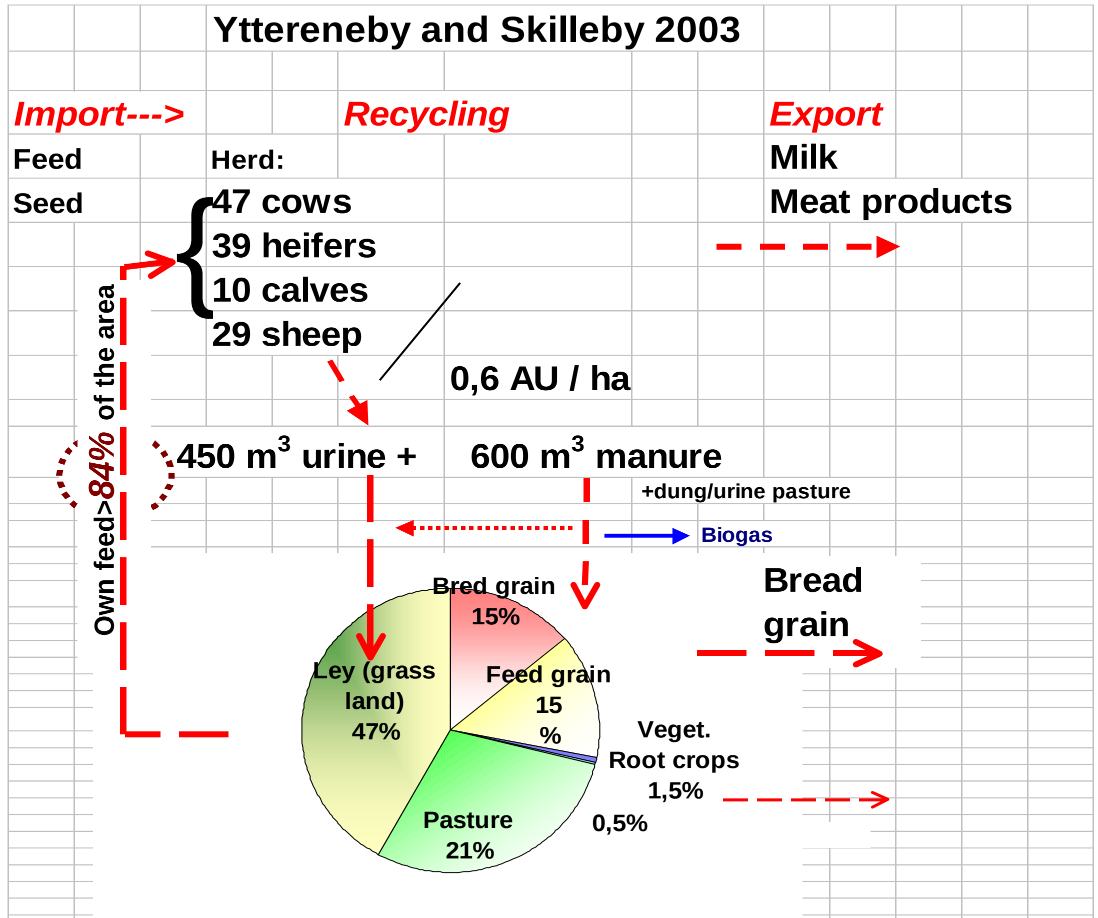
The inhabitants in Sweden increased from **2 millions to 7 millions** between 1800 to 1950 before the introduction of artificial fertilizers and pesticides. How was this increased demand for food met?

Answer is Ecological Recycling Agriculture before the introduction of artificial fertilizers, specialization and pesticides..

Example of Ecological Recycling Agriculture / ERA

The prototype farm Yttereneby – Skilleby in Järna)

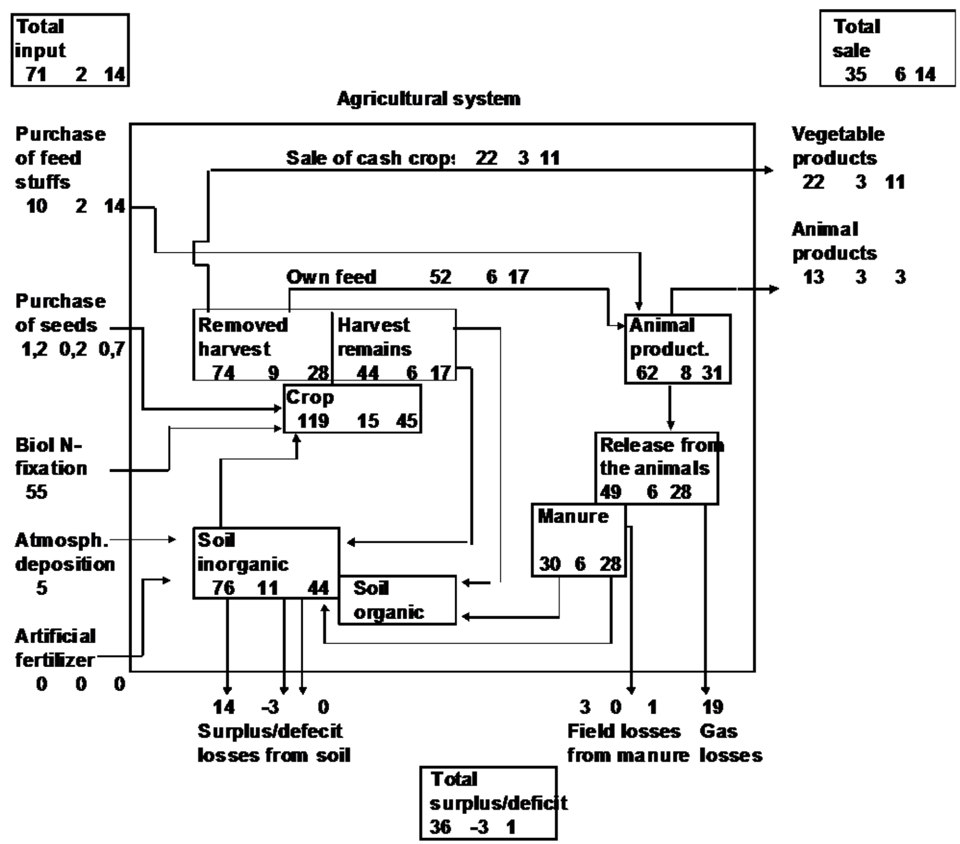
- The animal density is adjusted to the farm's feed production capacity. In this case fodder crops on 84 % and crops for sale on 16 % of the farm area and with a animal density of 0,6 AU/ha



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		

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

Areal 96 ha. Farmer: Alfons Weisler-Trapp



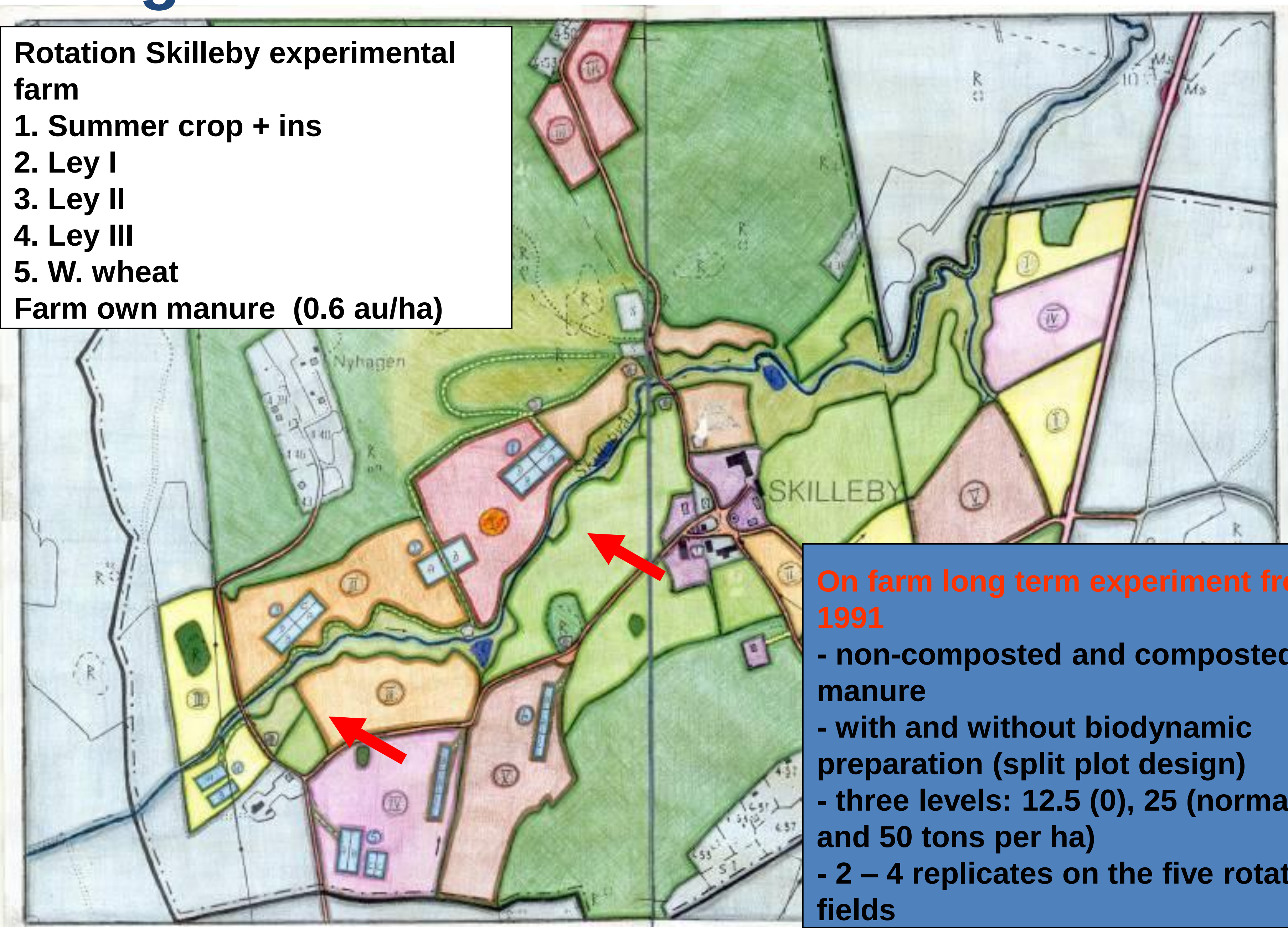
Calculation factors	N	P	K
Store losses from manure	0,40		
Field losses from manure	0,1	0,05	0,1
Fodder/animal production	4,6	3,0	10
Harvest remain	0,6	0,6	0,6

areal ha 96 96 96

Given data	N	P	K
Purchace to anim. prod	10	2,1	14
Purch. seeds	1,2	0,2	0,7
Biol. N-fix	55		
Atmosph. dep.	4,9		
Artificial fertilizer	0		
Crop export	22	3	11
Export of animal prod.	13	2,7	3

Long term on farm research

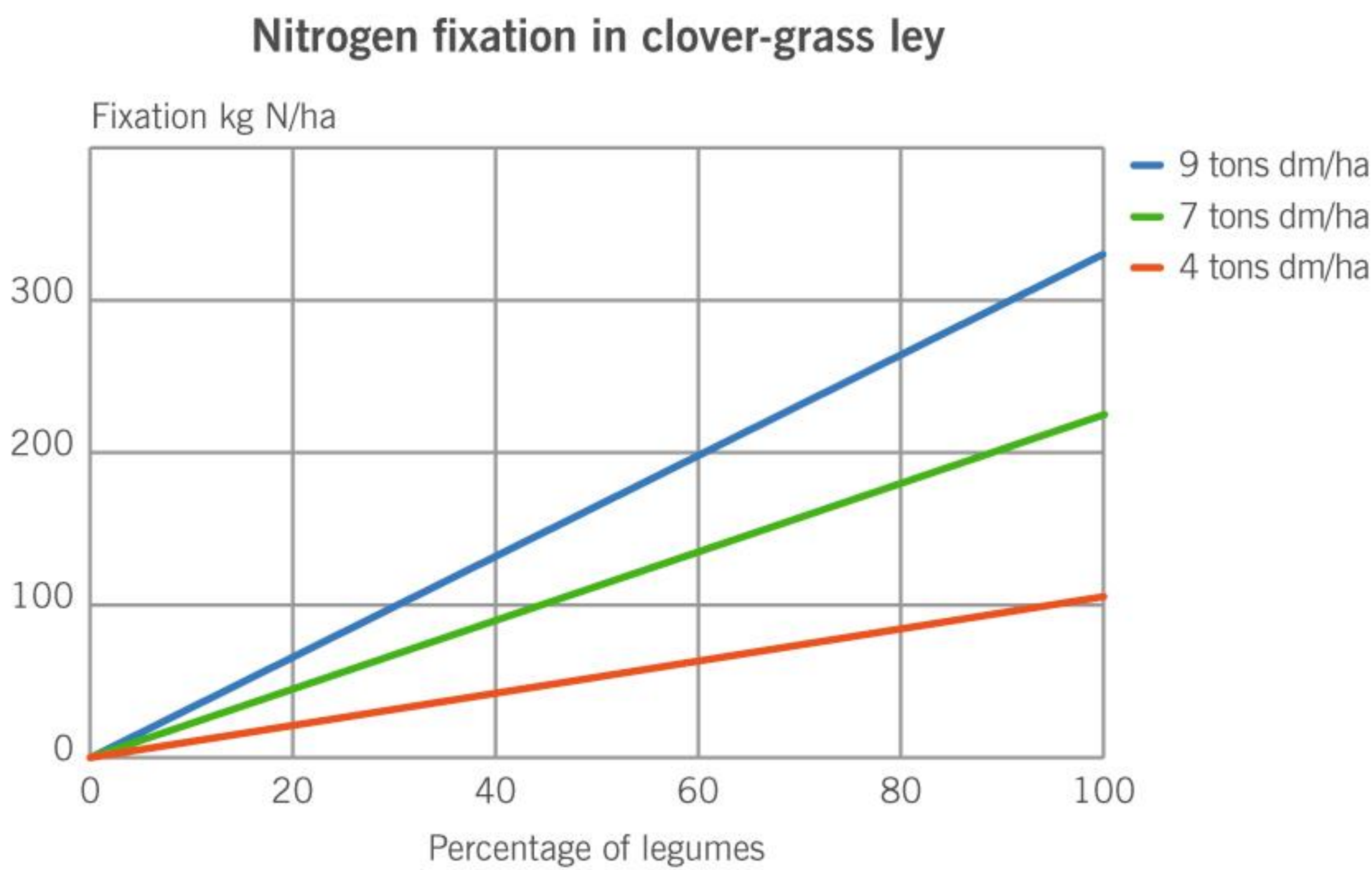
Rotation Skilleby experimental farm
1. Summer crop + ins
2. Ley I
3. Ley II
4. Ley III
5. W. wheat
Farm own manure (0.6 au/ha)



On farm long term experiment from 1991

- **non-composted and composted manure**
- **with and without biodynamic preparation (split plot design)**
- **three levels: 12.5 (0), 25 (normal) and 50 tons per ha)**
- **2 – 4 replicates on the five rotation fields**

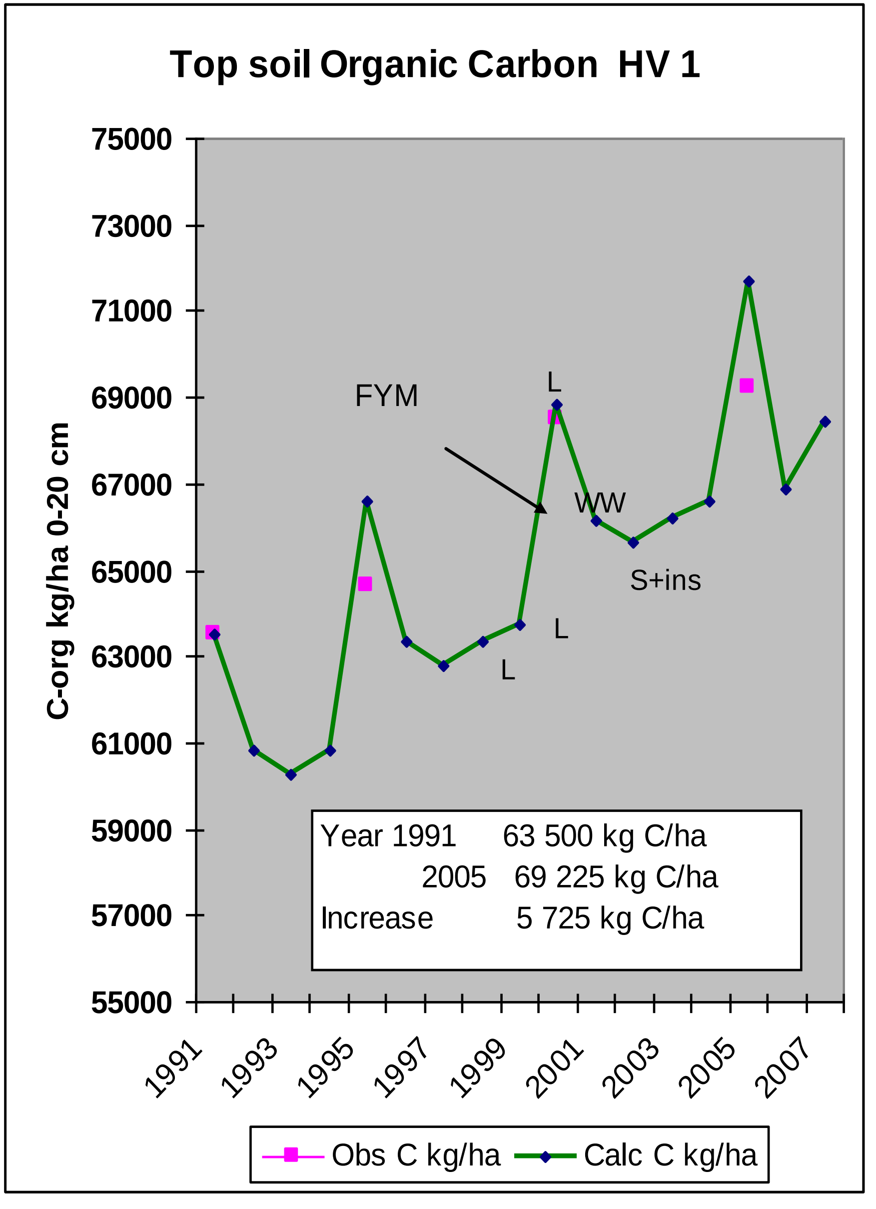
Soil building and nitrogen supply through biological N-fixation legume crops in rotation

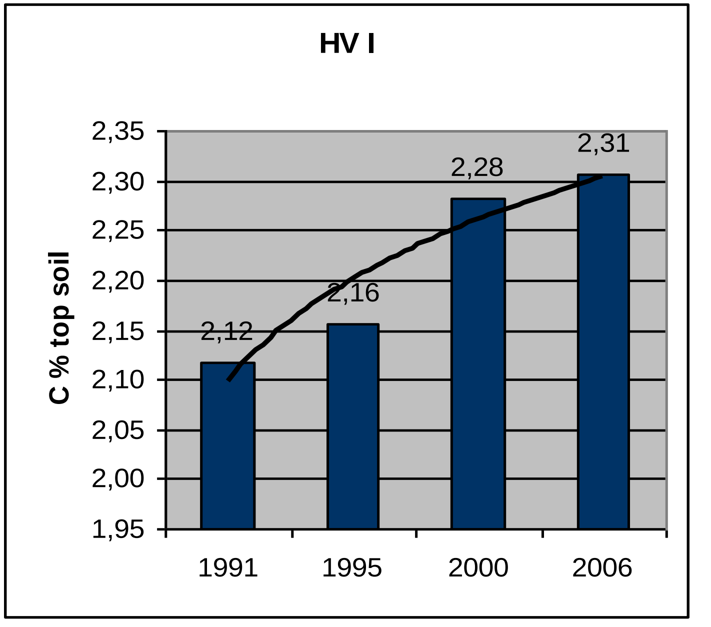

Nitrogen fixation in clover-grass ley
Fixation kg N/ha
300
200
100
0
0
20
40
60
80
100
Percentage of legumes
9 tons dm/ha
7 tons dm/ha
4 tons dm/ha

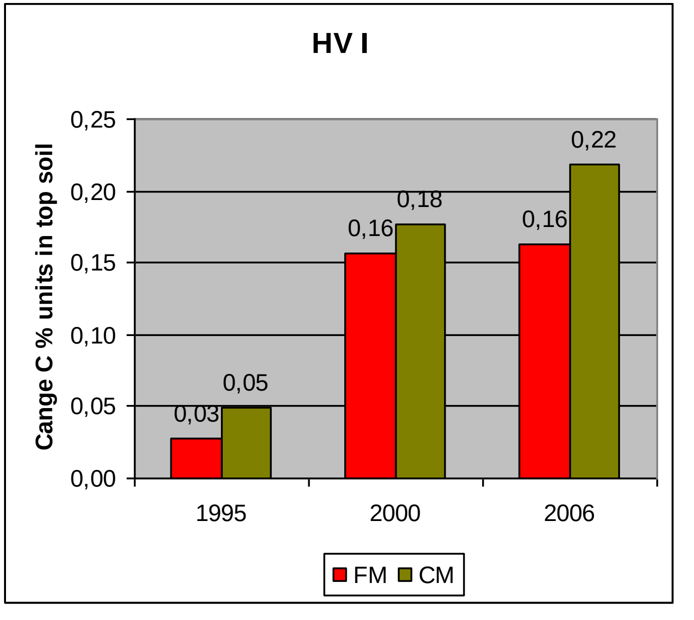
Recycling long term manure experiment learn

Experimental plan from 1991

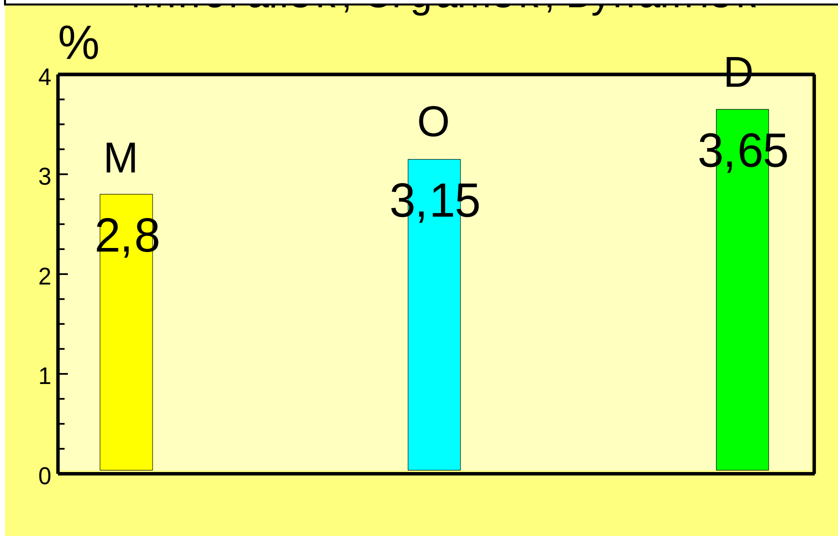
Main plot	Treatments winter wheat
F1	Not composted manure 12.5 ton (0 from 1995)
F2	25 ton
F3	50 ton
K1	Composted manure 12.5 ton (0 from 1995)
K2	25 ton
K3	50 ton
Subplot (split plot) +	BD preparation each plot each year
-	Without BD preparation


Top soil Organic Carbon HV 1
C-org kg/ha 0-20 cm
75000
73000
71000
69000
67000
65000
63000
61000
59000
57000
55000
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
1991
1993
1995
1997
1999
2001
2003
2005
2007
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

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



K

D

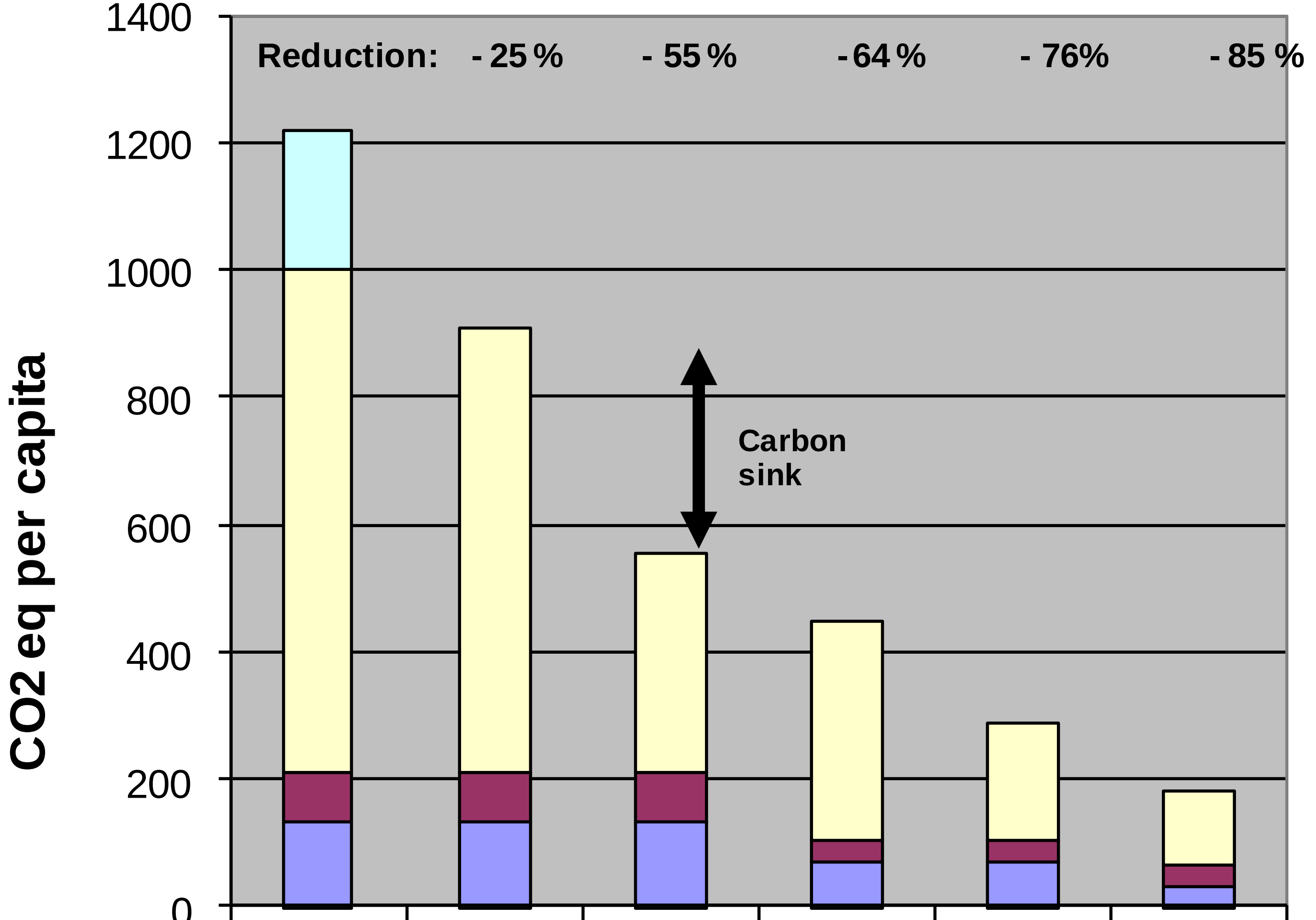
DOK-experiment

[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).

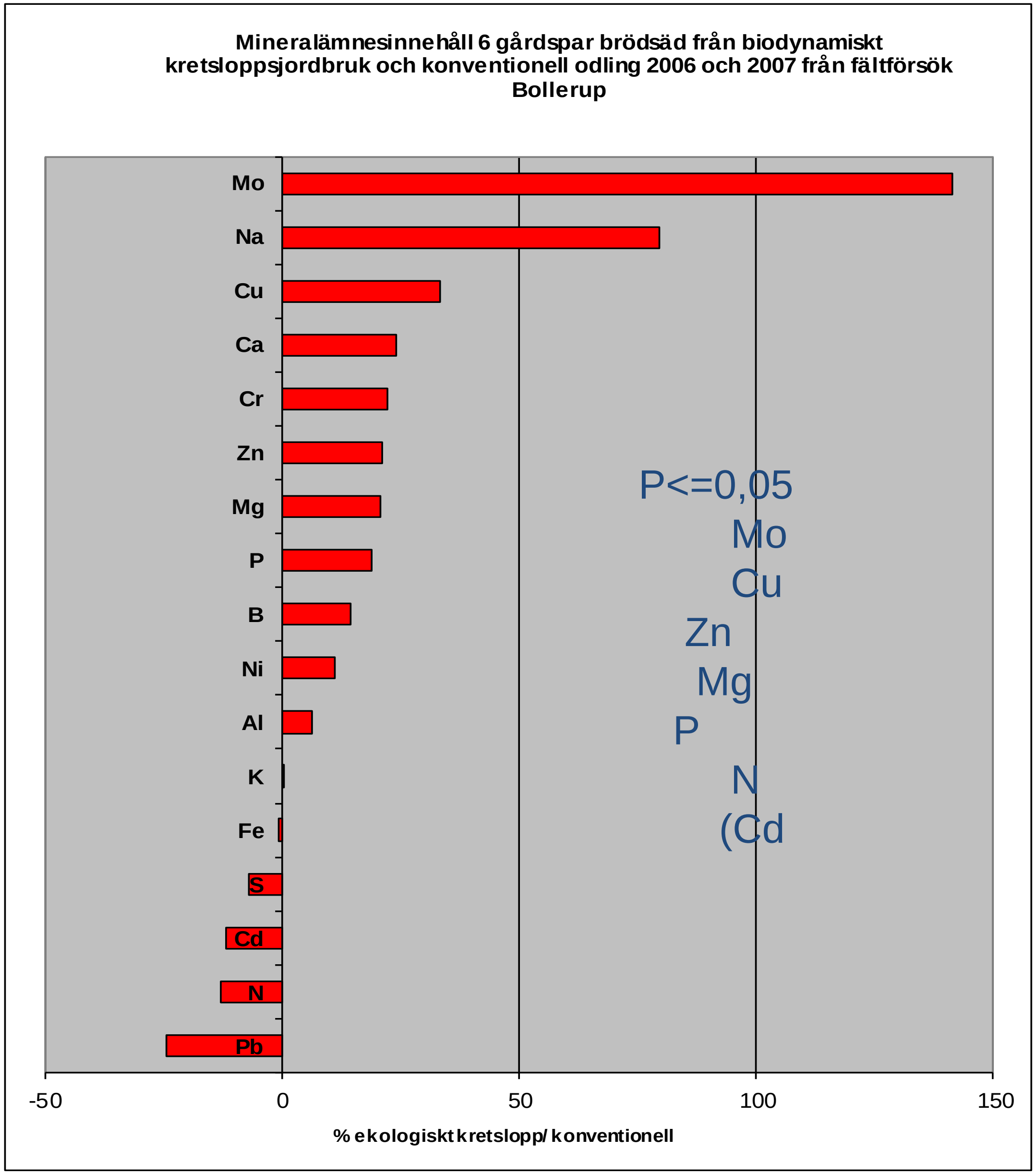
Mäder, P., Fliessbach, A.,Dubois D., Gunst L., Fried P. & Niggli, U. 2002. Soil Fertility and Biodiversity in Organic Farming. Science VOL 296 pp 1592-1597.

Basic food CO_2 eq



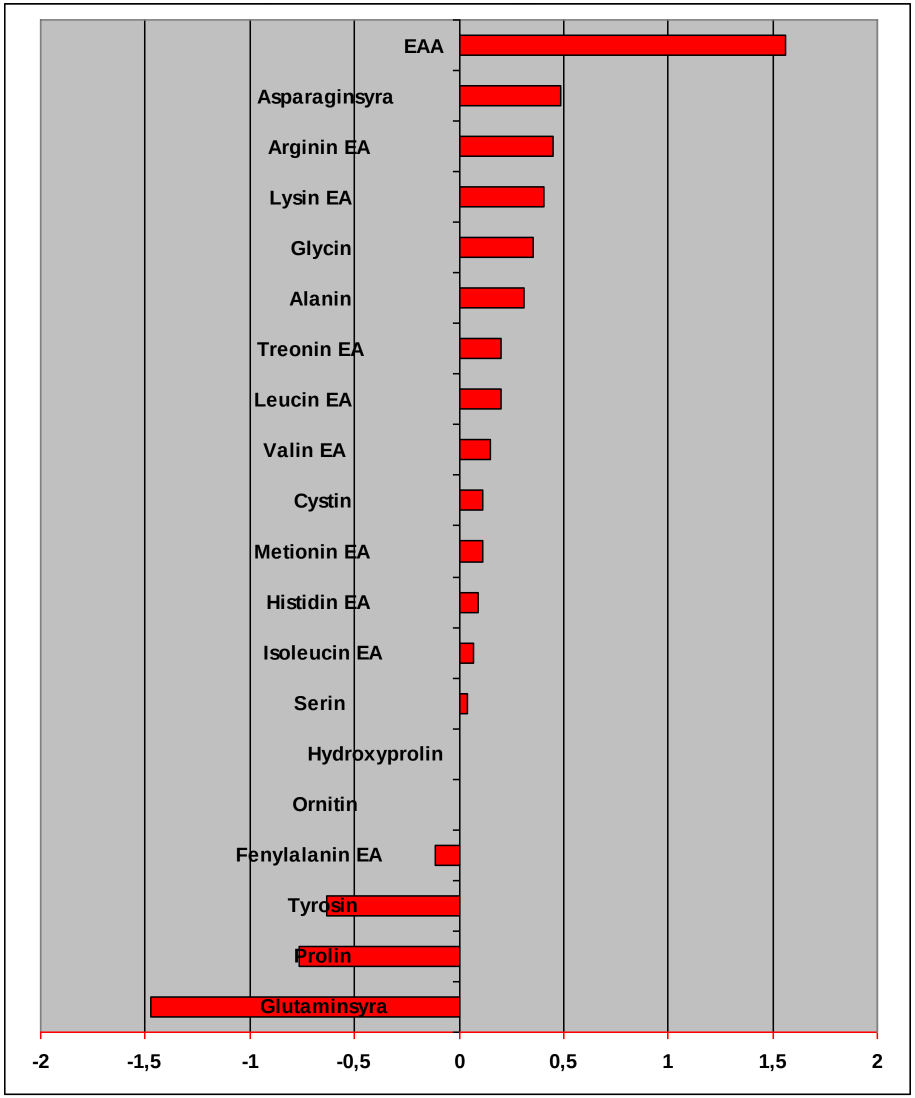
	CONV	ERA	ERA.SOM	ERA.SOM.LOC	ERA.SOM.LOC	ERA.SOM.LOC.BG.VEG
Land-use change	220					
Agriculture	790	699	344	344	188	120
Processing	80	80	80	35	35	30
Transports	130	130	130	66	66	31

The ratio of the mineral content - biodynamical grown bread grain/conventionally grown bread grain. From a long term field experiment in Bollerup, Skåne Sweden 2006 and 2007



6/16/2014

Essential amino acids in BD-organic wheat compared to conventional wheat



Differens Biodynamisk - Konventionell

AC

Conclusions:

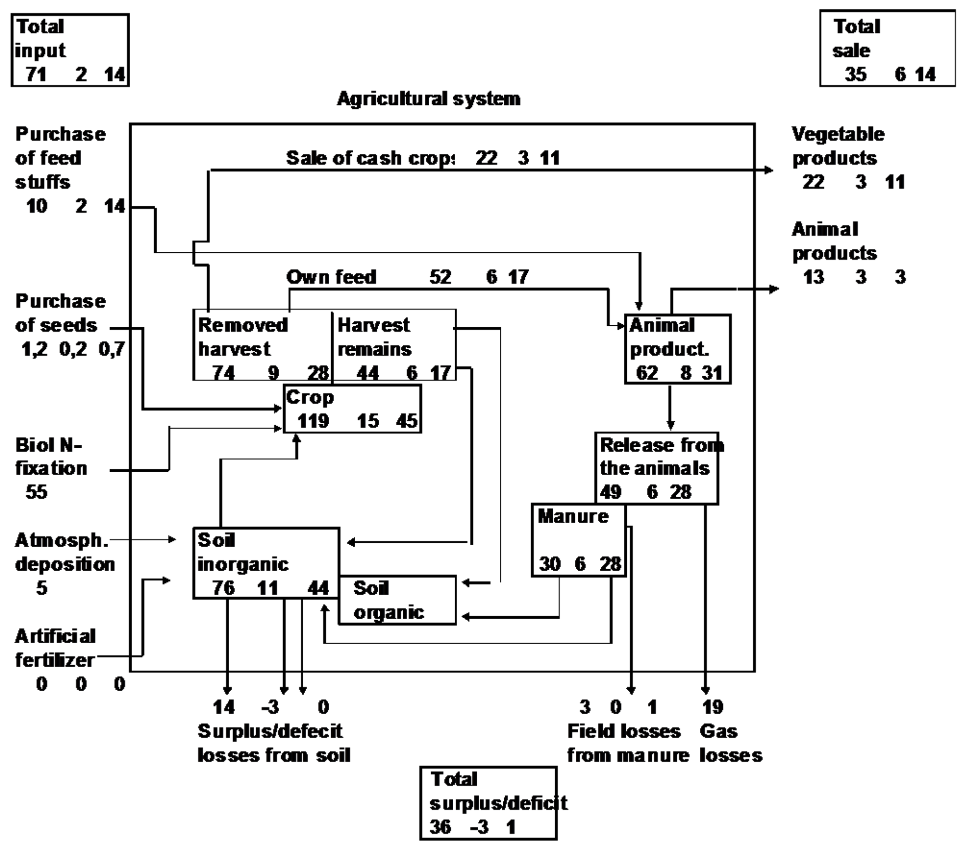
A shift to basic principles of ecological recycling agriculture based on integrated crop and animal production with effective recycling of nutrients and organic biomass and crop rotations in balance with rebuilding nitrogen fixation legumes, grasslands and other crops has the possibility to :

1. stop the exploitation and degradation of the earth basic natural resources (above and under ground biomass and biological diversity)
2. rebuild fertile soils
3. stop hazard nutrient emissions to air and water
4. prevent negative human impacts on the climate from food production
5. give a nutritionally healthy food

For discussion - questions

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

Areal 96 ha. Farmer: Alfons Weisler-Trapp

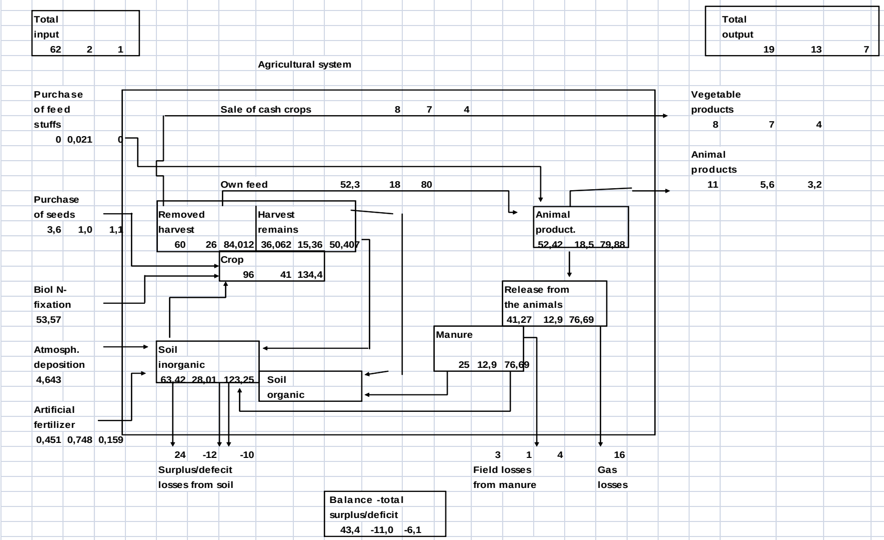


Calculation factors	N	P	K
Store losses from manure	0,40		
Field losses from manure	0,1	0,05	0,1
Fodder/animal production	4,6	3,0	10
Harvest remain	0,6	0,6	0,6

Given data	N	P	K	areal ha		
				96	96	96
Purchace to anim. prod	10	2,1	14			
Purch. seeds	1,2	0,2	0,7			
Biol. N-fix	55					
Atmosph. dep.	4,9					
Artificial fertilizer	0					
Crop export	22	3	11			
Export of animal prod.	13	2,7	3			

Flow of N/P/K kg ha^{-1}, year 2012

Balraj, Areal 2,8 ha.



Areal acre	7,0	7,0	7,00
Areal ha	**2,8**	**2,8**	**2,8**

Calculation factors	N	P	K
Store losses from manure	**0,40**		
Field losses from manure	**0,1**	**0,05**	**0,1**
Fodder/animal production	**4,7**	**3,3**	**25**
Harvest remain	**0,6**	**0,6**	**0,6**

Given data (per ha)	N	P	K
Purchace to anim. prod.	**0**	**0**	**0**
Purch. seeds	**3,6**	**1,0**	**1,1**
Biol. N-fix	**53,6**		
Atmosph. dep.	**4,6**		
Byed Org. Fertilizer	**0,45**	**0,75**	**0,16**
Input	***62,4***	***1,7***	***1,4***
Crop export	**7,8**	**7,1**	**4,2**
Export of animal prod.	**11,2**	**5,6**	**3,2**
Output	***19,0***	***12,7***	***7,4***
Balance (Input-Output)	***43,4***	***-11,0***	***-6,1***

Balances[1)]	Balances N	Balances P	Balances K	Efficiency[1)] N	Efficiency P	Efficiency K
Farmgate balance	43	-11	-6	0,3	7,3	5,5
Field balance	27	-11	-6	0,7	1,8	1,1
Primery nytrient Balance	2,2	-23,9	-82,7	1,0	32,3	334,5
Circulation factor (C=(P+S)/P)				1,4	17,9	310,1
Field balance efficiency (F=Y/P+S)				0,7	1,8	1,1
C*F				1,0	32,3	334,5

Calculated data	N	P	K
Own feed	**52,3**	**18,5**	**79,8**
Harvest remains	**36,1**	**15,4**	**50,4**

P : Primery nutrient if importded from outside of farm to the crop production including the manure based on imported fodder

S: Secundare nutrient produced within the farm and put into the crop production

Y: Crop production to sell and for own fodder Y/P= 0,96

C= circulation factor (P+S)/P

F = field balance(efficiency) = Y/(P+S)

Y/P need to be identic with CxF

Fodder?
Groundnut Cake

Tot
Per ha

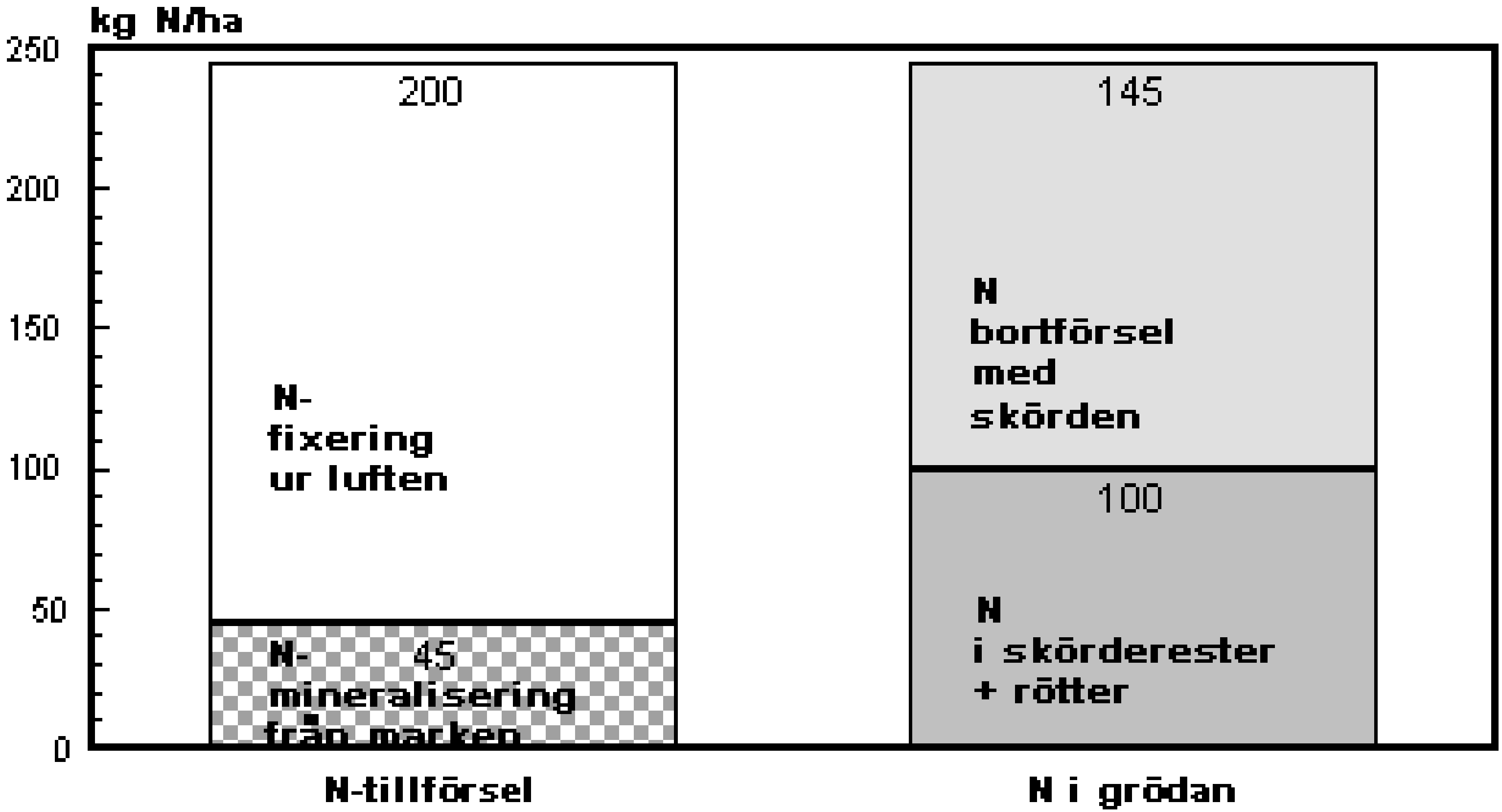
Seeds?
Black Gram
Groundnut Seed
Watermellon seed
Greenmanure seeds
Tot
Per ha

Biol N-fix? (estim fr by see
Per ha

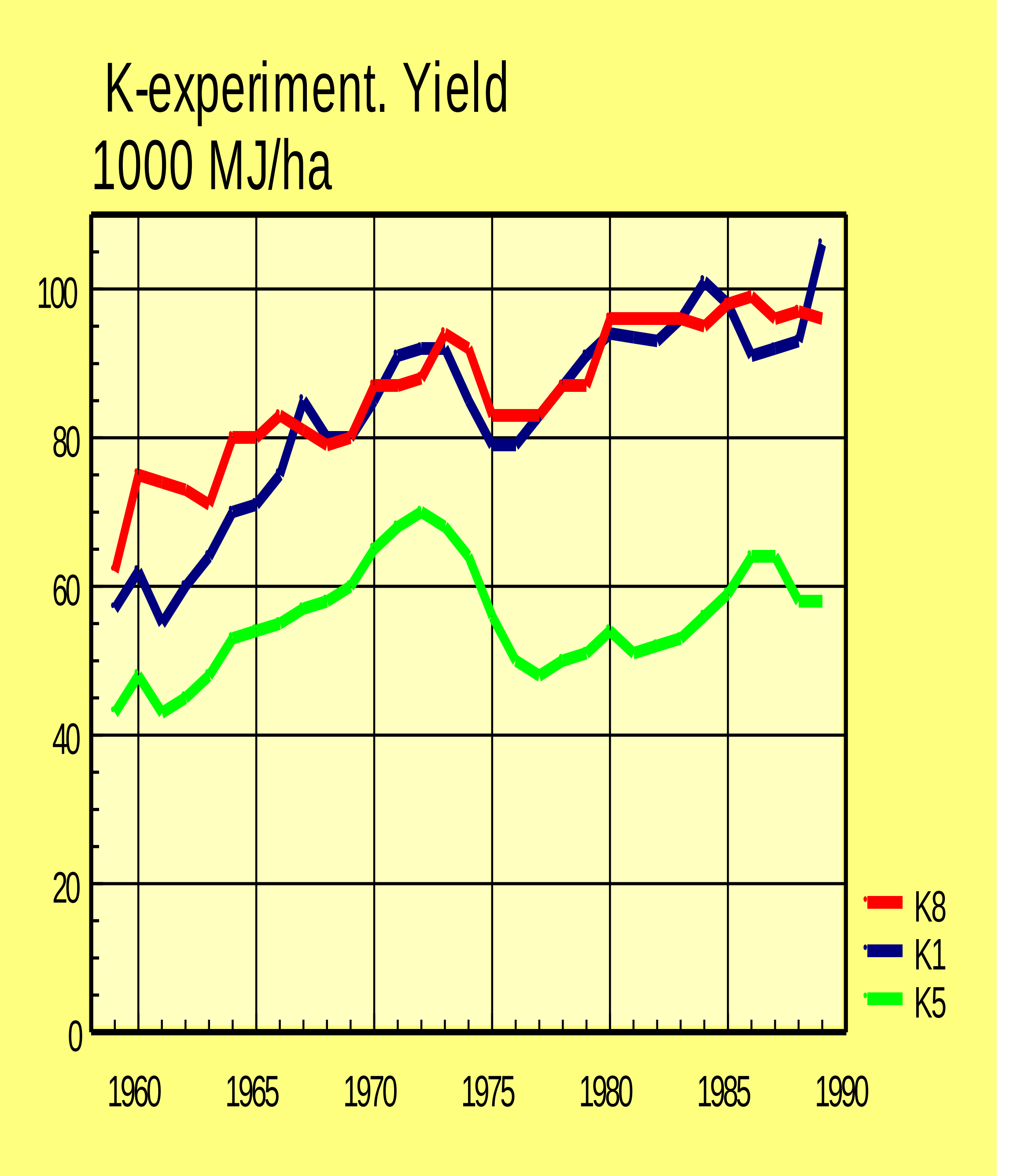
Atm deposition
Per ha

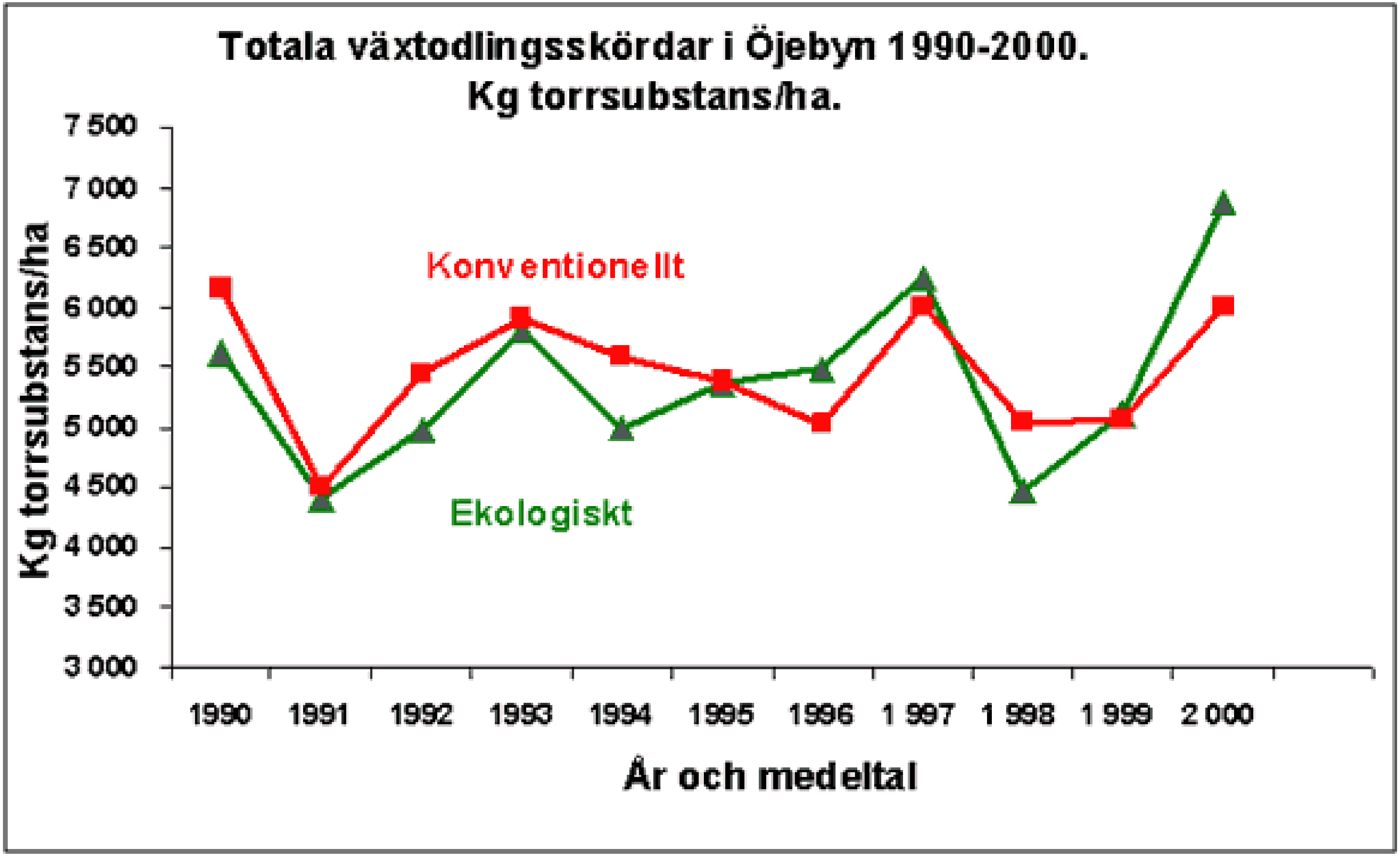
Org fertilizers?
Fishguts
Egg
Rockphosphate
Jaggery
Neemcake
Worms
Lemons
Tot
Per ha

Crop export (from the farm
Sugarcane
Chilli
Tomato
Beans
Ragi
Coconut
Groundnut
Tot
Per ha

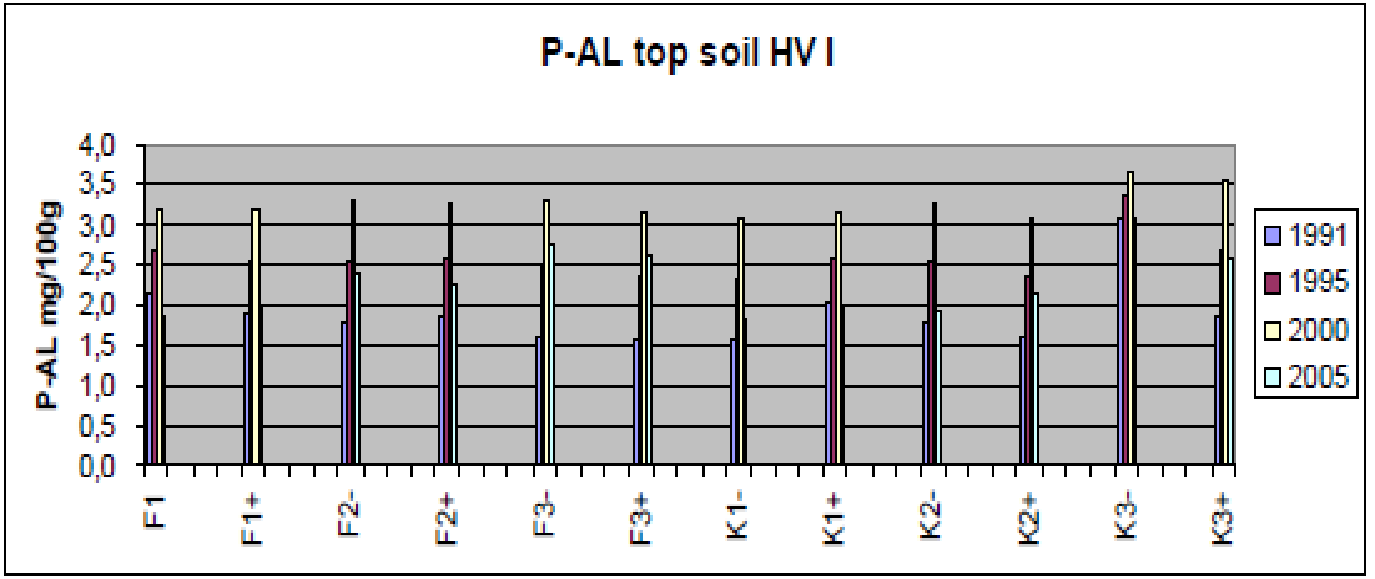


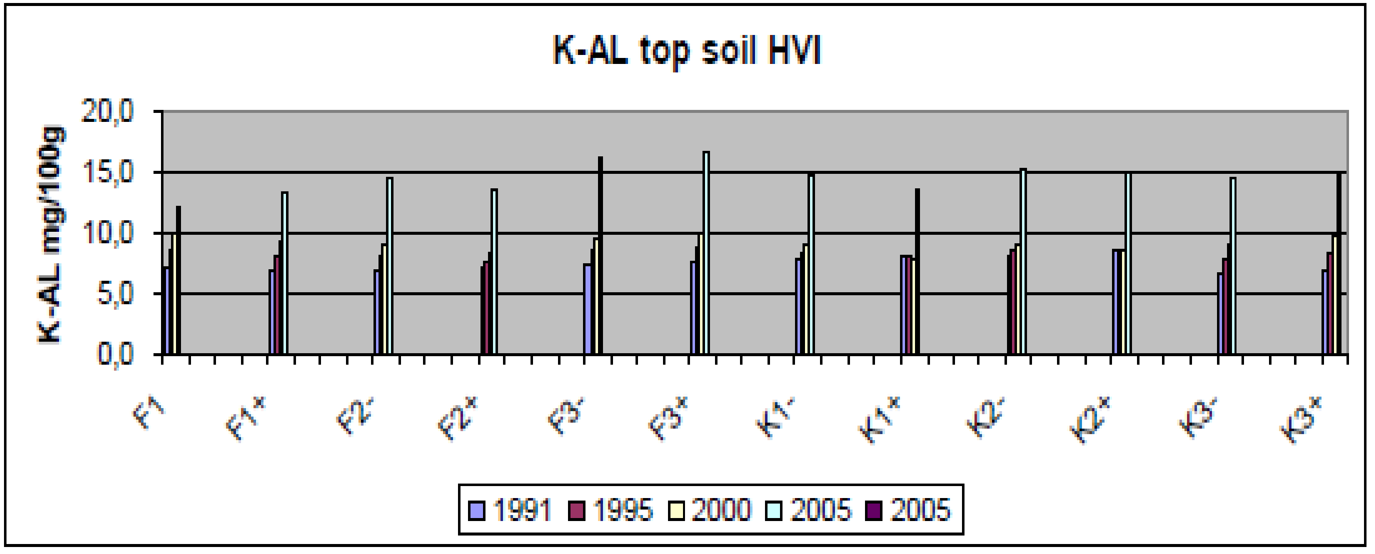
kg N/ha
250
200
150
100
50
0
200
N-
fixering
ur luften
N-
45
mineralisering
från marken
145
N
bortförsel
med
skörden
100
N
i skörderester
+ rötter
N-tillförsel
N i grödan


K-experiment. Yield
1000 MJ/ha
100
80
60
40
20
0
1960
1965
1970
1975
1980
1985
1990
K8
K1
K5

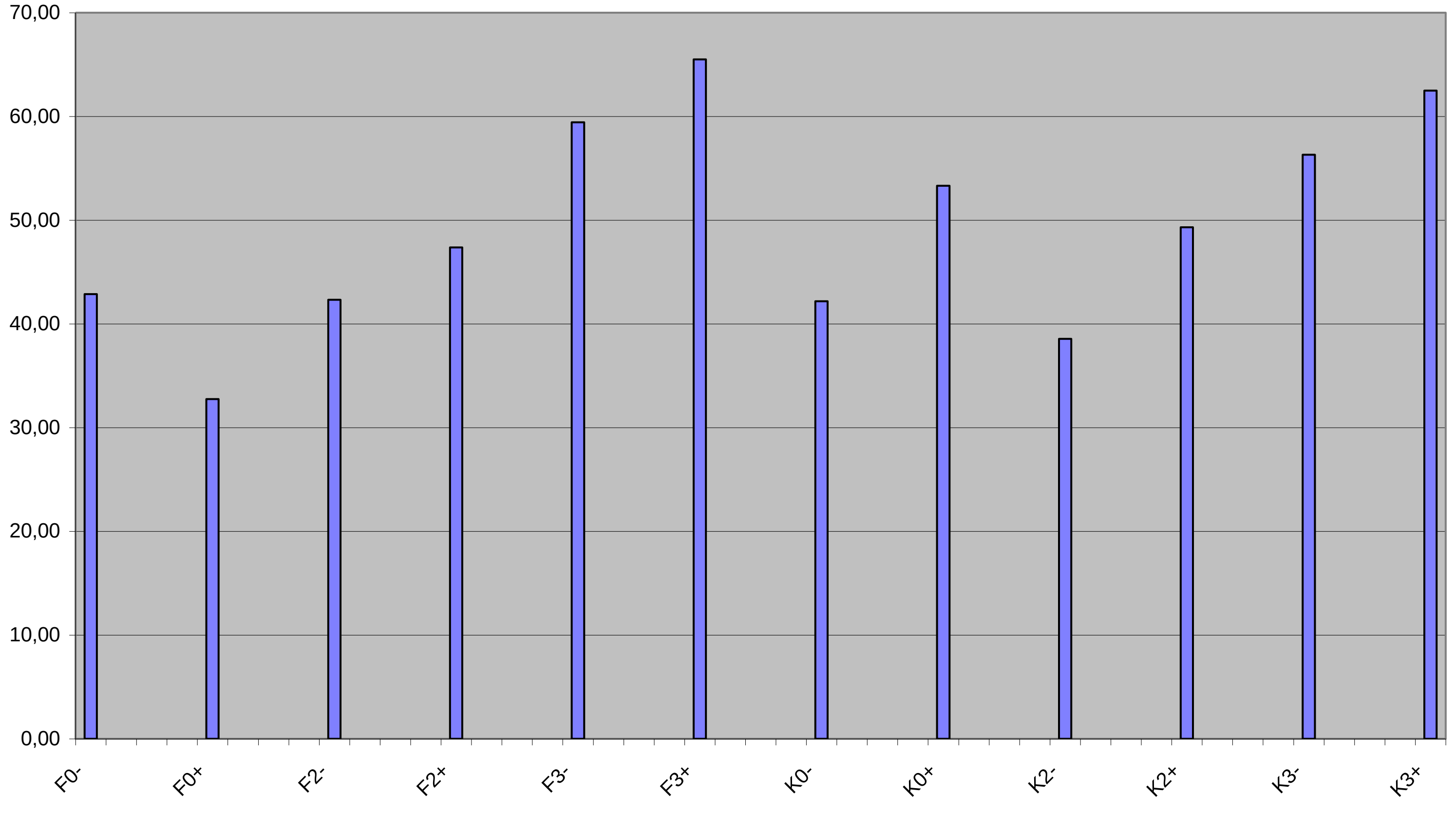

Totala växtodlingsskördar i Öjebyn 1990-2000.
Kg torrsubstans/ha.
7 500
7 000
6 500
6 000
5 500
5 000
4 500
4 000
3 500
3 000
Kg torrsubstans/ha
Konventionellt
Ekologiskt
1990
1991
1992
1993
1994
1995
1996
1 997
1 998
1 999
2 000
År och medeltal

Increase solouble P. K, Ca, Mg on all plots withaut external input



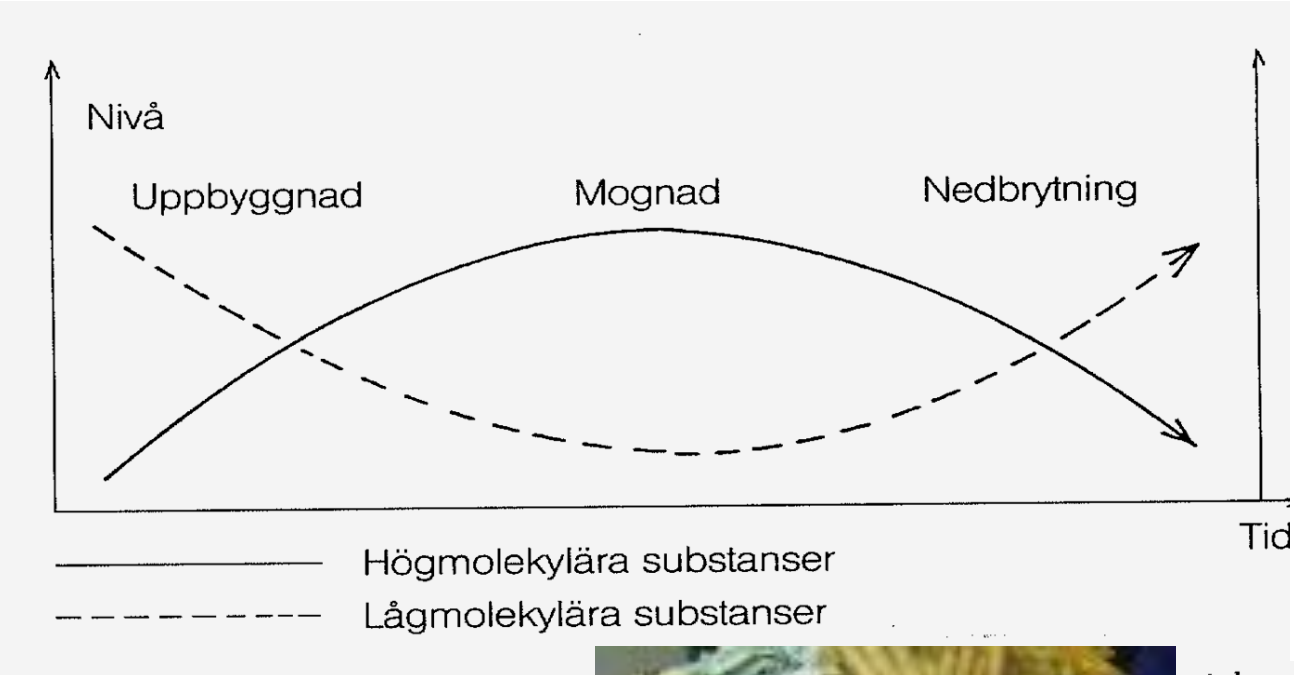


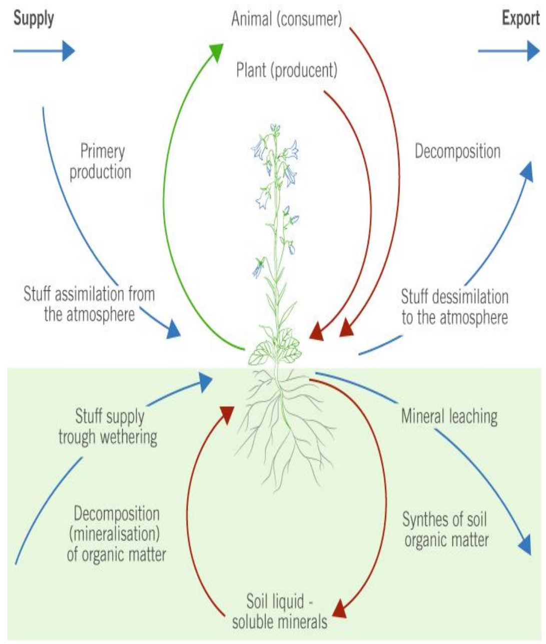
Worm locks Skilleby long term field experiment



Qualitity tests

Synthesis Ripeness Breaking down





Figur 2 a 2 b)

cupper chloride crystallization on a 9 cm plate during 12 hours (1,5 g $CuCl_2$) without plant extract (Selawry, 1957, Die Kupferchloridkristallisation), b) cupper chloride crystallized with extract from Veronica officinalis, letter (Granstedt, A. 1960, Natura).

Figur 4. Kristallisationsbilder som illustrerar ordnade (till vänster) respektive oordnade kristallstrukturer (till höger).
Källa: Andersen, J.O. 2006. Är äppelsaft äppelsaft eller? Biodynamisk Forskningsforening, Danmark