Optimising the C cycle

Benefits of turning organic waste back to farmlands

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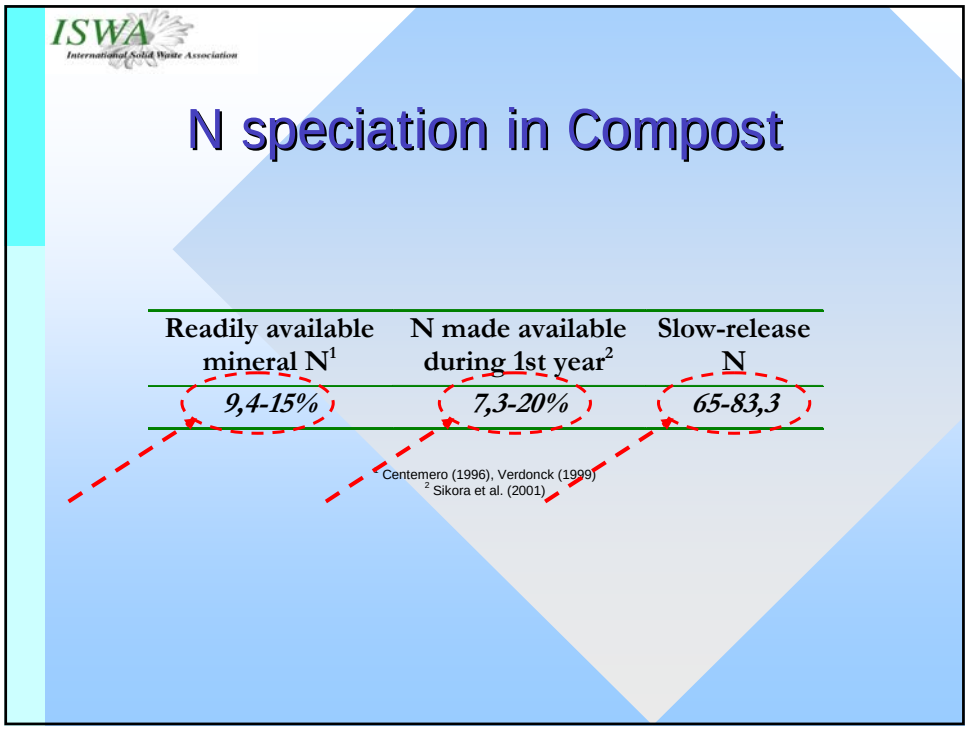
Drivers for the management of Biowaste in the EU

- Landfill Directive 99/31
- European Climate Change Programme
  - C sequestration
  - Reduced production / application of pesticides and mineral fertilisers
  - Improved water retention
  - Improved workability
- Directive 2001/77 on "renewable energy"
- TS on Soil Protection
  - WG "Exogenous Organic Matter"
  - Regions in Italy giving subsidies to farmers to use organic fertilisers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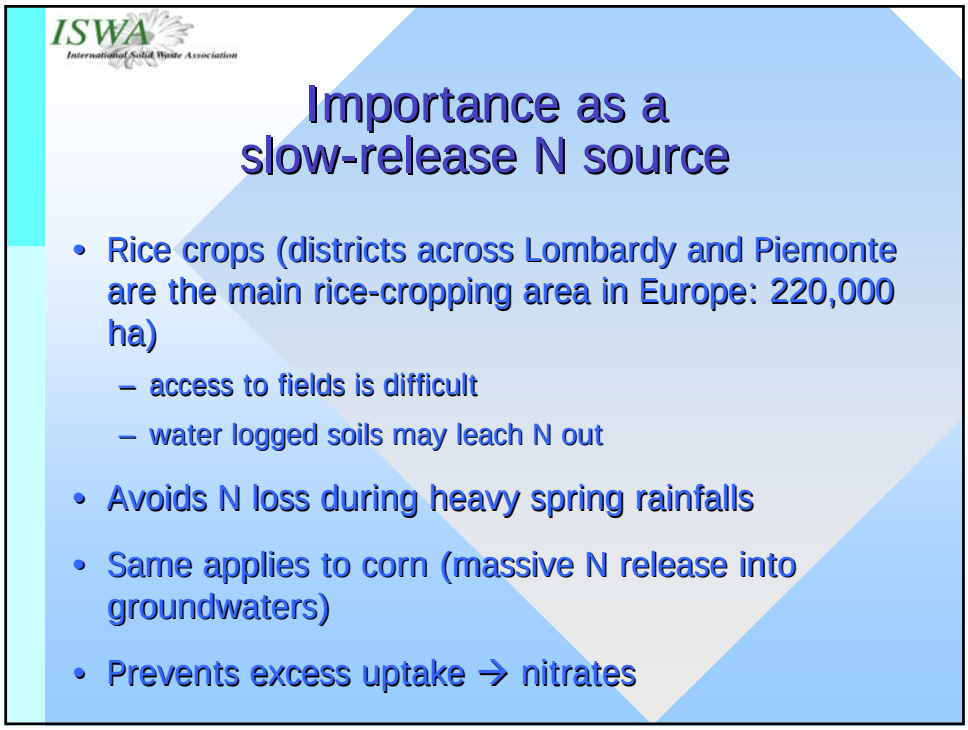
N speciation in Compost
Readily available mineral N[1]
N made available during 1st year[2]
Slow-release N
9,4-15%
7,3-20%
65-83,3
[1] Centemero (1996), Verdonck (1999)
[2] Sikora et al. (2001)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Importance as a slow-release N source
• Rice crops (districts across Lombardy and Piemonte are the main rice-cropping area in Europe: 220,000 ha)
– access to fields is difficult
– water logged soils may leach N out
• Avoids N loss during heavy spring rainfalls
• Same applies to corn (massive N release into groundwaters)
• Prevents excess uptake → nitrates

Effects on yield and nitrates

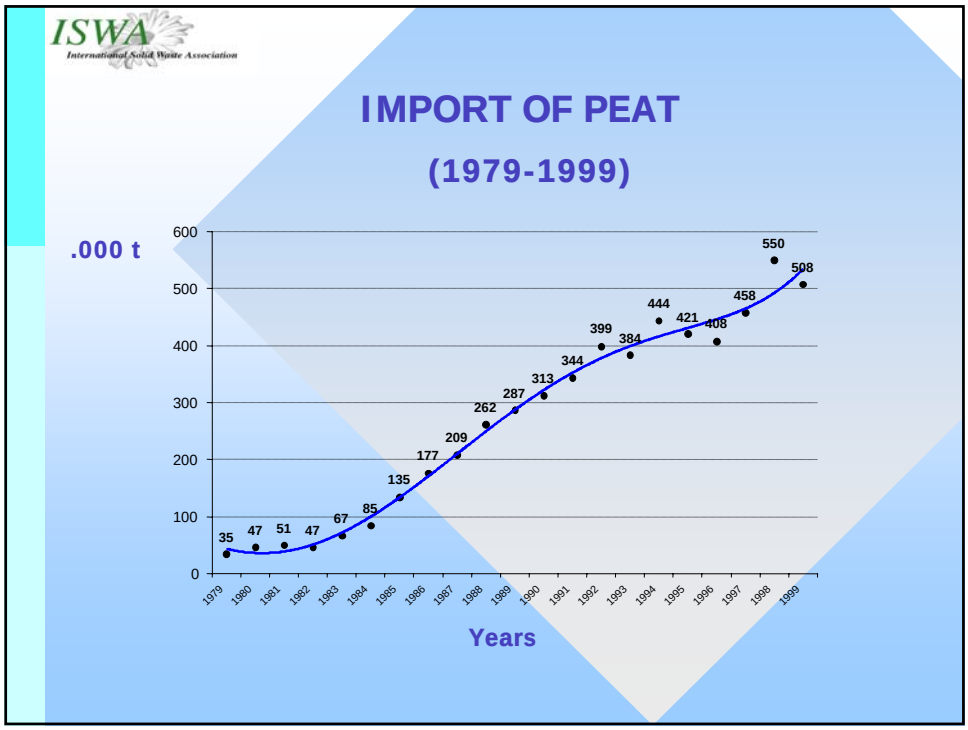
Trial		symbol
1	Blank (no fertilisation)	T
2	Mineral fertilisers	M
3	Only compost @ 30 tonnes f.m./ha	C
4	Compost + Nitrogen – dose 1 (50% of mineral fertilisation)	CN1
5	Compost + Nitrogen - dose 2 (100% di mineral fertilisation)	CN2

SPINACH

Trial	Yield f.m. (g/m2)	Yield d.m. (g/m2)	Total N %	NO3-N mg/kg
T	3555	267	4.5	4142
M	3868	272	5.0	8712
C	4241	297	4.4	4218
CN1	4420	295	4.9	7740
CN2	3770	261	4.9	8904

Vineyards

- 827,000 ha (2002)
- High added value – therefore, possibility to afford soil improvers also at high prices
- Use of compost as both mulch and soil improver
- Many areas on clayey soils, high slopes, dry areas
  - Soil improving action and water retention highly appreciated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IMPORT OF PEAT
(1979-1999)
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600
500
400
300
200
100
0
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67
85
135
177
209
262
287
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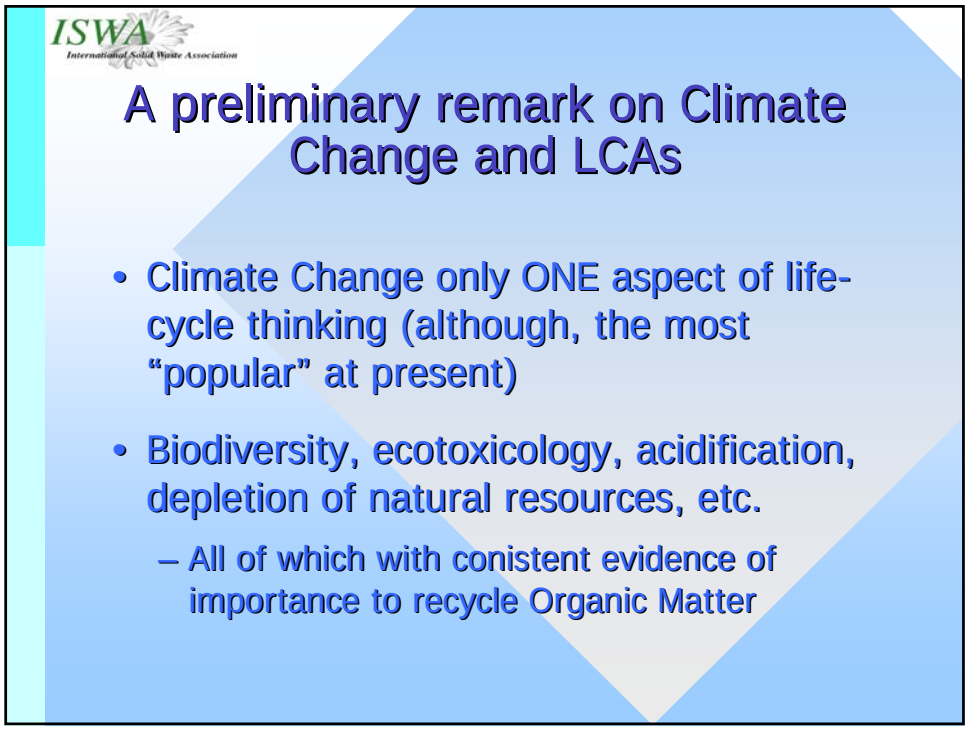
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A preliminary remark on Climate Change and LCAs
• Climate Change only ONE aspect of life-cycle thinking (although, the most "popular" at present)
• Biodiversity, ecotoxicology, acidification, depletion of natural resources, etc.
– All of which with conistent evidence of importance to recycle Organic Matter

Biowaste and climate change

- Biowaste emits CO2 – short-term (biogenic) carbon → C neutral
- Use of compost replaces fertilisers – avoidance of CO2 and other GHG's ought to be considered
- Use of compost may lock-up carbon in the soil – "sequestration" ought to be considered
- AD turns carbon into a substitute fuel – this replaces fossil fuels

Problems with many LCAs ("inherent limitations")

- Many LCAs only *tend to* account for material replacement, not for induced effects (e.g. soil improvement / improved workability)
  - Only nutrients (NPK) considered, organic matter neglected!
- Many beneficial effects of soil improvers difficult to quantify - anyway important !!
  - Improved workability
  - Better water retention
  - C sequestration in a landfill (MBT) or in soil (compost)

What are the GHG-savings in BT

use of biogas as a fuel (diesel trucks)	2792
less NO_2-emissions by gas fuel	1643
displacing mineral fertiliser	723
displacing organic matter: peat (1/3)	2401
displacing organic matter: straw (2/3)	400
TOTAL SAVINGS	7959

Based On...

- **Survey carried out on behalf of the European Commission – DG ENV**
- **Other International Research**
- **Results of WG Soils in the European Climate Change Programme (ECCP)**

Avoided N_2O Emissions from soils

- **Dynamics of N release from humified organic matter are much less likely to promote N_2O production – it might be considered as negligible**
- **The massive release of N from chemical fertilisers promotes kinetics which are far more likely to produce N_2O**

year	N displaced		N20 avoided 0,5%	N20 avoided 0,05%
1	58,4 kilos	58,4	0,292207792	0,02922078
2	40,9 "	99,4	0,496753247	0,04967532
3	28,6 "	128,0	0,639935065	0,06399351
4	20,0 "	148,0	0,740162338	0,07401623
5	14,0 "	162,1	0,810321429	0,08103214
6	9,8 "	171,9	0,859432792	0,08594328
7	6,9 "	178,8	0,893810747	0,08938107
8	4,8 "	183,6	0,917875315	0,09178753
9	3,4 "	186,9	0,934720513	0,09347205
10	2,4 "	189,3	0,946512151	0,09465122
	189,3 kilos	Cumulative	Cumulative	Cumulative

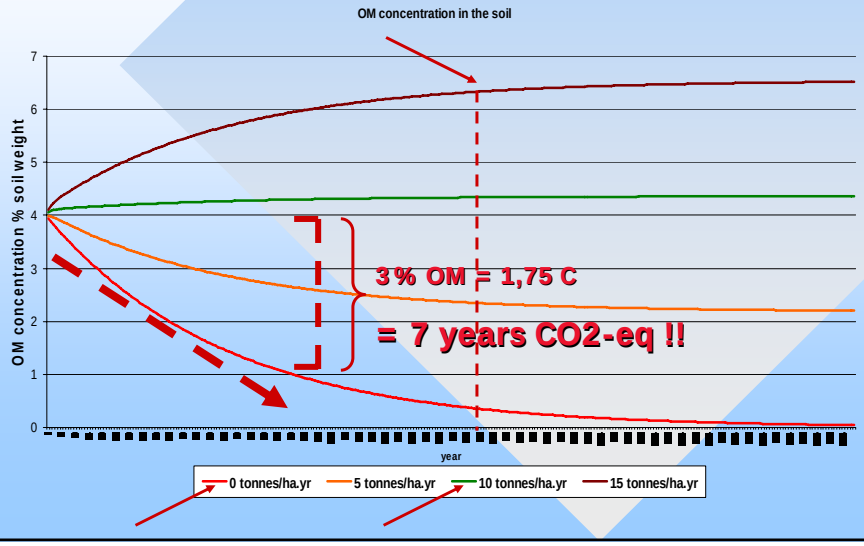
Importance of locking-up C

•545.000	•Gg CO2	•Source: "National •Communications from Parties •included in Annex 1 to the •Convention: Greenhouse Gas •Inventory Data from 1990 to 1998"	
•148.636.364	•ton C		
•16.000.000	•hectares	•Arable Land Area	
•3600	•ton/ha	•unit weight of the soil	
••57.600.000.000,00	•ton soil		
•0,258%	•% of Carbon to be locked up in the soil in •order to balance the overall national •emissions of carbon dioxide in 1 year		

C sequestration: where the trick is

- According to the standard IPCC methodology, C may only be considered "sequestered" if kept for > 100 yrs
- This is just an arbitrary cut-off, in order to have a border between "short-term" and "fossile/sequestered" C.
- In the case of soil C, this leads to major and misleading consequences

Soil Carbon accumulation



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Rothamstead field trials

Type of vegetation or crop	% C
Pasturelands	1.52
Under a forest	2.38
After cropping wheat continuously for 50 years, 1893	
No manure added since 1839	0.89
Only chemical fertilisation since 1843	1.10
14 tonnes manure yearly since 1843	2.23

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Decline of Soil OM – the evidence

NATURE (Vol. 437) of 8 September 2005

- ***CARBON CONTENT OF SOIL in England and Wales fell steadily in the period 1978-2003, with some 13 million tonnes of carbon released from British soil each year. On average, British soils have lost 15 % of their carbon.***
- ***much of the carbon may be entering the atmosphere in the form of greenhouse gases (eg CO2 and CH4), thus exacerbating global warming***
- ***losses of soil carbon in the UK, and in other temperate regions, are likely to have been offsetting absorption by terrestrial sinks***

Other benefits – an overview

- Disease suppression
  - less request for energy linked to the production of pesticides)
- Reduced susceptibility to soil erosion
  - lower loss of soil, therefore lower mineralisation of organic matter
- Reduced irrigation requirement
  - less energy inputs
- Improved soil structure and workability
  - less energy input for ploughing, tilling, etc.

Signs of a future approach?

- **Region Emilia Romagna: 150-180 €/ha to farmers using compost in order to promote a build-up of S.O.C. in depleted soils**
- **Region Piemonte: approx. 250 €/ha to farmers using up to 25 tonnes D.M./ha in depleted soils over a 5 years' time frame**
- **Rural Development Plans**
  - **Reduced N losses into groundwaters**
  - **War on desertification**
  - **C sequestration**

A "Carbon value" for composting ?

E uptake	17,4		processing		
Emissions	35,4				
	52,8	YES	Included?		
Composting	52,8				
Organic Matter	-140	YES	Included?	Organic Matter	-140
Nutrient replacement	-57,2				
N2O	-22,9				
savings	-167,3	-278,8333	kwh/t		
With ETS (20-30 €/tonn CO2)	5,02	30	€/t		
yield	0,4	tonn compost/tonn trattata			
€/tonn compost	12,55				
With subsidies for renewable energy	"Green Certficates"				
€cent/kg CO2	33,33	20	€cent/kWh		
€/tonn biowaste	55,77				
€/tonn compost	139,42				

Vielen Danke!

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