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Soils, biowaste and climate change:

The contribution of biowaste to tackle climate change: life-cycle benefits, relevance to policy-making and importance in local prectice

Enzo Favoino

Scuola Agraria del Parco di Monza

Chair, ISWA WG on Biological Treatment

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Organic waste and climate change

- Organics emits CO2 – short-term (biogenic) carbon → C neutral
- In landfills, CH4 is produced/released → net GHG contribution
- 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 (biogas: 100-150 m^3/tonne d.m.) – this replaces fossil fuels

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Global Warming Potentials (GWPs)

Gas	Atmospheric Lifetime	100-year GWP[a]	20-year GWP	500-year GWP
Carbon dioxide (CO_2)	50-200	1	1	1
Methane (CH_4)[b]	12±3	21	56	6.5
Nitrous oxide (N_2O)	120	310	280	170
HFC-23	264	11,700	9,100	9,800
HFC-125	32.6	2,800	4,600	920
HFC-134a	14.6	1,300	3,400	420
HFC-143a	48.3	3,800	5,000	1,400
HFC-152a	1.5	140	460	42
HFC-227ea	36.5	2,900	4,300	950
HFC-236fa	209	6,300	5,100	4,700
HFC-4310mee	17.1	1,300	3,000	400
CF_4	50,000	6,500	4,400	10,000
C_2F_6	10,000	9,200	6,200	14,000
C_4F_{10}	2,600	7,000	4,800	10,100
C_6F_{14}	3,200	7,400	5,000	10,700
SF_6	3,200	23,900	16,300	34,900

Fonte: IPCC (1996)

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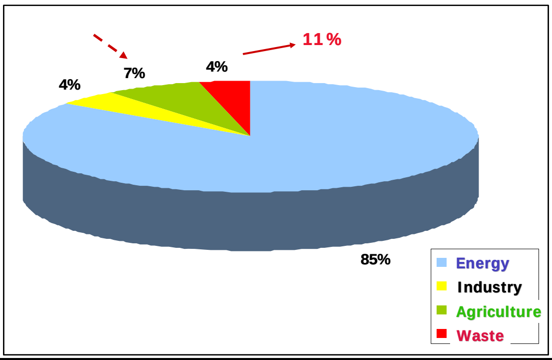
Magnitude of the issue



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Strategic approaches to reduce impact of organics in landfills

- Landfill diversion targets (Directive 99/31 EC)
  - ✓ Probably the most important driver for waste management in last decade in the EU (and elsewhere)
- Landfill Bans (e.g. US, Brazil)
  - ✓ Garden waste only or organics as a whole

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Food wastage: factual evidence

- "Love Food Hate Waste" programme (WRAP UK)
- 8.3 million tonnes of food thrown away by households in the UK every year.
  - ✓ Only considering those issues in the domain of retailers/households
  - ✓ NOT considering the leftovers from processing of food commodities !!
- wasting food costs the average family with children £680 a year
- By means of stopping wasting food that could have been eaten, the CO2 impact would be the equivalent of taking 1 in 4 cars off the road (!!)

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http://www.lovefoodhatewaste.com/

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Problems with LCAs on compost (“limitations”)

- LCAs often 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

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Total possible GHG savings from treatment of organics

GHG saving by	kg CO_2 eq.
Anaerobic digestion with CHP option	135
C-sink in the soil by added humus	80
Peat substitution and avoided transport	200 - 300[1]
Replaced mineral fertiliser	30
Total	**400 - 500**

[1] 94 to 188 (substitution) + 120 to 180 (transport)

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Savings due to nutrient replacement

Nutrient element	Nutrient content [kg / ton$_{biowaste}$]	Emissions from mineral fertilizers [kg$_{CO2\ eq.}$ / kg$_{element}$]	Avoided CO_2 emissions [kg$_{CO2\ eq.}$ / ton$_{biowaste}$]
N	4.0	5.30	21.2
P	1.5	0.52	0.78
K	3.0	0.38	1.14

GHG savings due to substitution of mineral fertilizers, per ton of biowaste treated

Source: *AEA Technology, 2001 Waste Management Options and Climate Change, Report to the European Commission*

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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%	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

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Carbon Sequestration – key remarks

- Compost Leads to Carbon Emissions over Extended Periods of Time
- Biogenic Fraction Partially Retained In Soil Over Time – provides for a “build up” of Carbon
- Provides Soil Organic Matter – Much Wider Benefits than C sequestration alone

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Importance of C in soils

545.000	Gg CO2	Source: "National Communications from Parties included in Annex 1 to the Convention: Greenhouse Gas Inventory Data"
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	

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Decline of Soil OM – recent findings

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.***
- ***losses of soil carbon in the UK, and in other temperate regions, are likely to have been offsetting absorption by terrestrial sinks***

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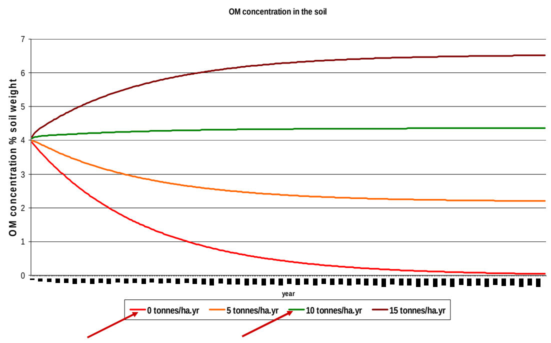
Soil Carbon trends



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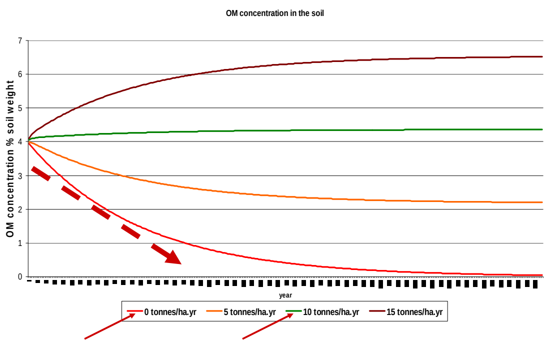

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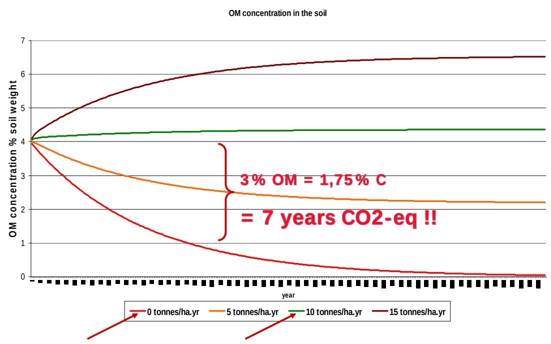

Conclusions on compost, soils and climate change

- Most benefits are dfficult to be quantified – nevertheless, they are important !
- LCAs currently *showing limitations*
- *Discrepancy between accountability and efficacy of actions*
- Waste Policies, Climate Change Policy and Inventories of Carbon Should Recognise Role of Soils (and compost)

"Climsoil" Report, EC 2009.

"The report underlines the need to sequester carbon in soils. The technique is cost competitive and immediately available, requires no new or unproven technologies, and has a mitigation potential comparable to that of any other sector of the economy."

http://ec.europa.eu/environment/soil/review_en.htm

Signs of a future approach?

- **10 Italian Regions subsidising farmers to use soil improvers, including compost, in order to promote a build-up of C in depleted soils**
- **Unit subsidies in the range 200-700 Euro/ha**
- **Grant schemes established in the frame of Rural Development plans**

GHG-balance for a modelled scenario

(100 ktpa MSW; 60% recycling, including AD + composting; 40% incineration)

	Quanti-ties	CO_2 emitted	CO_2 saved	CO_2 net
collection	100000	741		741
recycling	40000	28580	36220	-10650
biological treatment	20000	2210	7959	-5749
incineration	40000	16427	18403	-1976
total	**100000**	**47951**	**62581**	**-17640**

What are the GHG-savings related to?

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

Conclusions

- **CO_2 savings by AD are a certain gain**
- **The savings due to peat substitution by 1/3 of the compost (going to horticulture) are much larger**
- **The savings by nutrient substitution are rather marginal**
- **The benefits brought by physical effects on the soil (water retention, less erosion.....) are promising,**
- **A lot of research is still necessary to integrate these aspects correctly in LCAs**
- ***Benefits of biological treatment, typically much larger than what may be accounted for.***

AND:
Organics a big part of MSW
optimising management of organics with ready-to-implement strategies a key driver for improvement


ISWA
Thank you
ISWA
International Solid Waste Association
Enzo Favoino
enzofavoino@alice.it