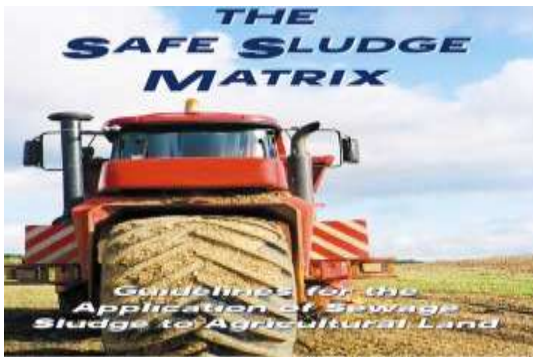


5<sup>th</sup> Organic Producers Conference  
17-18 January 2011



# Biosolids and Organic Farming

**Brian J Chambers**  
**Head of Soils & Nutrients**



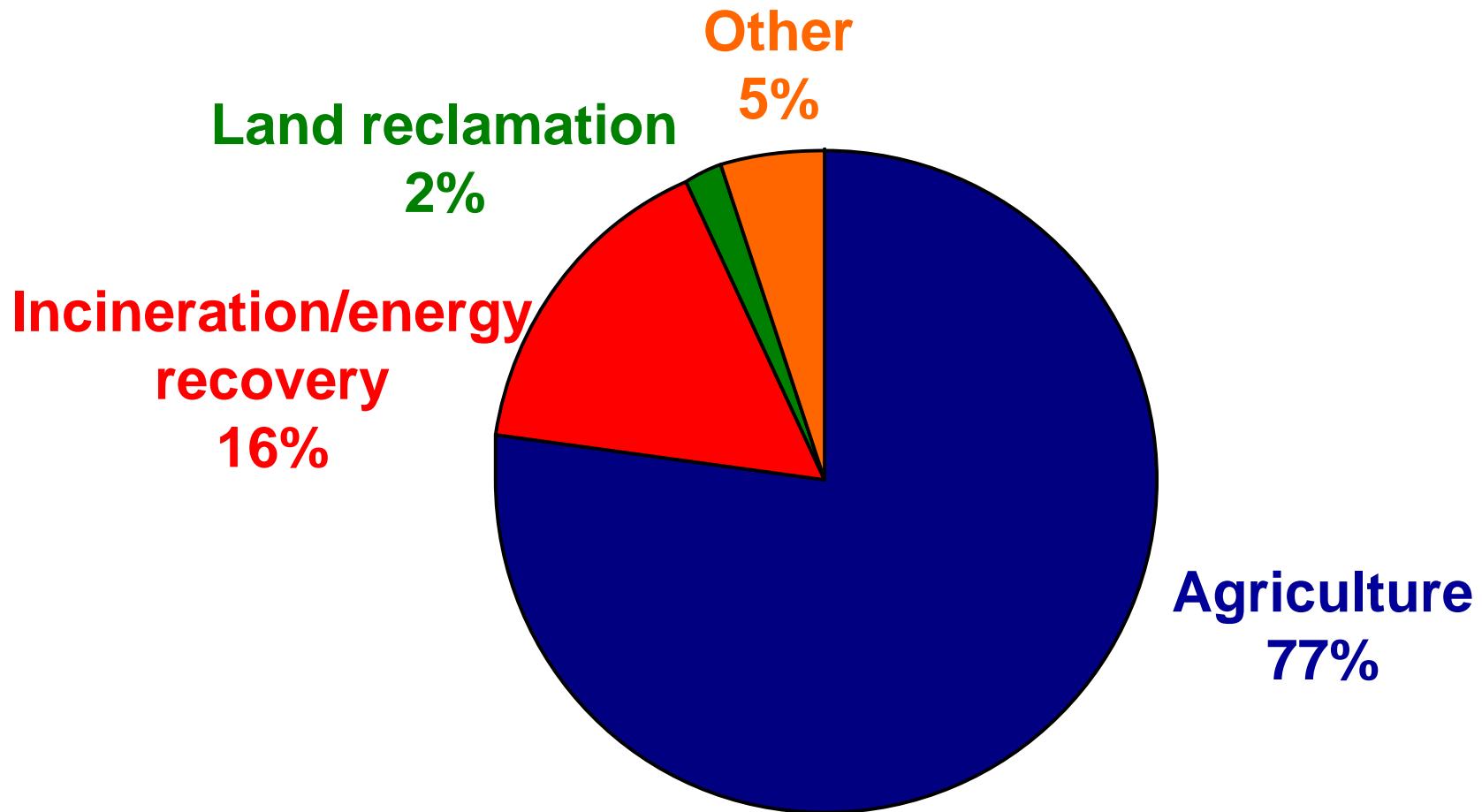
# Why do we apply sewage sludge (biosolids) to agricultural land?

- **Best Practicable Environmental Option in most circumstances (*Government and EU*)**
  - **valuable source of nutrients (N, P, S, Mg etc.)**
  - **organic matter**
  - **completes *natural* nutrient and carbon cycles**

## **But:**

- **can contain contaminants (heavy metals, pathogens, organic pollutants etc.)**
- **only other major option - incineration (£850 million to build + extra £41 million per year operation)**

# Biosolids routes in the UK (2008)



**1.1 million tonnes dry solids (>150,000 ha)**

# **Biosolids recycling - a regulated process**

- **1986 EU Directive on Sludge Use in Agriculture**
- **1989 Sludge (Use in Agriculture) Regulations**
- **1996 Code of Practice for Agricultural Use of Sewage Sludge – *best practice guidance***

# **THE SAFE SLUDGE MATRIX**



**Guidelines for the  
Application of Sewage  
Sludge to Agricultural Land**

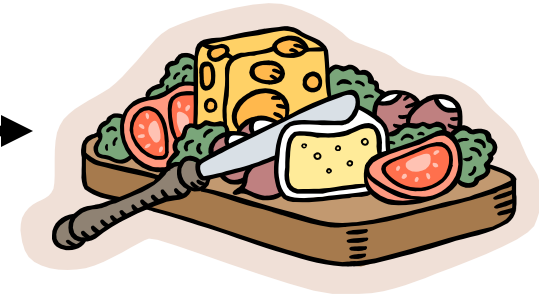
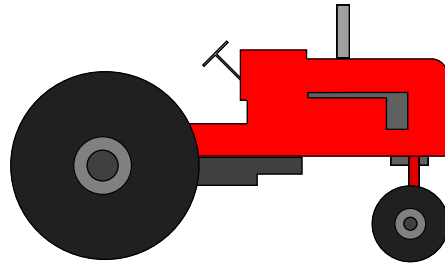
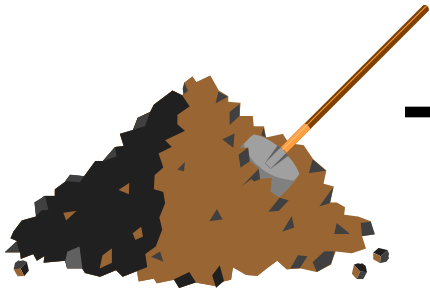
# The “Safe Sludge Matrix”

Forms the basis of the agreement made between *Water UK* and the *British Retail Consortium* as the minimum standard for sewage sludge (biosolids) recycling to agricultural land in the UK.

The agreement came into force on 31  
December 1998

# Managing biosolids to minimise microbiological risks to food safety

**(multiple barrier approach)**









**Treatment**

**Land spreading  
(soil)**

**Food crops**

# “Safe Sludge Matrix” (April 2001)

Crop Group	Untreated sludges	Conventionally treated	Enhanced treated sludges
FRUIT	<b>X</b>	<b>X</b>	  10 month harvest interval applies
SALAD	<b>X</b>	<b>X</b> (30 month harvest interval applies)	
VEGETABLES	<b>X</b>	<b>X</b> (12 month harvest interval applies)	
HORTICULTURE	<b>X</b>	<b>X</b>	
FEED CROPS COMBINABLE AND ANIMAL	<b>X</b>		
GRASS - GRAZING	<b>X</b>	<b>X</b> (Deep injected or ploughed down only)  3 week no grazing and harvest interval applies	 3 week no grazing and harvest interval applies
GRASS - SILAGE	<b>X</b>		
MAIZE - SILAGE	<b>X</b>		

✓ All applications must comply with the Sludge (Use in Agriculture) Regulations 1989 and DoE Code of Practice 1996

**X** Applications not allowed (except where stated conditions apply)



# Cropping Categories within “Safe Sludge Matrix”

Fruit	Salad (e.g ready to eat crops)	Vegetables	Horticulture
<p>Top fruit (apples, pears etc.)</p> <p>Stone fruit (plums, cherries etc.)</p> <p>Soft fruit (currants &amp; berries)</p> <p>Vines</p> <p>Hops</p> <p>Nuts</p>	<p>Lettuce</p> <p>Radish</p> <p>Onions</p> <p>Beans (incl runner, broad &amp; dwarf French)</p> <p>Vining peas</p> <p>Mange tout</p> <p>Cabbage</p> <p>Cauliflower</p> <p>Calabrese/broccoli</p> <p>Courgettes</p> <p>Celery</p> <p>Red beet</p> <p>Carrots</p> <p>Herbs</p> <p>Asparagus</p> <p>Garlic</p> <p>Shallot</p> <p>Spinach</p> <p>Chicory</p> <p>Celeriac</p>	<p>Potatoes</p> <p>Leeks</p> <p>Sweetcorn</p> <p>Brussel sprouts</p> <p>Parsnips</p> <p>Swedes / turnips</p> <p>Marrows</p> <p>Pumpkins</p> <p>Squashes</p> <p>Rhubarb</p> <p>Artichokes</p>	<p>Soil based glasshouse and Polythene tunnel production (including tomatoes, cucumbers, peppers etc.)</p> <p>Mushrooms</p> <p>Nursery stock and bulbs for export. Basic nursery Stock</p> <p>Seed potatoes for export Basic seed potatoes</p> <p>Basic seed production</p>

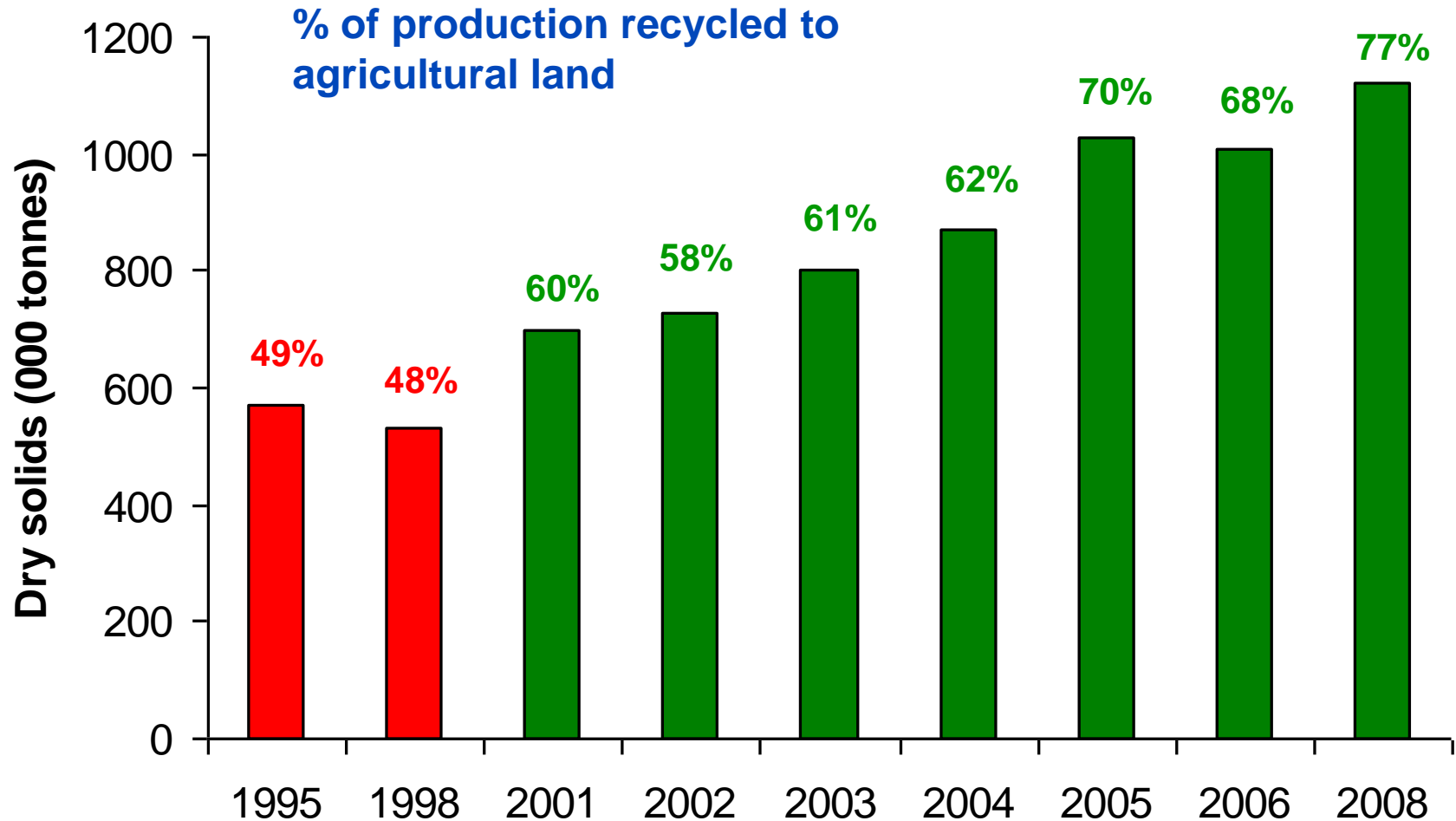
# Cropping Categories within “Safe Sludge Matrix”

Combinable and animal feed crops	Grassland and maize	
	Silage	Grazing
Wheat	Cut grass	Grass
Barley	Cut maize	Forage
Oats	Herbage	Swedes/turnips
Rye	seeds	Fodder mangolds/ beet/kale
Triticale		Forage rye & triticale
Field peas		Turf production
Field beans		
Linseed/flax		
Oilseed rape		
Hemp		
Sunflower		
Borage		
Sugar beet		

# Main Impacts of Matrix

- **Untreated sludge phased out (1999)**
- **Conventionally treated sludge:**
  - not to surface of grazed grassland
  - 30 month harvest interval for ready to eat crops (forward cropping plans)
- **New category sludges:**
  - Conventional treated (2 log reduction)
  - Enhanced treated (6 log reduction)

# Biosolids recycling to agricultural land



# Operational land recycling

- **nitrogen (NVZs)**
- **heavy metals**

# Nitrate Vulnerable Zones (NVZs)

## - organic manure N field limit



- In each field, in each 12 month period
- no more than 250 kg N/ha of total N from all organic manures
  - includes biosolids, composts etc

# Heavy metal concentrations in biosolids used in agriculture (mg/kg dry solids)

	1982/83*	1990/91*	1996/97**	2001/07***
Zinc	1205	889	802	636
Copper	625	473	565	330
Nickel	59	37	59	38
Cadmium	9	3.2	3.4	1.7
Lead	418	217	221	151
Mercury	3	3.2	2.3	1.4
Chromium	124	86	163	92

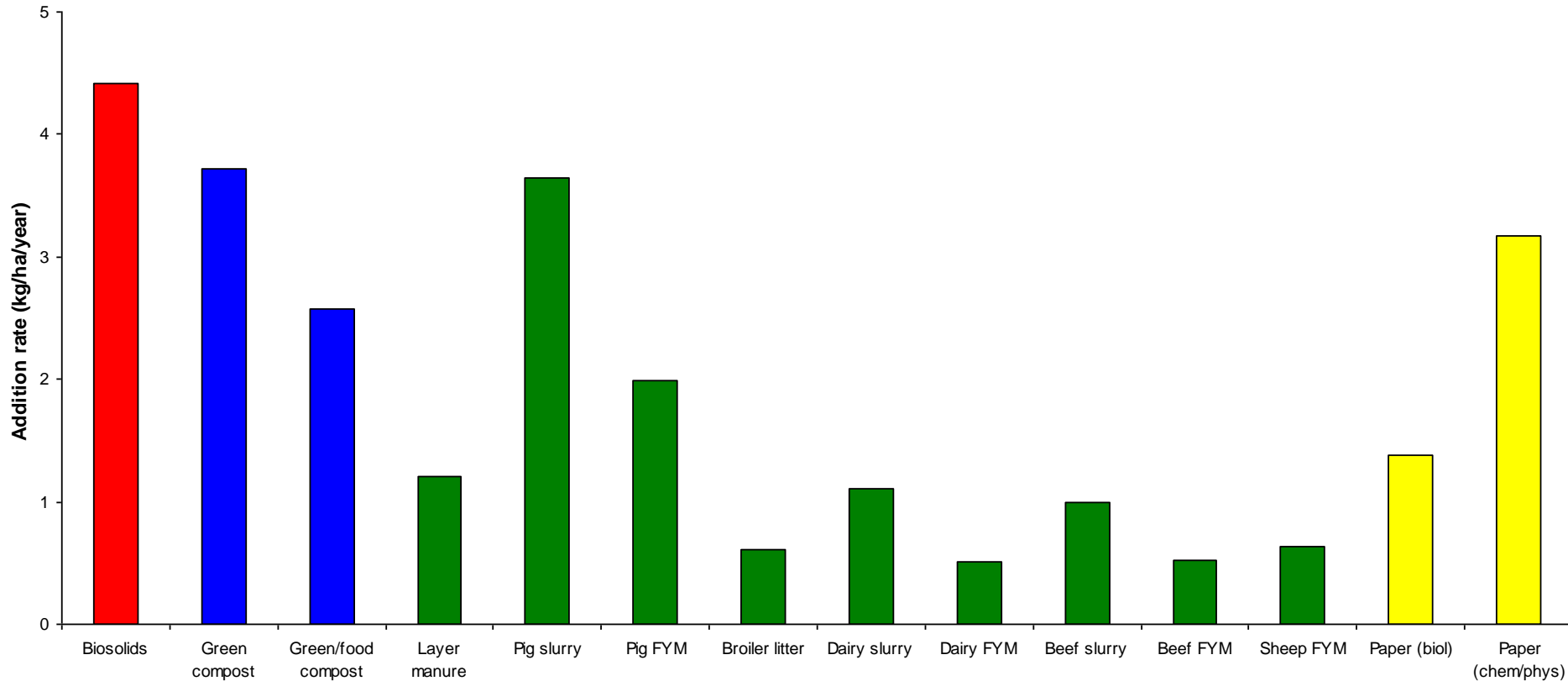
\*Median

\*\*Weighted average mean

\*\*\*Mean

# Zinc addition rates - field level (kg/ha/yr)

The Defra “Agricultural Soil Heavy Metal Inventory” - 2008



**Livestock manures, biosolids and compost spread at a rate equivalent to 250 kg N/ha (maximum field N rate in NVZs)**



# Biosolids benefits to soils

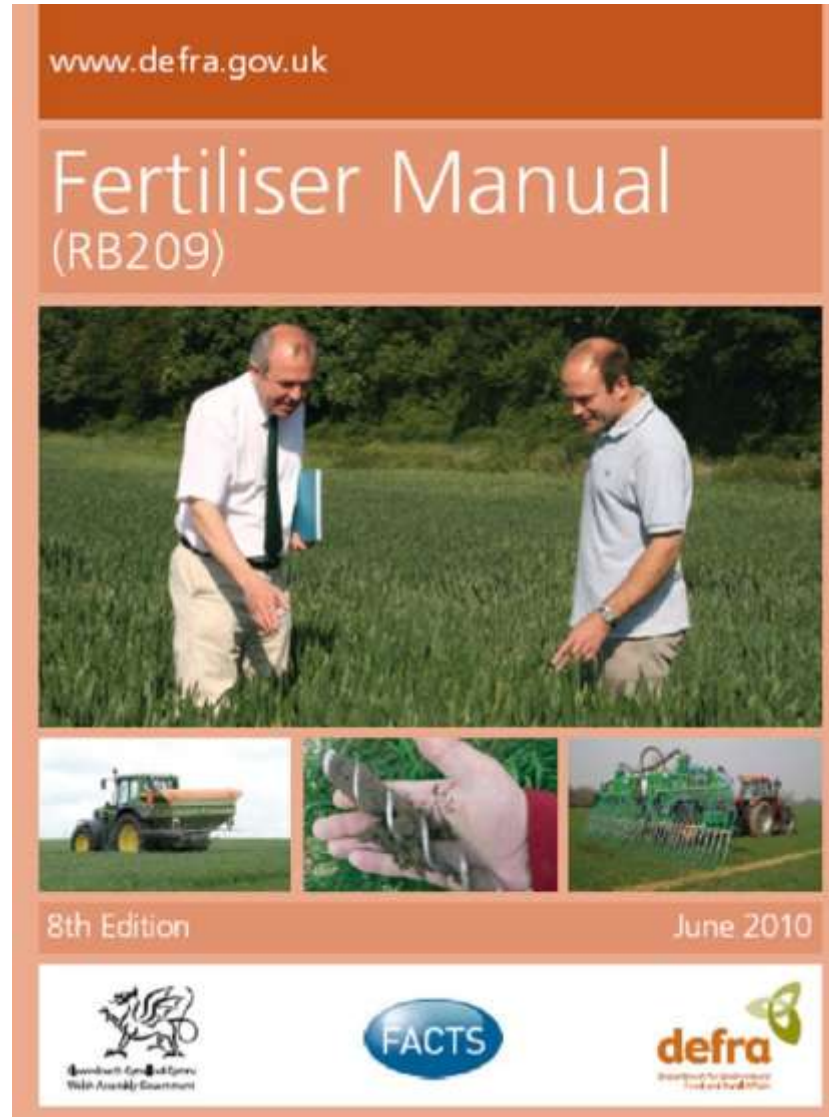
- Major plant nutrients:
  - nitrogen and *phosphorus*
  - sulphur and magnesium
- Trace elements (copper)
- Liming value
- Organic matter

# Biosolids – a good source of *stable* organic matter

Type of organic material (dry matter)	Application rate (t/ha) - 250kg N/ha	Organic matter applied (t/ha)
Digested cake (25%)	20	3.5
Green compost (60%)	30	4.5
Cattle FYM (25%)	40	5.5

# “The Fertiliser Manual (RB209)”

## 8<sup>th</sup> Edition, June 2010



# Typical dry matter and total and readily available N content of biosolids (fresh weight basis)

Biosolids type	Dry matter (%)	Total nitrogen (kg/ t or m <sup>3</sup> )	Readily available nitrogen (kg/t or m <sup>3</sup> )
Digested liquid	4	2.0	0.8
Digested cake	25	11	1.6
Thermally dried	95	40	2.0
Lime stabilised	40	8.5	0.9
Composted	60	11	0.6

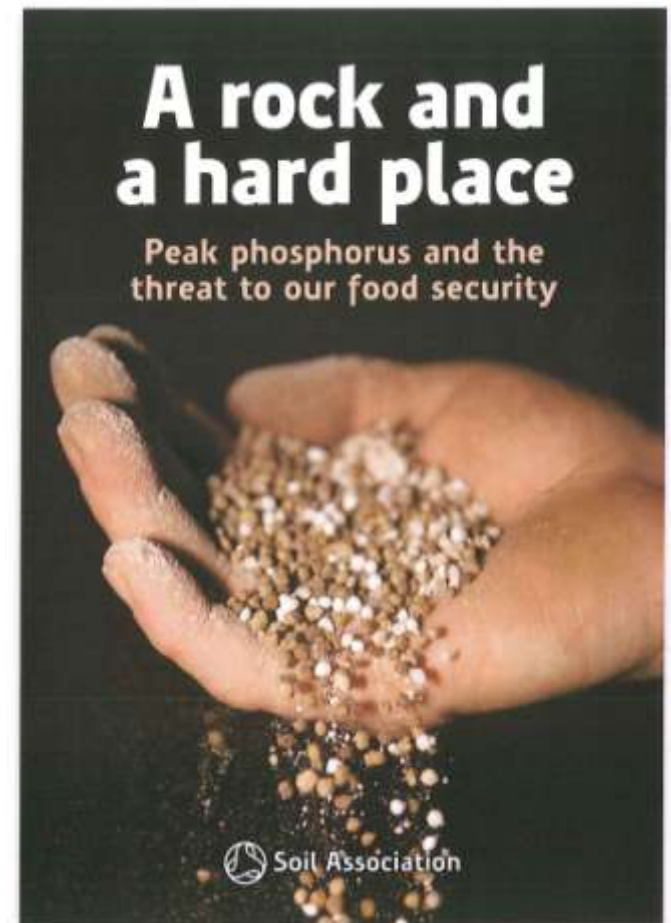
# Typical phosphate, potash, magnesium and sulphur content of biosolids (fresh weight basis)

<b>Biosolids type</b>	<b>Phosphate (<math>P_2O_5</math>) (kg/t or <math>m^3</math>)</b>	<b>Potash (<math>K_2O</math>) (kg/t or <math>m^3</math>)</b>	<b>Sulphur (<math>SO_3</math>) (kg/t or <math>m^3</math>)</b>	<b>Magnesium (MgO) (kg/ t or <math>m^3</math>)</b>
<b>Digested liquid</b>	<b>3.0</b>	<b>0.1</b>	<b>1.0</b>	<b>0.3</b>
<b>Digested cake</b>	<b>18</b>	<b>0.6</b>	<b>6.0</b>	<b>1.6</b>
<b>Thermally dried</b>	<b>70</b>	<b>2.0</b>	<b>23</b>	<b>6.0</b>
<b>Lime stabilised</b>	<b>26</b>	<b>0.8</b>	<b>8.5</b>	<b>2.4</b>
<b>Composted</b>	<b>6.0</b>	<b>3.0</b>	<b>2.6</b>	<b>2.0</b>

**Phosphate availability 50%; Potash availability 90%**

# Phosphorus

- **A finite non-renewable resource**
- **Phosphorus fertiliser prices have increased dramatically over recent years**
- **Three 'main' producers (USA export ban; China reintroduced export tariff)**





Hydrogen



Helium



Lithium



Beryllium



Boron



Carbon



Nitrogen



Oxygen



Fluorine



Neon



Sodium



Magnesium



Aluminum



Silicon



Phosphorus



Sulfur



Chlorine



Argon



Potassium



Calcium



Scandium



Titanium



Vanadium



Chromium



Manganese



Iron



Cobalt



Nickel



Copper



Zinc



Gallium



Germanium



Arsenic



Selenium



Bromine



Krypton



Rubidium



Strontium



Yttrium



Zirconium



Niobium



Molybdenum



Technetium



Ruthenium



Rhodium



Palladium



Silver



Cadmium



Indium



Tin



Antimony



Tellurium



Iodine



Xenon



Cesium



Barium



Hafnium



Tantalum



Tungsten



Rhenium



Osmium



Iridium



Platinum



Gold



Mercury



Thallium



Lead



Bismuth



Polonium



Astatine



Radon



Francium



Radium



Rutherfordium



Dubnium



Seaborgium



Bohrium



Hassium



Meitnerium



Darmstadtium



Roentgenium



Ununblum



Ununtrium



Ununquadium



Ununpentium



Ununhexium



Ununseptium



Ununoctium



Lanthanum



Cerium



Praseodymium



Neodymium



Promethium



Samarium



Europium



Gadolinium



Terbium



Dysprosium



Holmium



Erbium



Thulium



Ytterbium



Lutetium



Actinium



Thorium



Protactinium



Uranium



Neptunium



Plutonium



Americium



Curium



Berkelium



Californium



Einsteinium



Fermium



Mendelevium



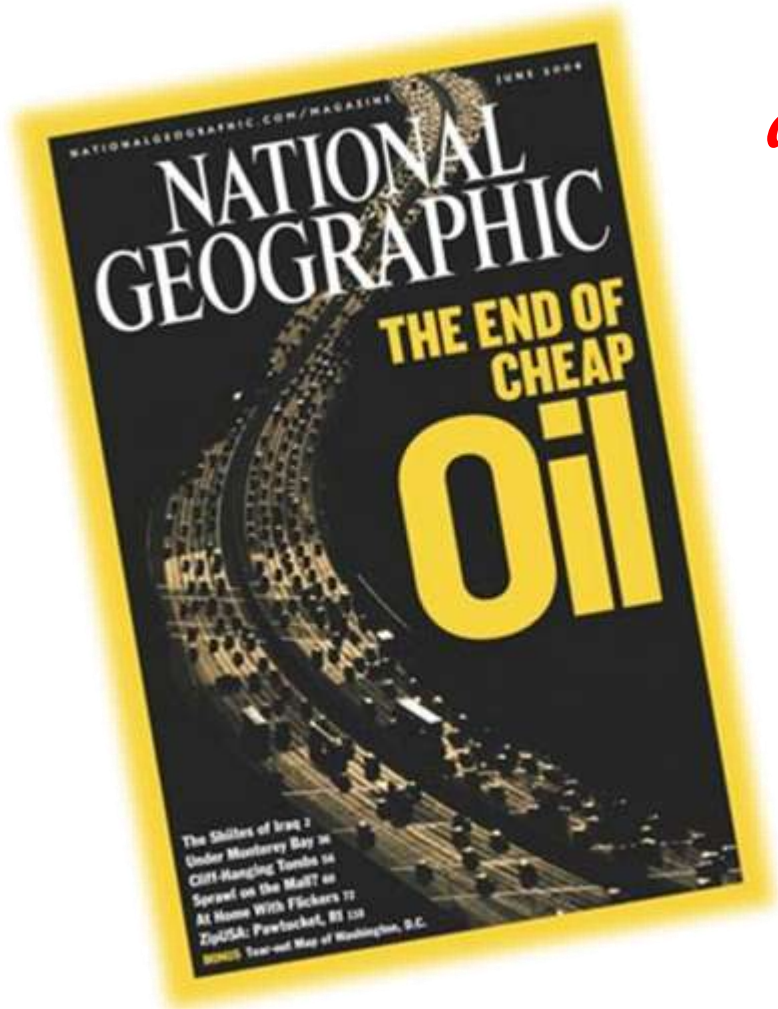
Nobelium



Lawrencium

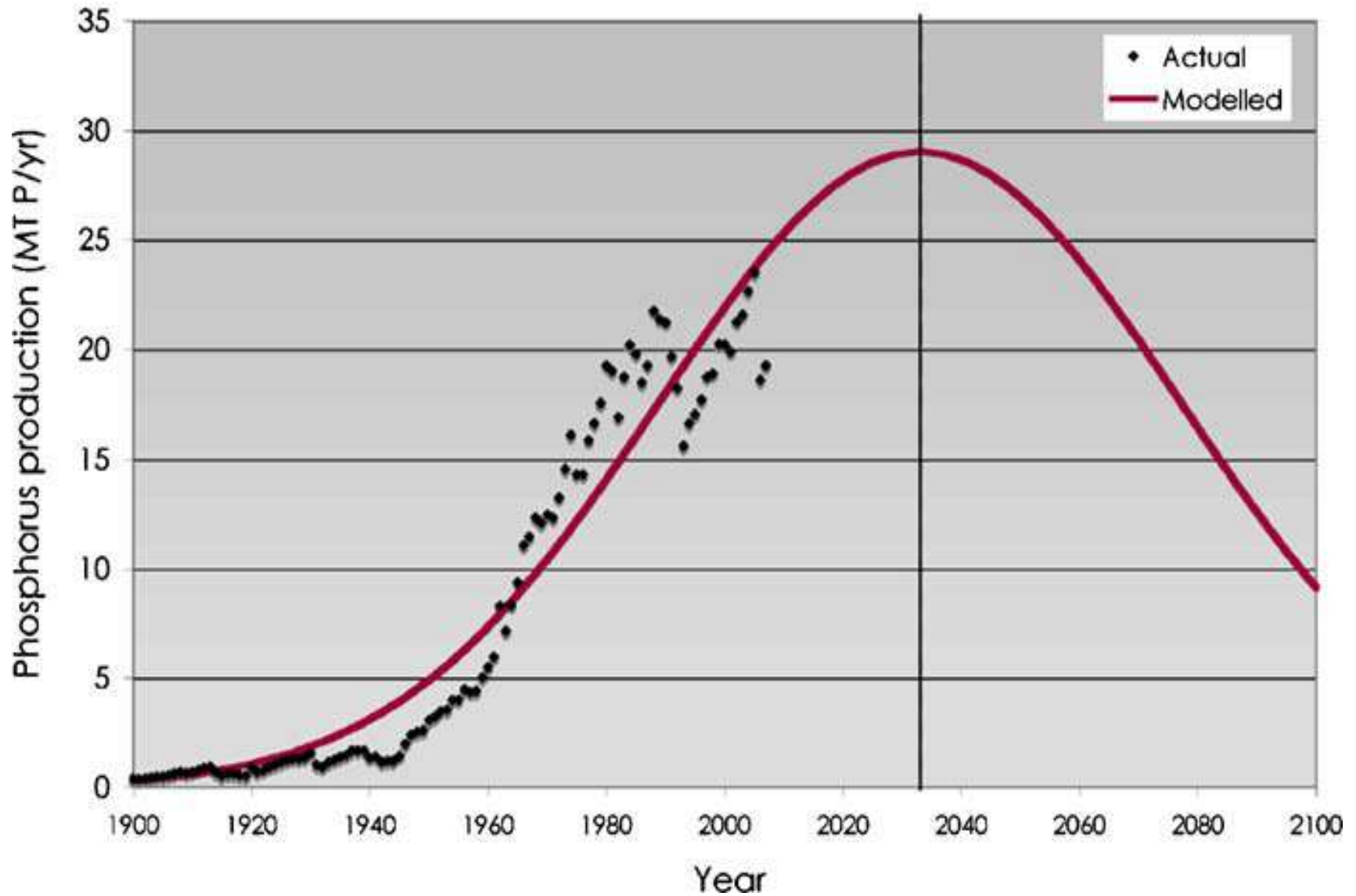
*“We can get around declining oil production by using alternatives: but we have no alternatives to rock phosphate”.*

Andy Barr, Farmers Weekly, June 2009





# Peak phosphorus curve



# Biosolids - Phosphorus supply

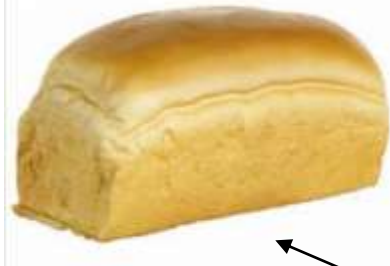
- **A 'rich' source of phosphate:**
  - 74 kg phosphate- $P_2O_5$ /tonne dry solids
  - Based on an application rate of 7 tonnes dry solids/hectare, enough phosphate to supply a number of years of crops (*rotational management*)
- **Value >£250/ha (typical field application rates)**

**BLACK GOLD.....**

# Biosolids recycling to land – completes natural nutrient and carbon cycles



**Not presently permitted under  
EU regulation No.889/2008**



**Previously allowed under Soil Association rules**



**Thank you  
- Questions?**