






Fertilisers and World Food Demand – Implications for Environmental Stresses

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Scope of presentation

- Fertiliser use and the trade-offs between food security and environmental degradation
- Main environmental stresses from mineral fertilisers
- Environmental stresses at the extremes of fertiliser use
- Conclusions – no end to the tradeoffs

Trade-offs between food security & environment I

- Improved food security  > production
 > fertiliser
- Improved food security  > purchasing power  > fertiliser  > incomes and/or lower prices

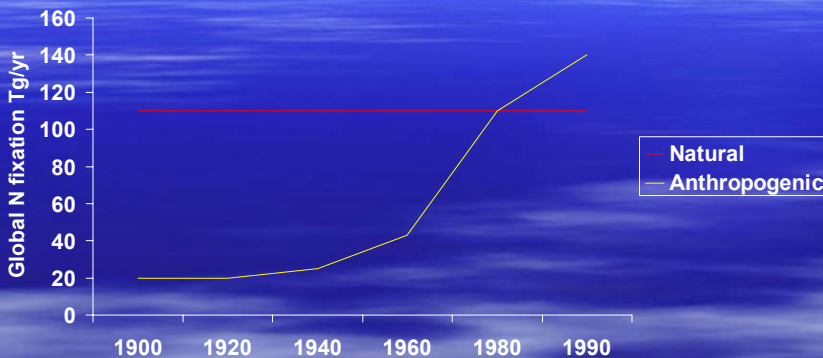
Trade-offs between food security & environment II

- > fertiliser  negative impacts on the environment
- global impacts : increased GHGs & changes in biogeochemical cycles
- local & regional impacts: water pollution, eutrophication, human health

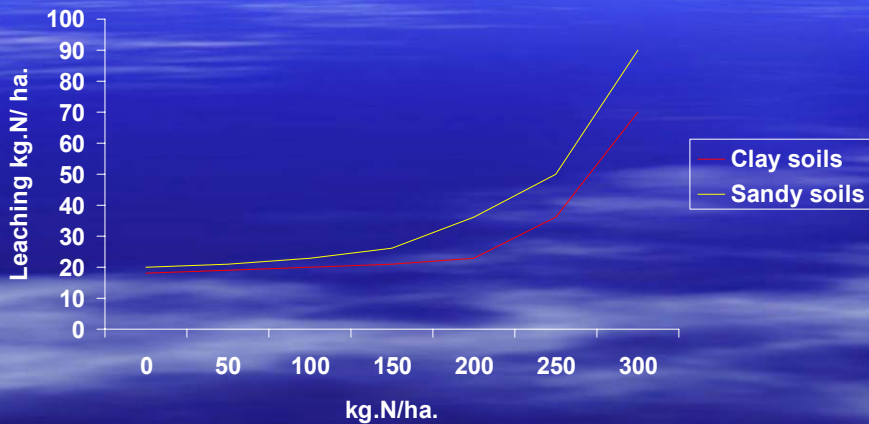
Fertiliser's contributions to GHG and ammonia emissions

	Nitrous oxide	Nitric oxide	Ammonia
Main effect	climate change	acidification	acidification eutrophication
% share of global emissions	8	2	17
% share of total anthropogenic	19	4	22
Agriculture's % share of total anthropogenic	66	27	93

Change in Anthropogenic N Fixation



N leaching risk



Recent & projected fertiliser use

Region	Nutrients (mill.tonnes)		Average kg/ha (arable)	
	1997/99	2030	1997/99	2030
S.S.Africa	1.1	2.6	5	9
L.Amer. & C	11.3	16.3	56	67
NE/N. Africa	6.1	9.1	71	99
S.Asia	21.3	28.9	103	134
E.Asia	4.2	6.9	113	178
Ind.countries	45.2	58.0	60	71
T.countries	7.6	10.1	49	58
World	138	188	92	

Fertiliser use and groundwater pollution by nitrates

Location	N applied Kg/ha	N uptake Kg/ha	Groundwater nitrate mg/l
Fangzhuang	1894	383	180
Quandushu	1649	433	75
Sijiqing	778	444	150
Xidian	1073	384	75
Xishuiying	5580	480	500

N inputs to rivers & coastal waters

River	N inputs to rivers		N exports to sea	
	kg ⁻² year ⁻¹	% agric	kg ⁻² year ⁻¹	% agric
Mississippi	7489	89	597	63
Amazon	3034	17	692	6
Zaire	3427	18	632	9
Po	9060	81	1841	56
Ganges	9366	81	1269	55
Yangtze	11823	92	2237	83

Land savings – the benefits of fertiliser use (million ha)

	Least developed countries	World
Nelson & Mareida	160-300	230-340
Goklany	427	485
Avery	339	385
CGIAR Climate Group	340	386

Overuse of mineral nitrogen fertilizers in China

- Use has grown >2,500 % since 1960
- Average rate is about 225kg/ha cropland
- Average in 4 Provinces >400kg/ha
- In some vegetable areas 1-5,000kg/ha/yr
- International critical limit is about 150-225kg/ha
- Crop utilisation efficiency only 30-45%
- Most lost to atmosphere – acid rain & GHGs
- role in other problems - red tides and ozone

N balance sheet for Chinese agriculture, 1998

Input million tons		Output million tons	
Mineral fertiliser	24.8	Harvest	15.3
Organic manure	4.8	Loss of fertiliser	11.2
Biological fixation	3.5	Loss of manure	.6
Rainfall & irrigation	1.5	Leaching & runoff	2.0
Seeds	.4		
Total	35		29
Balance 1987 = 2.4 mill.t.		Balance 1998 = 6.0 mill.t.	

Nutrient depletion in Latin America & Caribbean (kg NPK/ha/yr)

	Wheat	Rice	Maize	All crops
1983-85	-111	-62	-61	-59
C.Amer.	-198	-89	-17	-39
Caribb.		-197	-70	-67
1993-95	-96	-77	-86	-54
Andean	-79	-73	-37	-40
S.Cone	-83	-72	-115	-59

Conclusions - no end to food security & environment trade-offs

- Continuing damage from overuse & under use
- Food security impossible without fertilisers
- Minimising the trade-offs:
 - ending direct and indirect subsidies to N
- Environmental costs of fertiliser use
- Wider health and trade dimensions

Consumer safety & nitrogen

Vegetable	NO ₃ mg/kg 1980	NO ₃ mg/kg 1996
Chinese cabbage	1818	3960
Cole	1094	5673
Spinach	2358	4089
Fennel	510	6528
Green onions	314	2596