Global environmental challenges and the poultry sector

Donal Murphy-Bokern

Presentation to the World Poultry Congress
London
21 May, 2009

Murphy-Bokern Konzepte

Some personal background

Farming systems and agronomy

Research direction in a public policy environment

Murphy-Bokern Konzepte

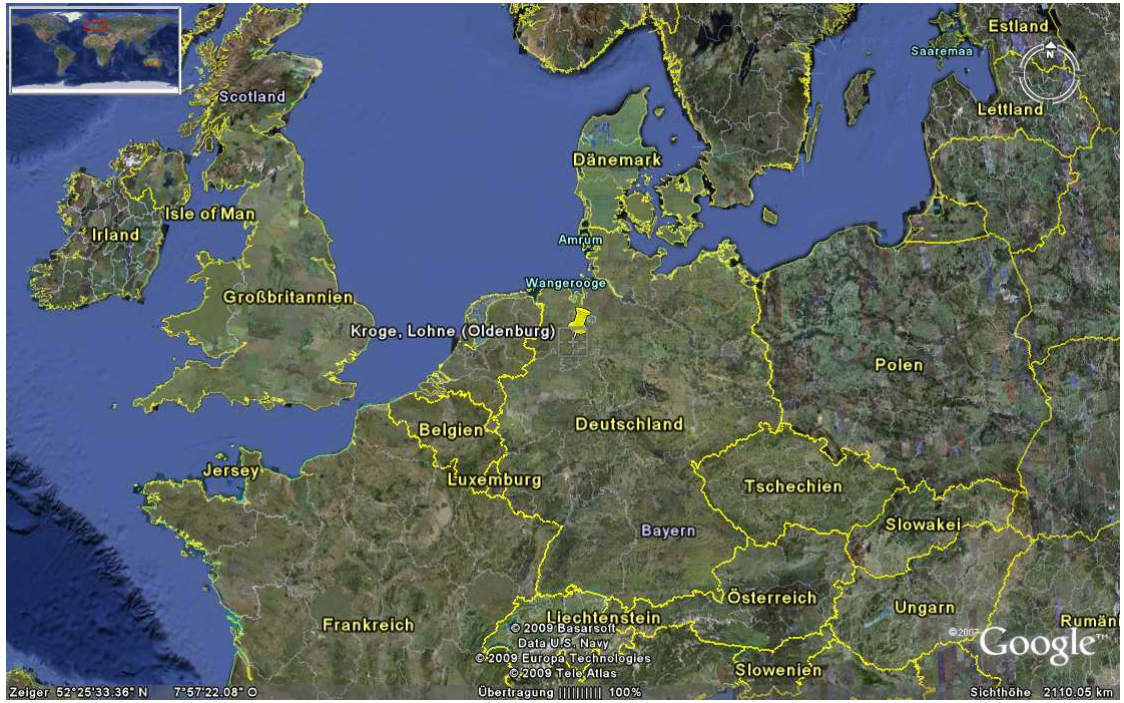
Some personal background

Since April 2007

Independent work on food policy

World Wide Fund for Nature

Department for International Development



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Some personal background

UK has become a world leader in climate change policy and food policy

**Lower Saxony is world leader in intensive livestock production,
renewable energy, environmental technology and agricultural engineering**

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Global environmental challenges and the poultry sector

Food security and consumption

Global challenges for the poultry sector

Product life-cycles

Resource use- and eco-efficiency

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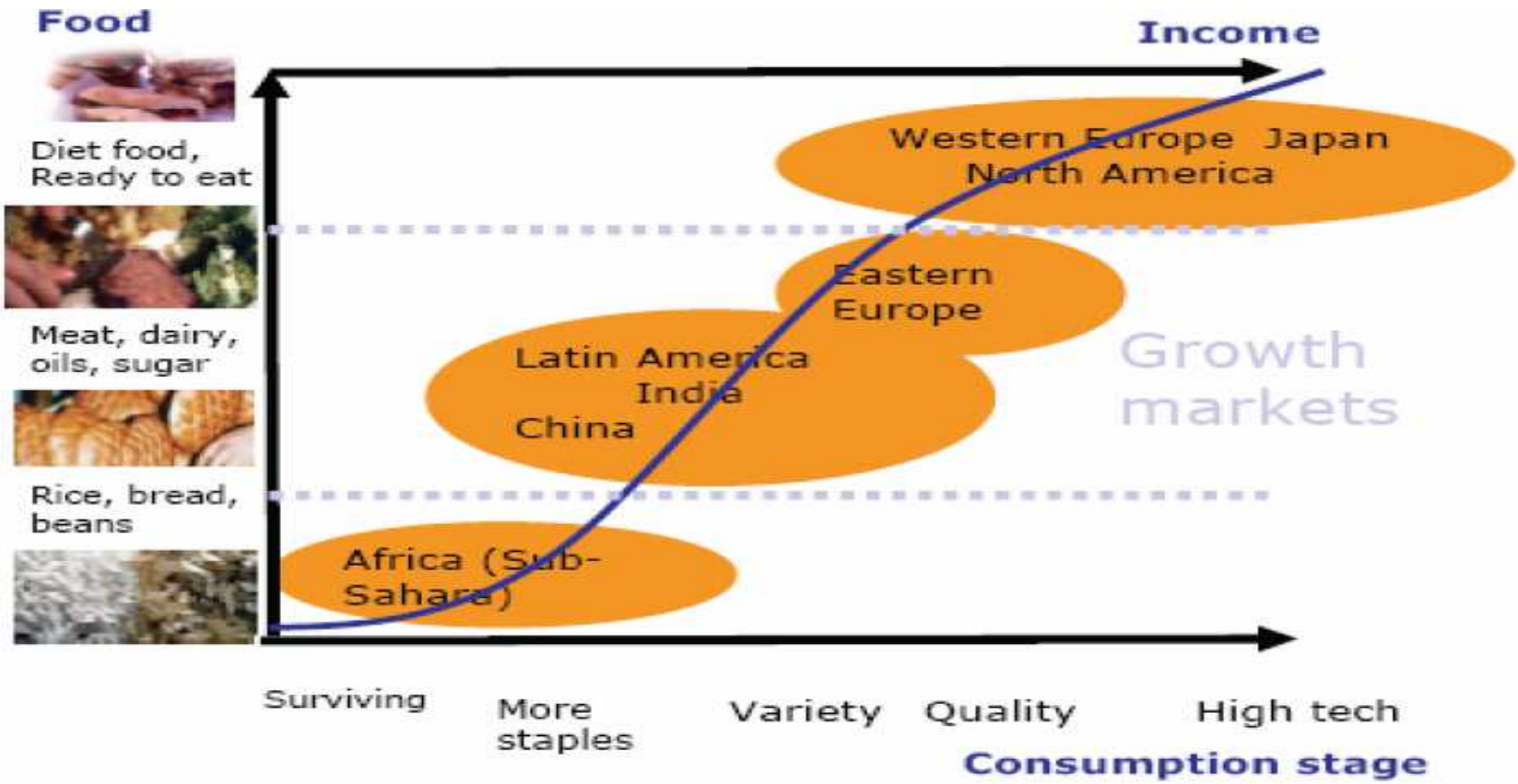
Food security and consumption

Evolution of food choice and demand



Source: Zwanenberg, Robobank

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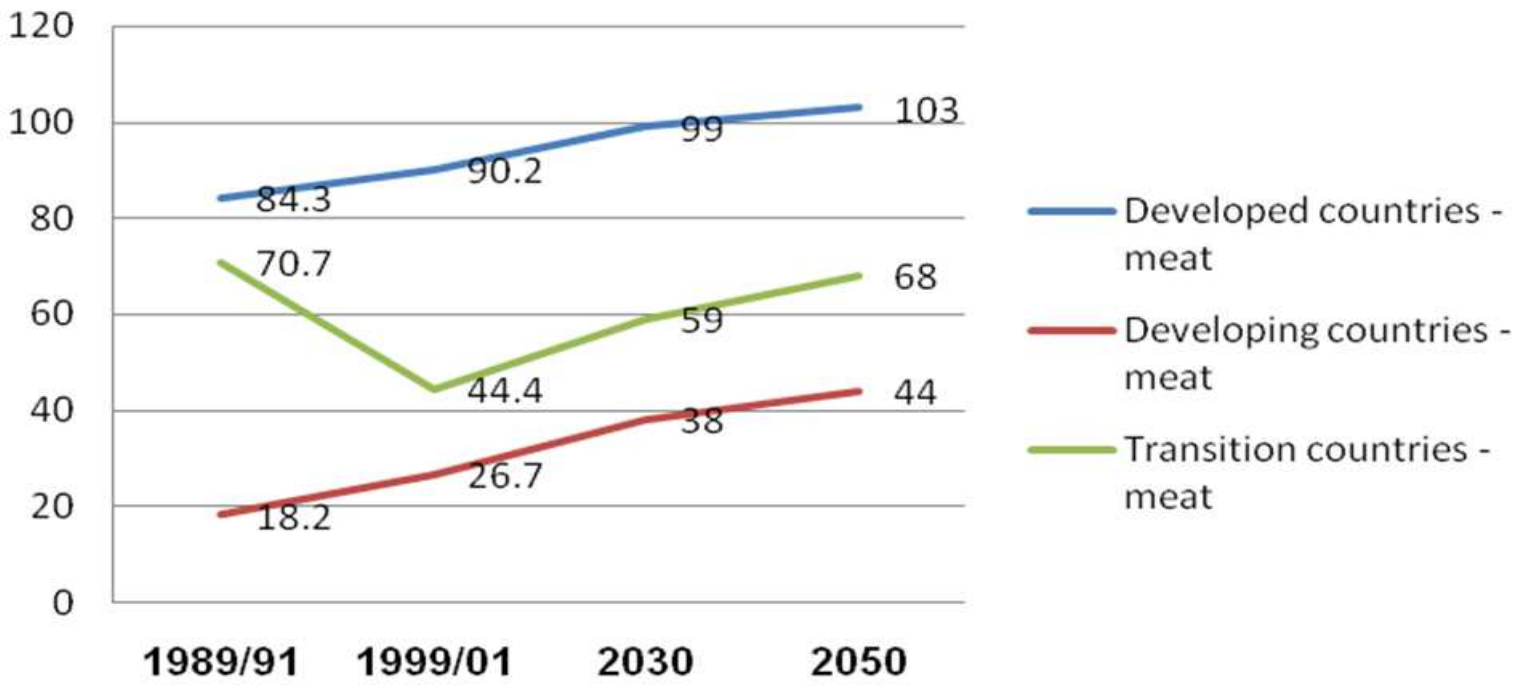
Projected trends in per capita consumption of meat products to 2050, kg/person/yr



Source: *World agriculture: towards 2030/2050* Interim report Global Perspective Studies Unit, Food and Agriculture Organization of the United Nations, Rome, June 2006. Presented by Tara Garnet

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Meat and dairy demand in 2000 and 2050

	2000 (population 6 bn)	2050 (population 9 bn)
Average *per capita* global demand - meat (tonne)	0.0374	0.052
Average *per capita* global demand - milk (tonnes)	0.0783	0.115
Total demand – meat (tonnes)	228	459
Total demand – milk (tonnes)	475	883

Source: FAO 2006 (World Agriculture towards 2030/2050) data presented by Tara Garnet

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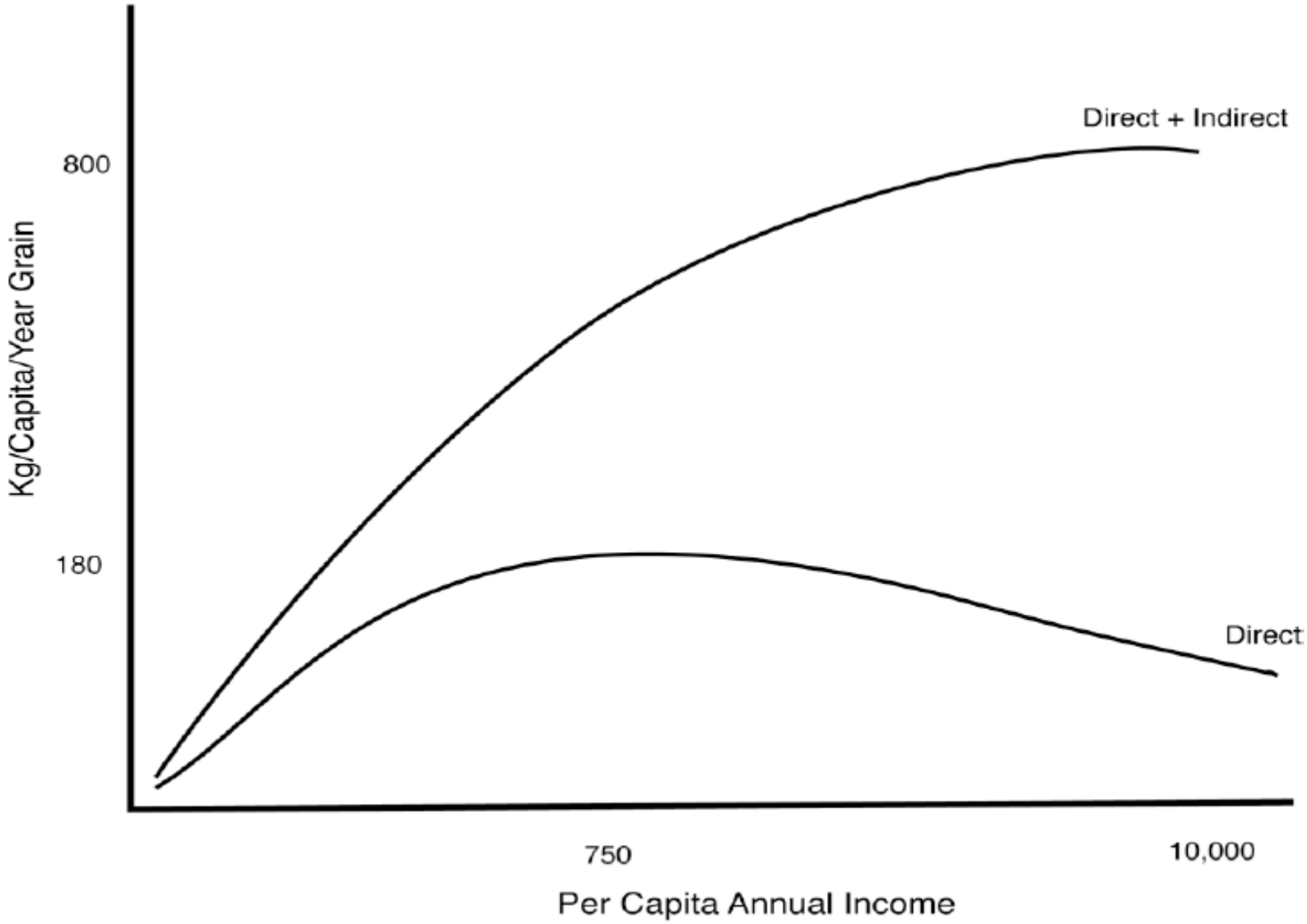
Direct and indirect grain consumption



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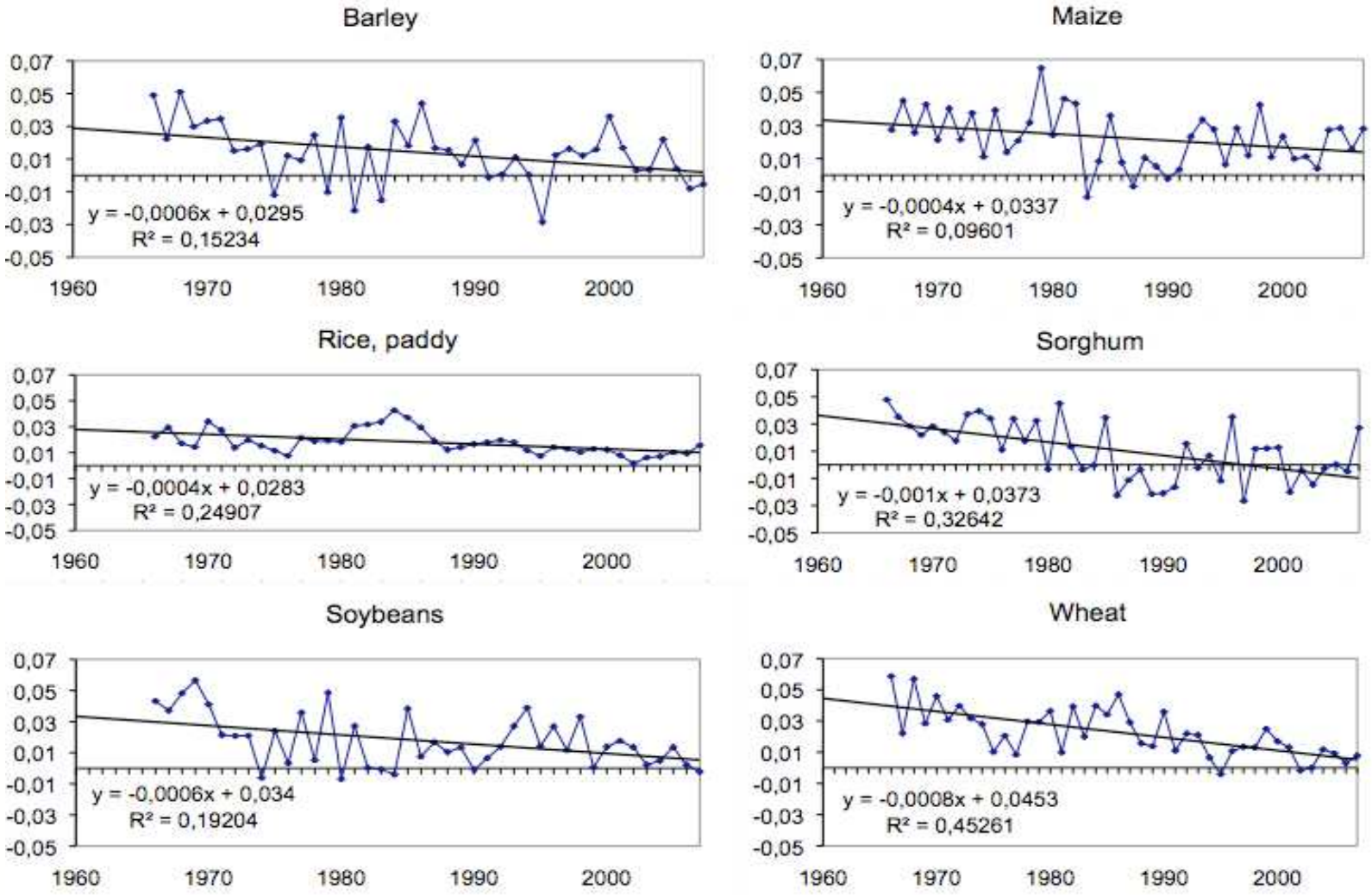
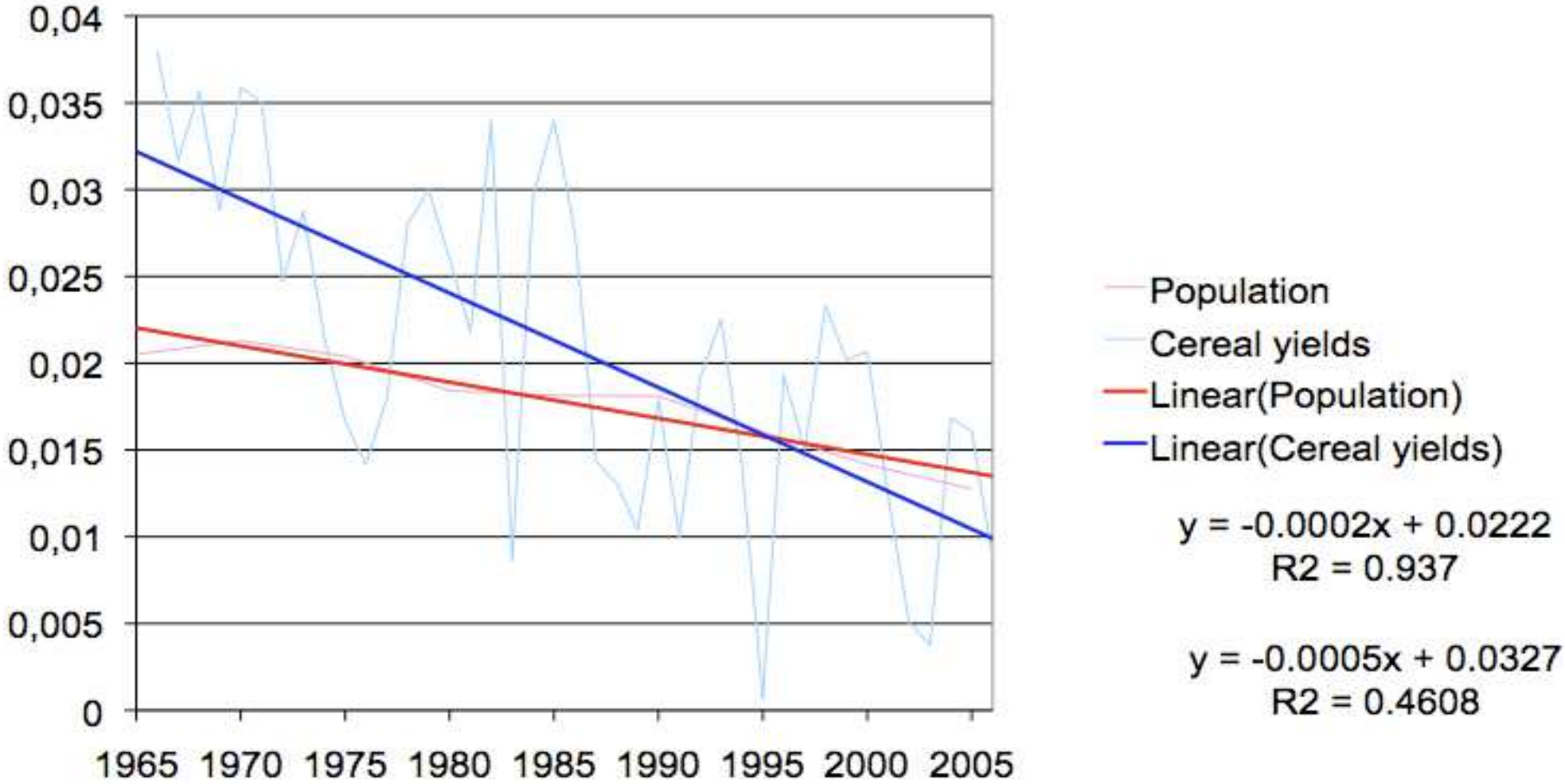
Global crop yields grow slower than in past 5 year moving averages



Source: based on FAOSTAT online data 2008 presented by Dr Stefan Bringezu.

Wuppertal Institute
for Climate, Environment
and Energy



Source: UN population statistics online; FAOSTAT online, presented by Dr Bringezu

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for Climate, Environment
and Energy

Fishery resources: fished out

Picture source: Greenpeace

Interim conclusion

There must be either:

An expansion in cropland

or

Increased rate of yield growth

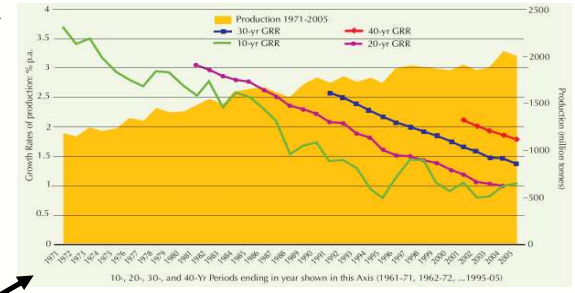
Constraints on expansion

Climate change

Water availability

GHG mitigation

Soil degradation



Deforestation

Biodiversity

Water quality

Resources, e.g. P

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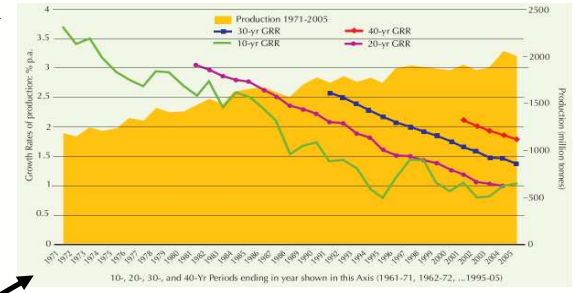
Constraints on expansion

Climate change

Water availability

GHG mitigation

Soil degradation



Deforestation

Biodiversity

Water quality

Resources, e.g. P

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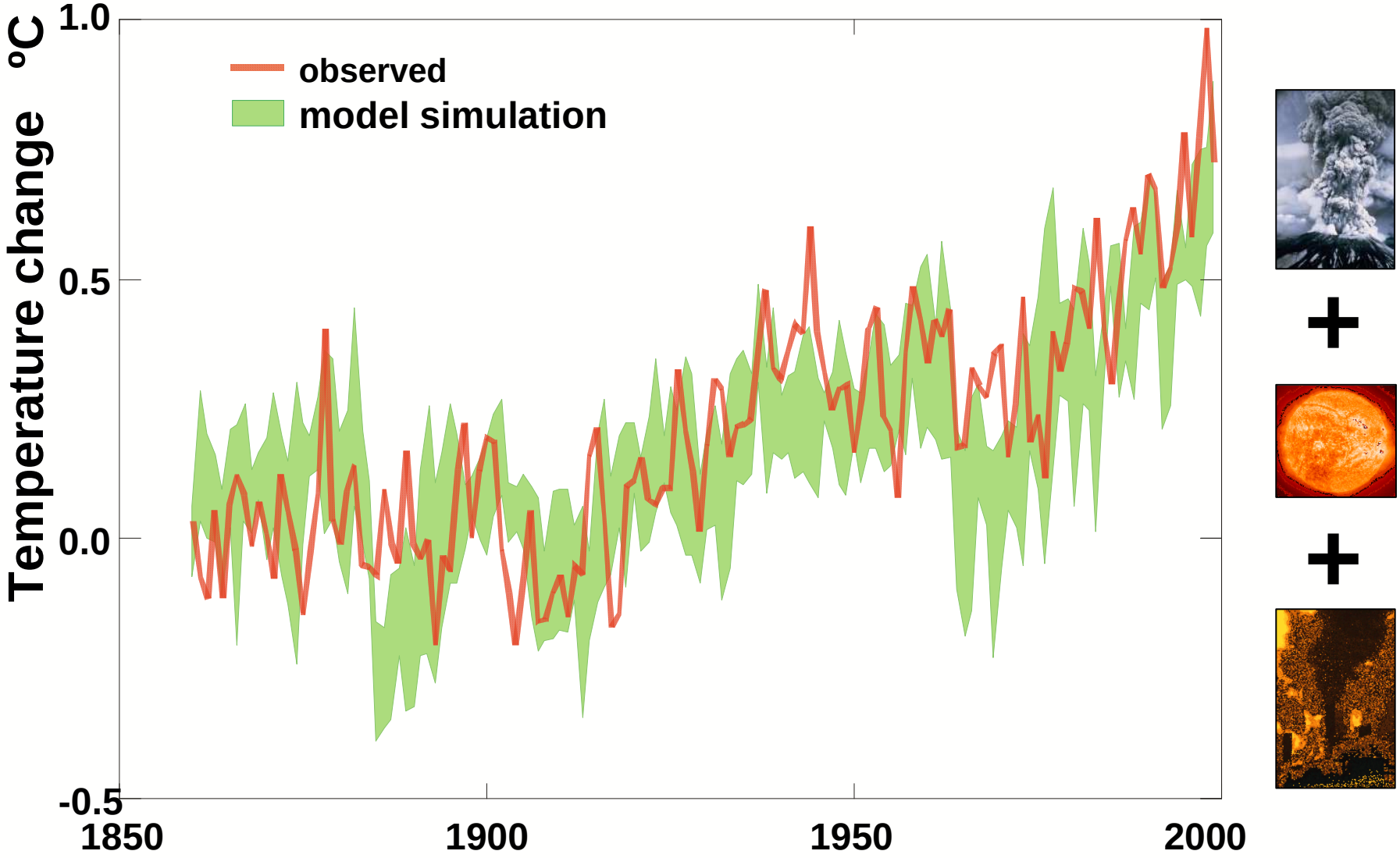
Climate change

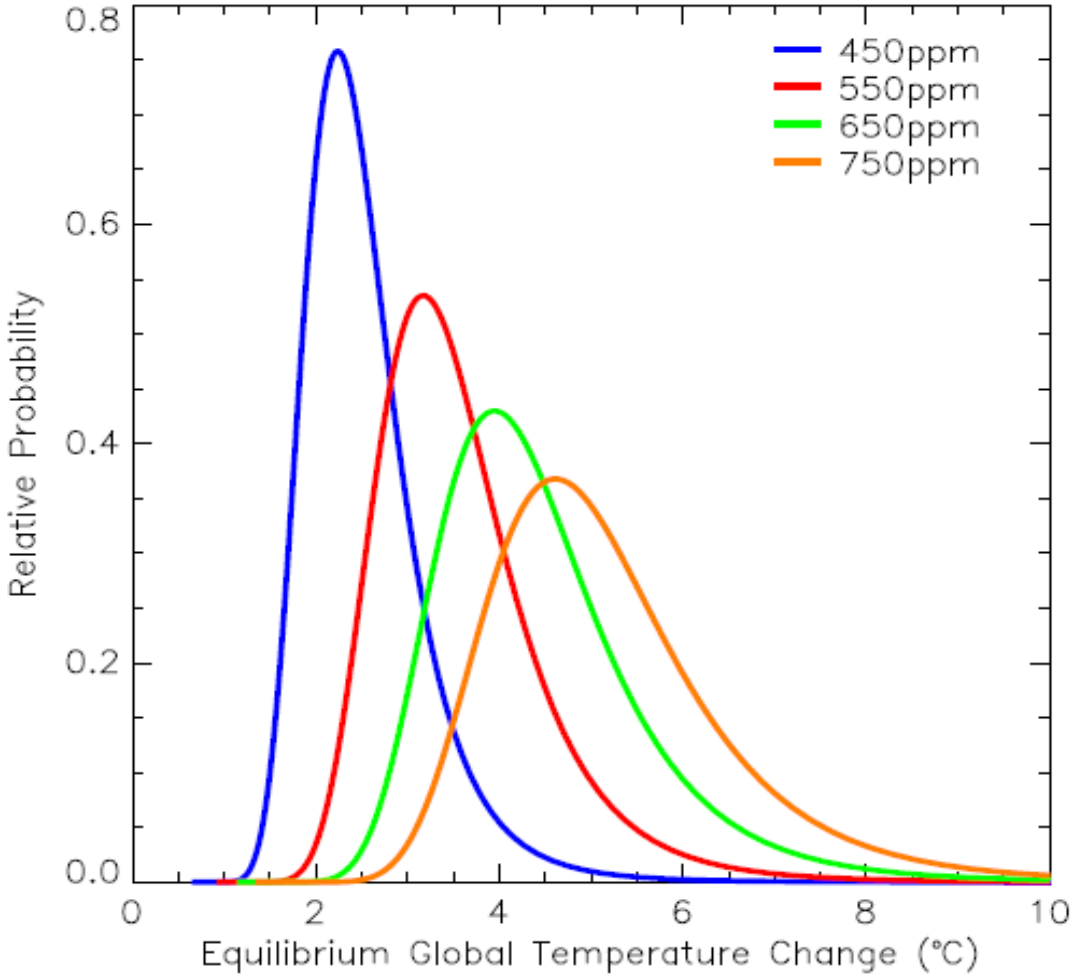
“Climate change is probably the greatest long-term challenge facing the human race.”

Tony Blair – Climate Change: The UK Programme 2006 (Defra)

Recent warming can be simulated when man-made factors are included



Global warming – the dangerous sting is in the risk tail



Source: Hadley Centre, cited by Sir David King

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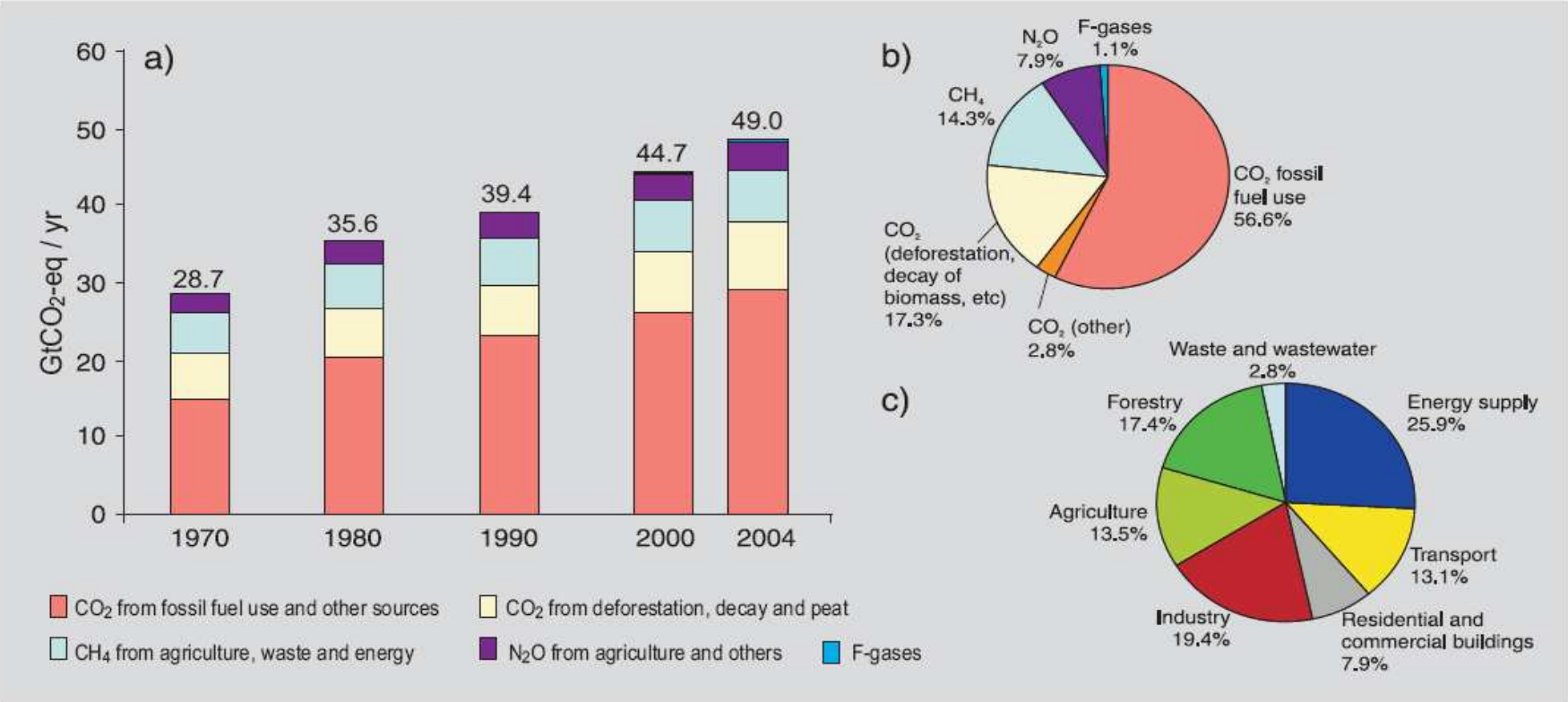
GHG emissions



Source: IPCC Fourth Assessment Report

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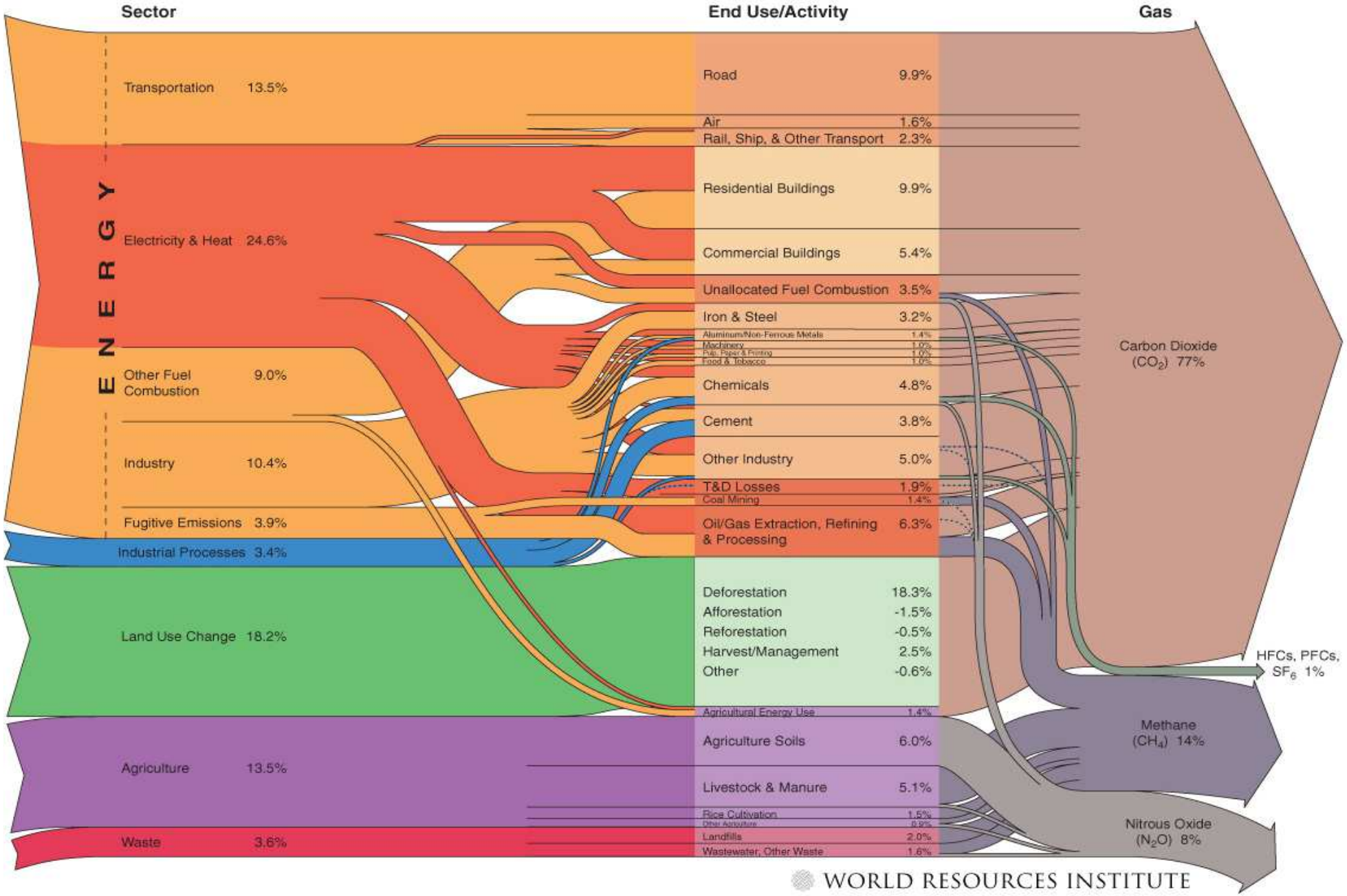
World GHG Emissions Flow Chart



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Life-cycle assessment

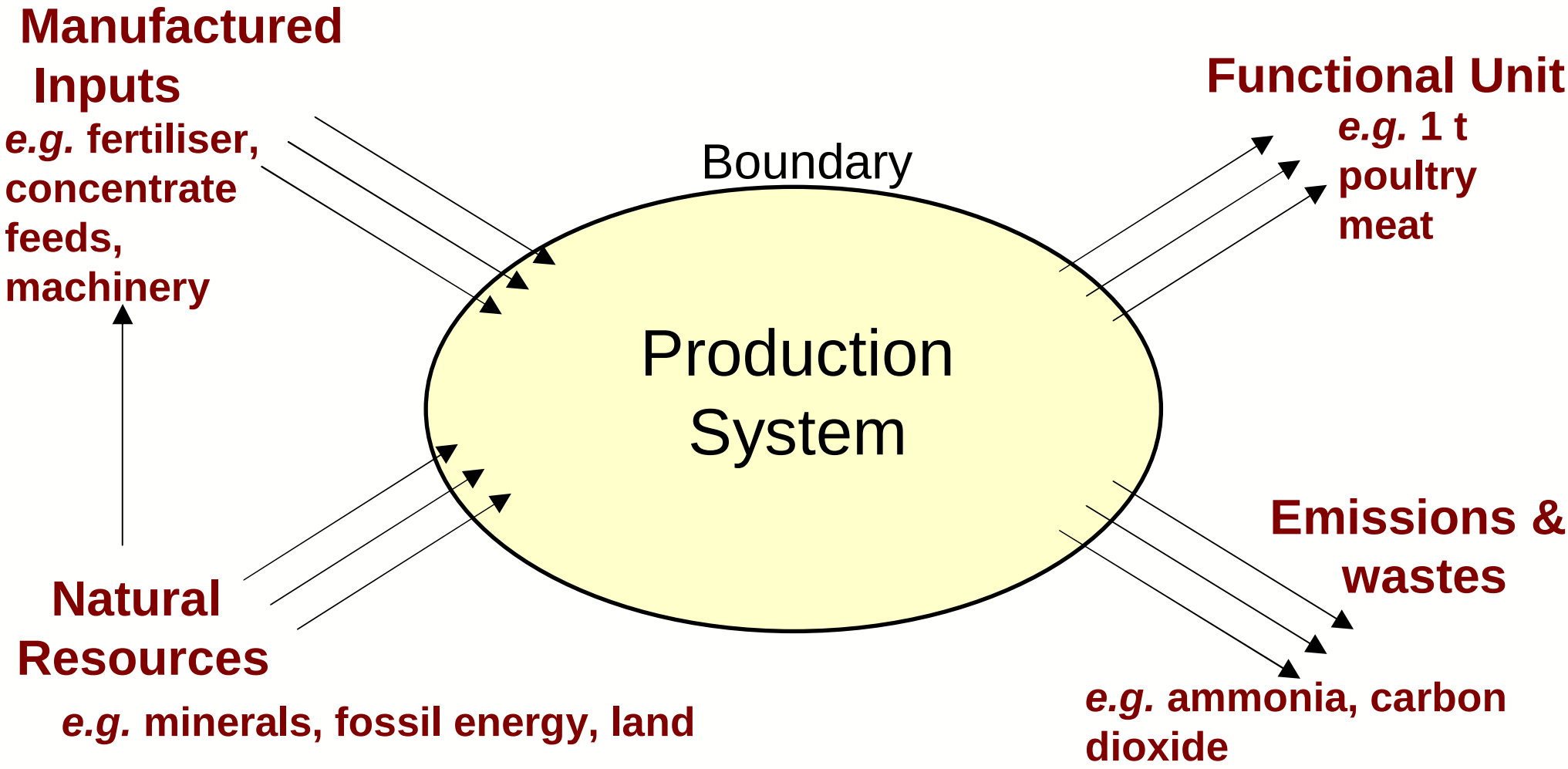
Life-cycle assessment links emissions to products – key to sustainable consumption

Attributional Life-Cycle Assessment is an objective process to evaluate the environmental burdens associated with a product, process, or activity by identifying energy and materials used and wastes released to the environment, and to evaluate and implement opportunities to affect environmental improvements. (SETAC, 1990)

Analysis of a production system

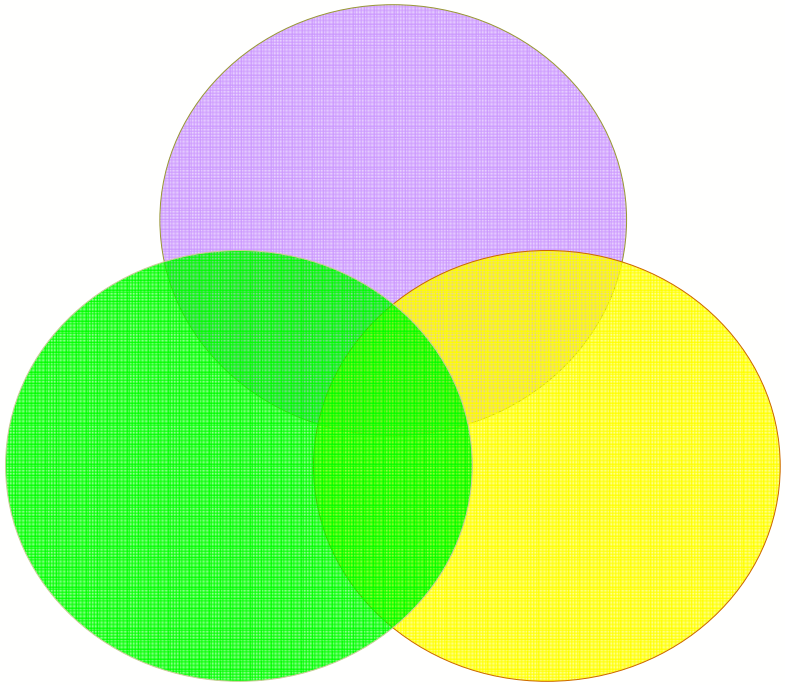
Inputs = Outputs

Mass flows measured at the system boundary must balance



What can you do with an assessment?

Policymakers



Producers

- ‘Eco-design’ of production

Consumers

- Sustainable consumption

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The ‘Cranfield’ Study (Defra project IS0205)

- Industry structure models
- Soil, crop & livestock process models
- Provides ability to address a wide range of questions

Resource use in UK animal production
1 tonne of carcase meat, 10 tonnes of milk, 20,000 eggs

Commodity	Primary energy used, MJ	Grade 2, ha	Grade 3a, ha	Grade 3b, ha	Grade 4, ha	Grade 1, ha	Grade 5, ha
Pig meat	23043	0.00	0.65	0.00	0.00	0.00	0.01
Poultry	16696	0.00	0.61	0.00	0.00	0.00	0.00
Beef	30210	0.03	0.63	0.81	0.65	0.00	1.32
Sheep meat	21834	0.07	0.49	1.32	1.06	0.00	2.65
Milk	26596	0.22	0.96	-0.06	-0.05	0.03	-0.10
Eggs	15710	0.00	0.54	0.00	0.00	0.00	0.01

Cranfield UNIVERSITY

Emissions in UK animal production

1 tonne of carcass meat, 10 tonnes milk, 20,000 eggs

Commodity	GWP100, kg CO2	Eutroph-ication potential, kg PO4 eqv.	Acid-ification potenti al, kg SO2 eqv.	NO3-N, to water, kg	NH3-N, to air, kg	N2O-N, to air, kg	Total N emitted, kg	CH4, to air, kg
Pig meat	4006	66	241	30	41	3	87	34
Poultry	2687	32	96	27	17	3	55	2
Beef	12114	121	296	104	64	9	185	239
Sheep meat	14605	207	495	191	36	10	286	310
Milk	10078	50	143	51	40	6	112	220
Eggs	2932	40	140	27	27	3	70	4

Cranfield UNIVERSITY

Emissions in UK animal production
1 tonne of carcass meat, milk dry matter, 20,000 eggs

Commodity	Primary energy used, MJ	GWP100, kg CO2	Soy use t/t
Pig meat	23043	4006	0.85
Poultry	16696	2687	0.62
Beef	30210	12114	0.14
Sheep meat	21834	14605	0.15
Milk	26596	10078	0.21
Eggs	15710	2932	0.52

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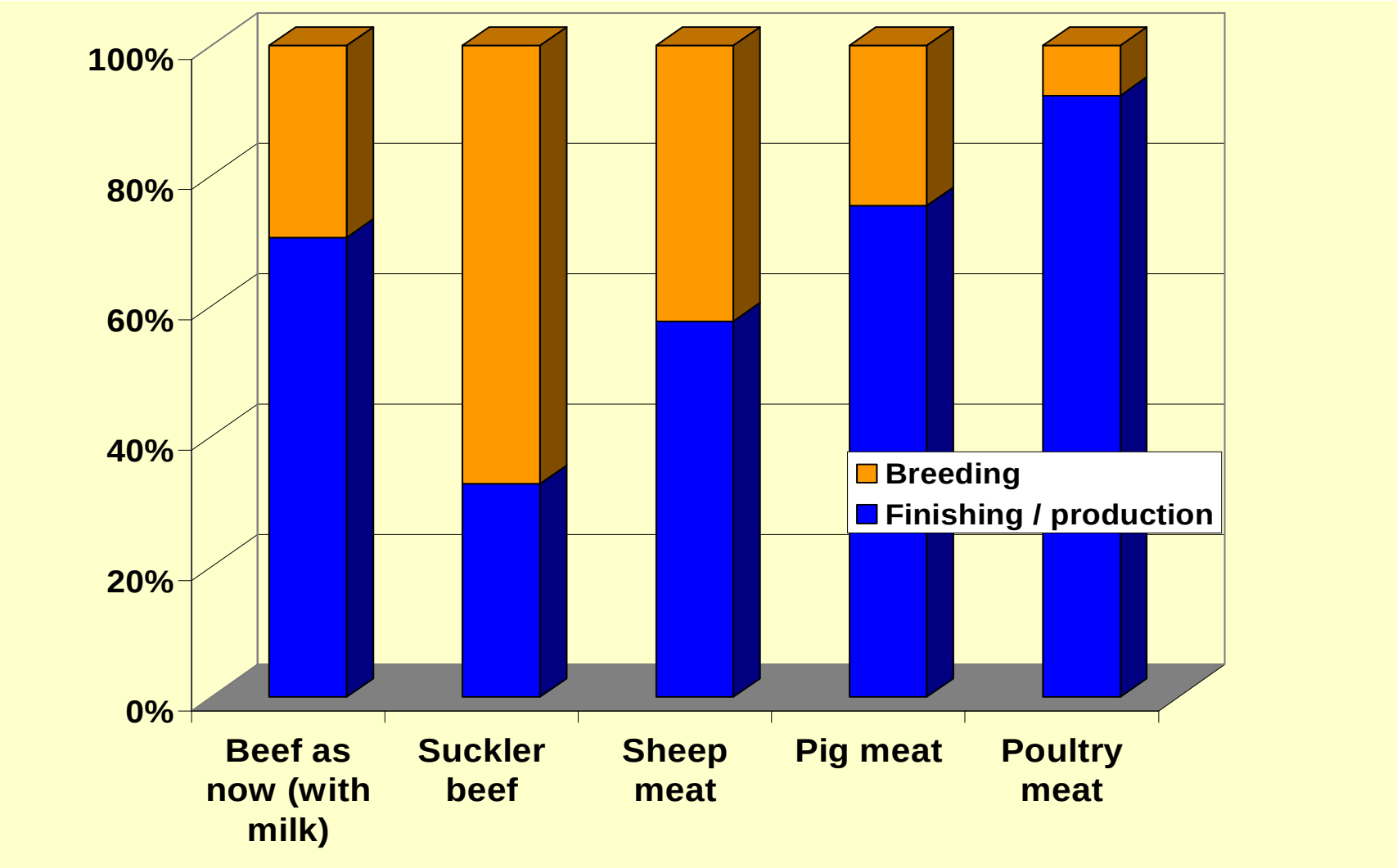
Distributions of energy in meat production



1 tonne poultry meat-
a closer look

1818 kg CO2	1818 kg CO2
27 kg Nitrate N	-
17 kg Ammonia N	-
3 kg Nitrous Oxide N	1516 kg CO2
55 kg N released	-
Ca 30 kg N recovered	-
2 kg Methane	46 kg CO2
kg CO2 equivalent	2687 kg CO2

Deforestation: ?????

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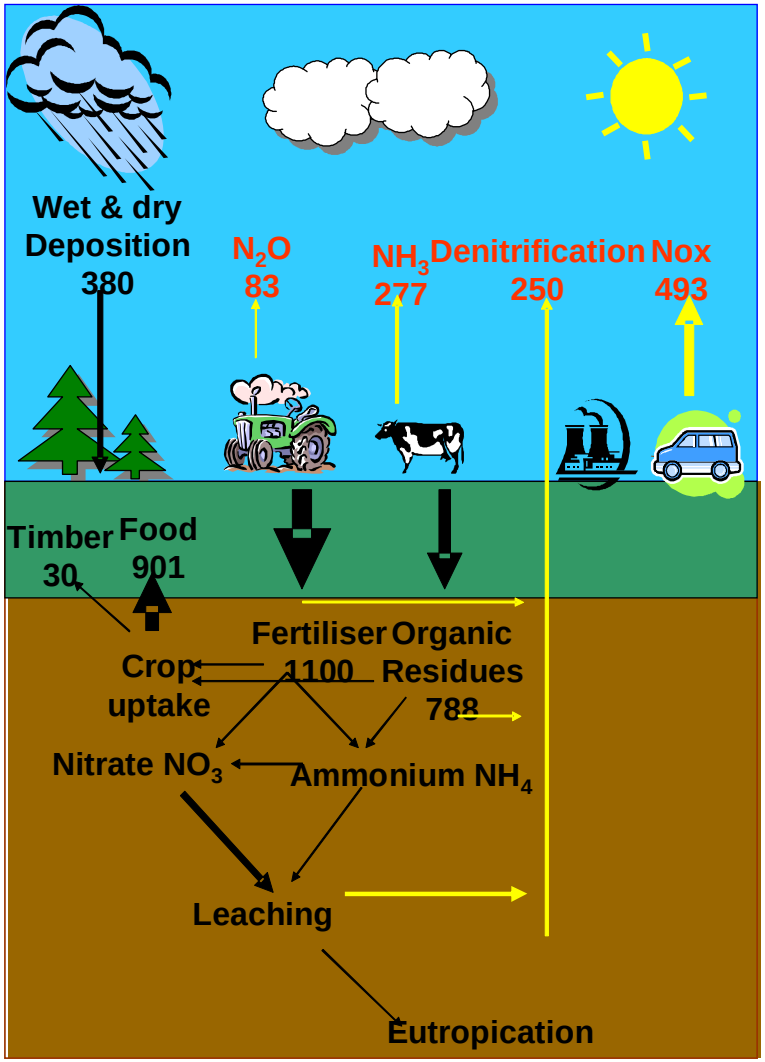
Nitrogen and the LCA of agricultural commodities



"… a carbon footprint inadequately describes agriculture; it has a *carbon-nitrogen footprint*…..The majority of environmental burdens arising from the production of agricultural food commodities arise either directly or indirectly from the nitrogen cycle and its modification….."

(Adrian Williams, Eric Audsley and Daniel Sandars of Cranfield University – Executive summary of the Defra Project Report IS0205)

Improving the nitrogen economy of agriculture lies at the centre of improving environmental performance re the major LCA parameters

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Qualifications on LCA

- **Steady states - not transition**
- **Soil C not included**
- **N_2O could be calculated by other methods**
- **Activity data are limited**
- **Not about environmental performance of individual farms or biodiversity**
- **Burdens, not impacts**
- **Land-use change (e.g. deforestation) not included**

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Resource use- and eco-efficiency

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Resource use- and eco-efficiency
The global environmental challenges for the poultry sector

- **Deforestation**
- **Concentration**
- **Nitrogen use**

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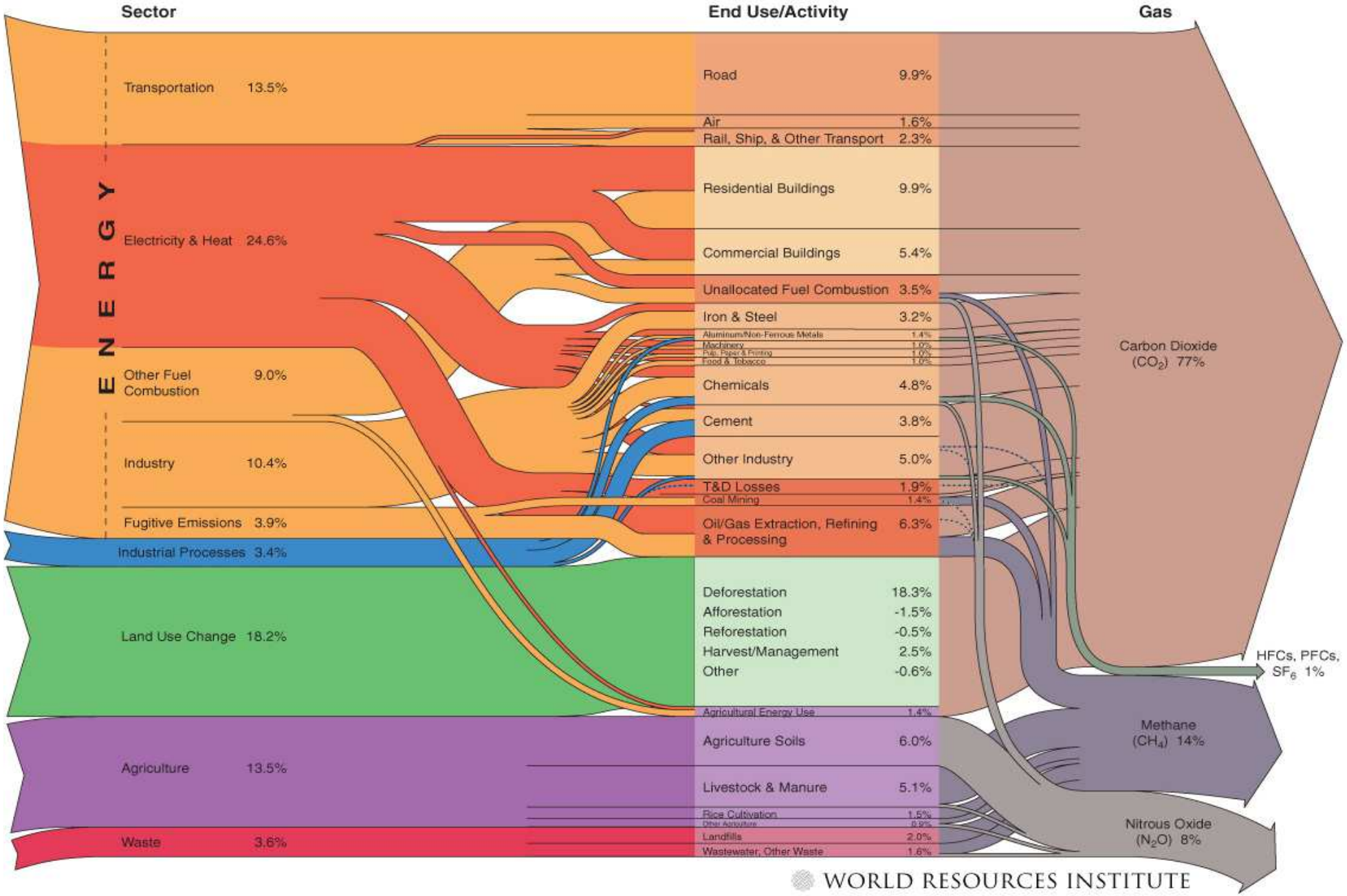
World GHG Emissions Flow Chart



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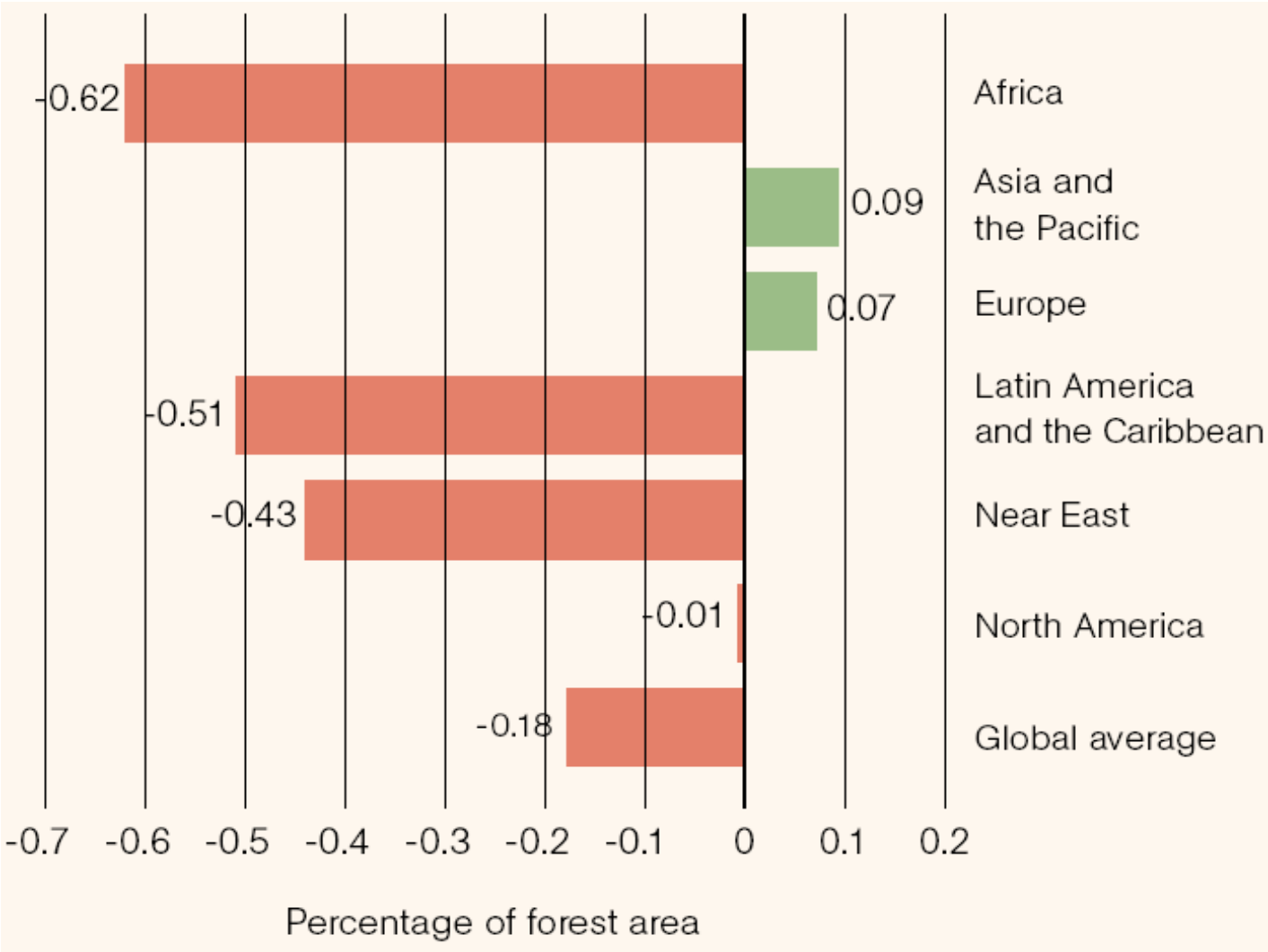
Annual net change in forest area 2000-2007



Source: FAO 2006, State of the world's forests

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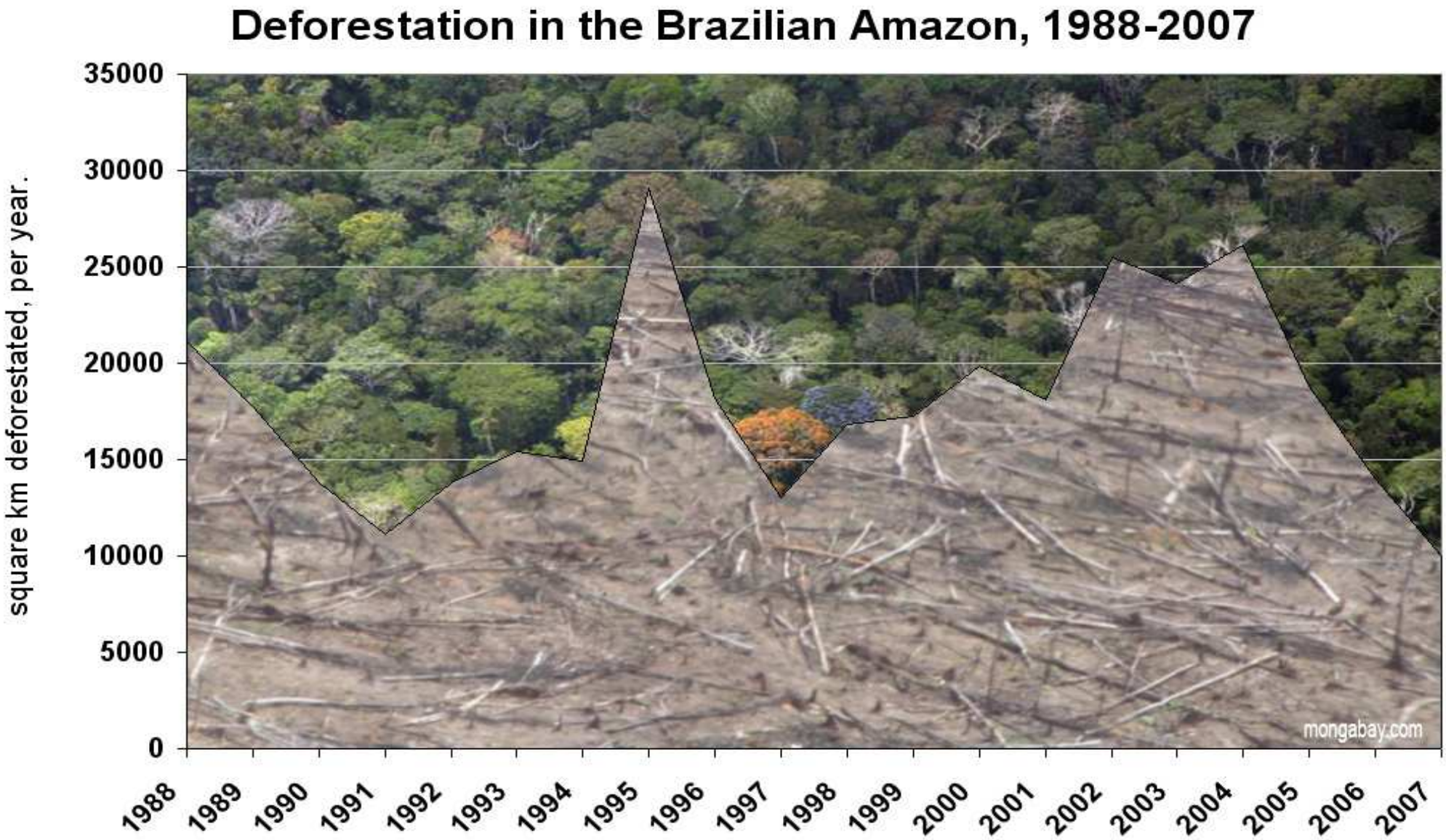
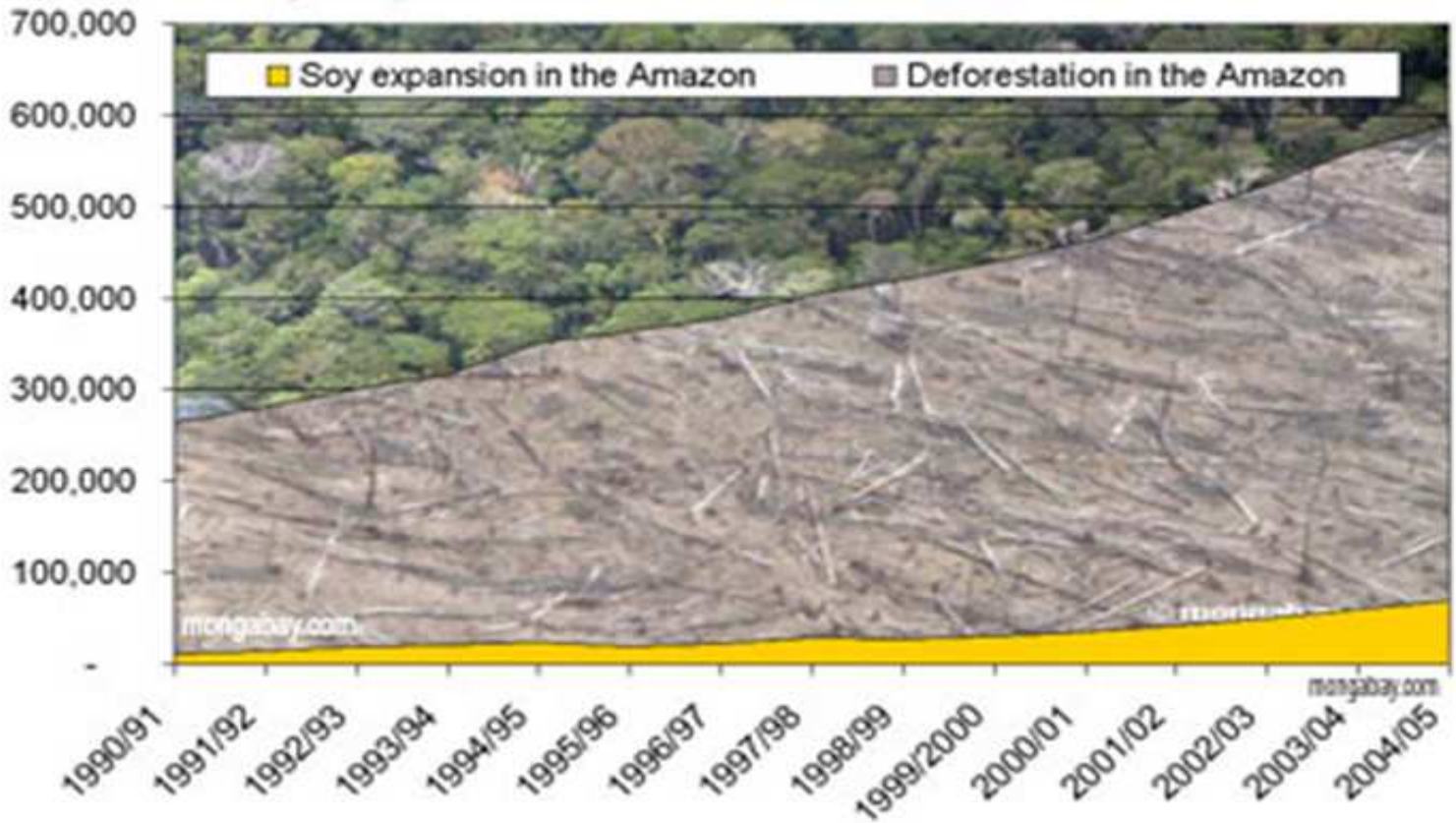


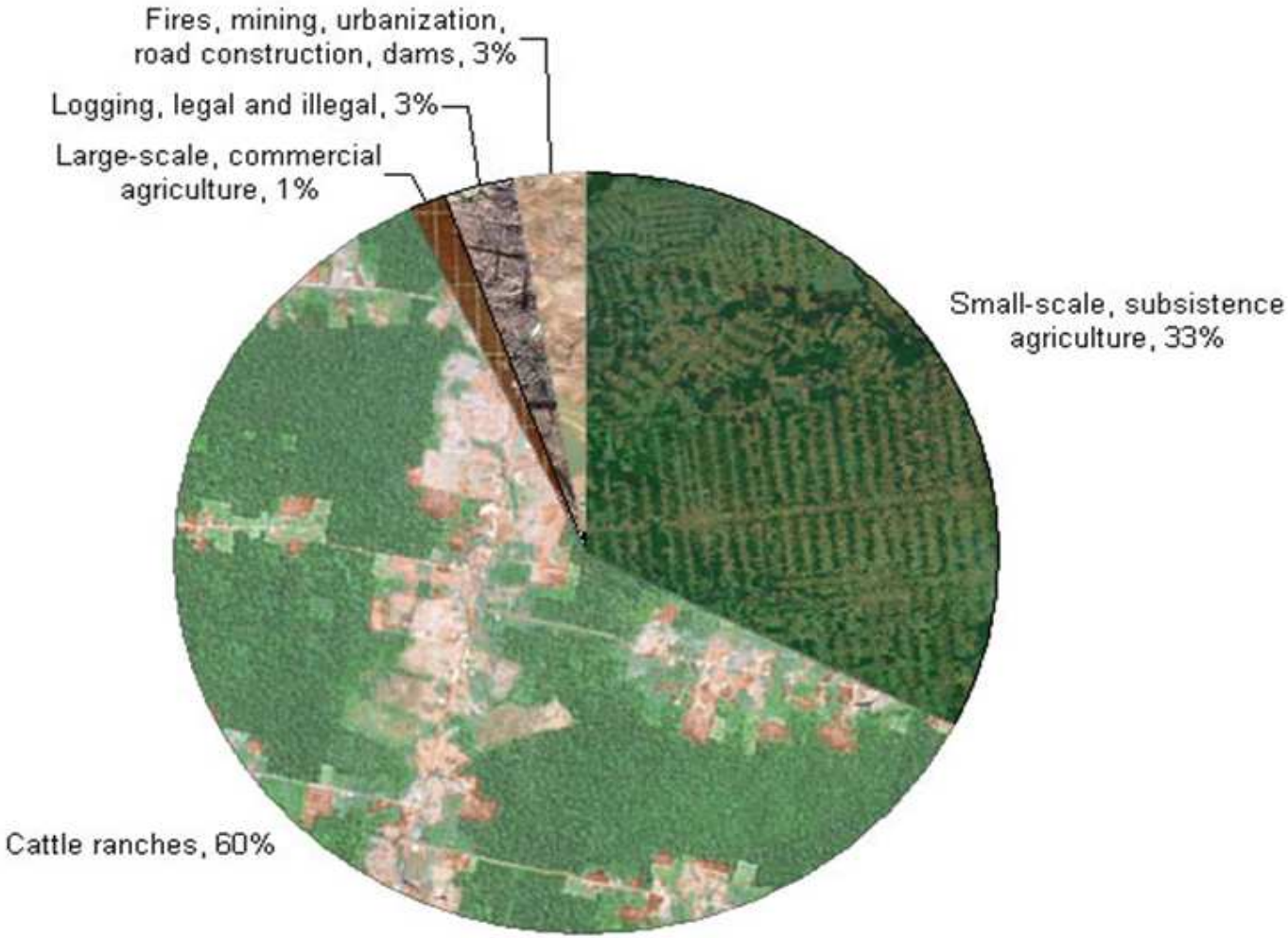
Source: Mongabay.com

Soy expansion in the Amazon in 2000-2005



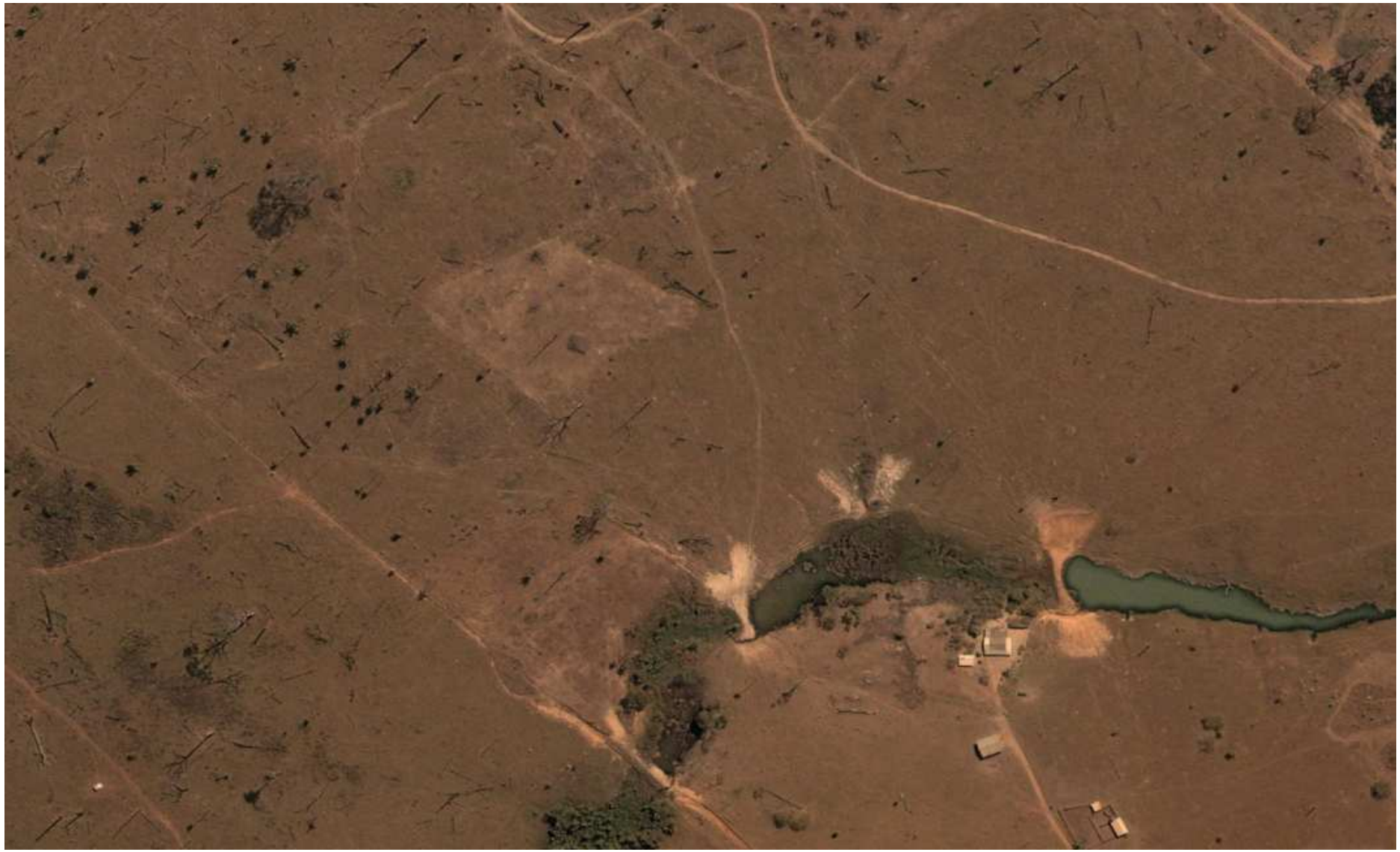
Source: Mongabay.com

Use of land in the Amazon deforested in 2000-2005

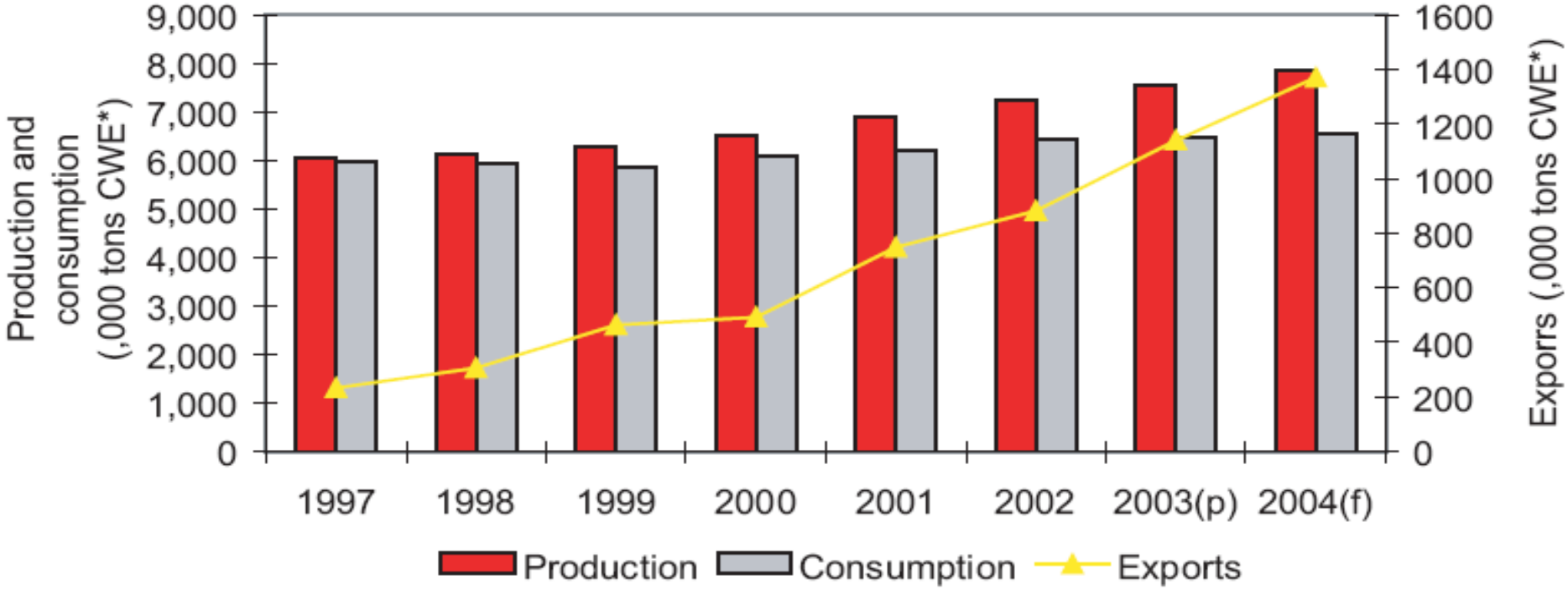


Source: Mongabay.com

Source: Mongabay.com



Changes in Brazilian beef production and consumption between 1997 - 2004



Source: United States Department of Agriculture (USDA),

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Hamburger Connection Fuels Amazon Destruction[1]

Cattle ranching and deforestation in Brazil's Amazon

CENTER FOR INTERNATIONAL FORESTRY RESEARCH
David Kaimowitz, Benoit Mertens, Sven Wunder and Pablo Pacheco

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Commodity markets driving agriculture north

Credit Aliança da Terra

Source: Paula Fridman/Carbis, Business Week May 22, 2008

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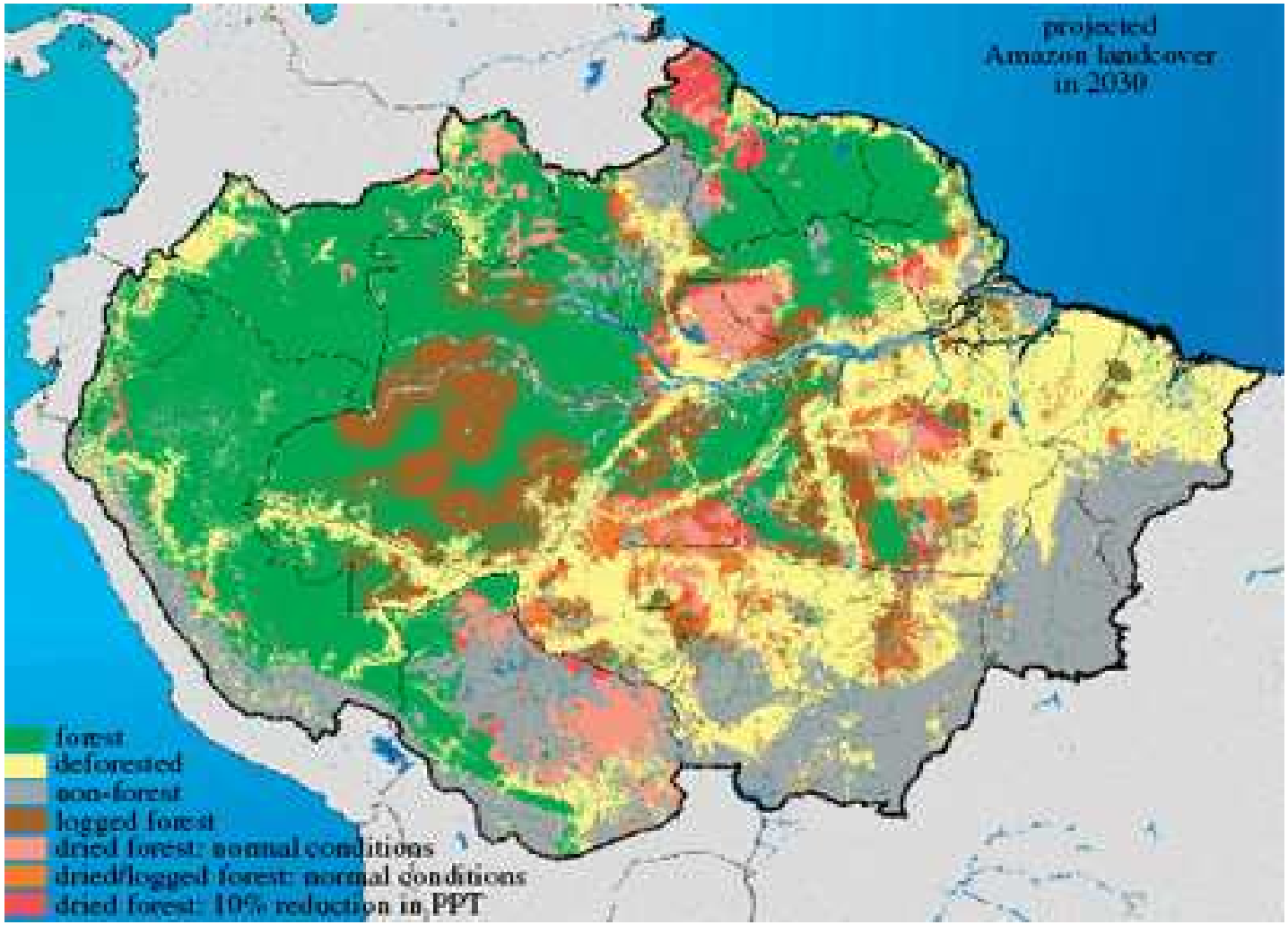
Projected deforestation to 2030



The Brazilian Amazon in 2030, showing drought-damaged, logged, and cleared forests. This map assumes that deforestation rates of 1997-2003 continue into the future, and that the climatic conditions of the last 10 years are repeated into the future. From Soares-Filho et al. 2006, Nepstad et al. 2004, 2007, Nepstad and Stickler in press, Merry et al. in review. (See Supplemental Online Material for description of methods at http://whrc.org/Brazilcarbonsupplement

Net present value of sustainably managed forest
0 – 350 USD/ha

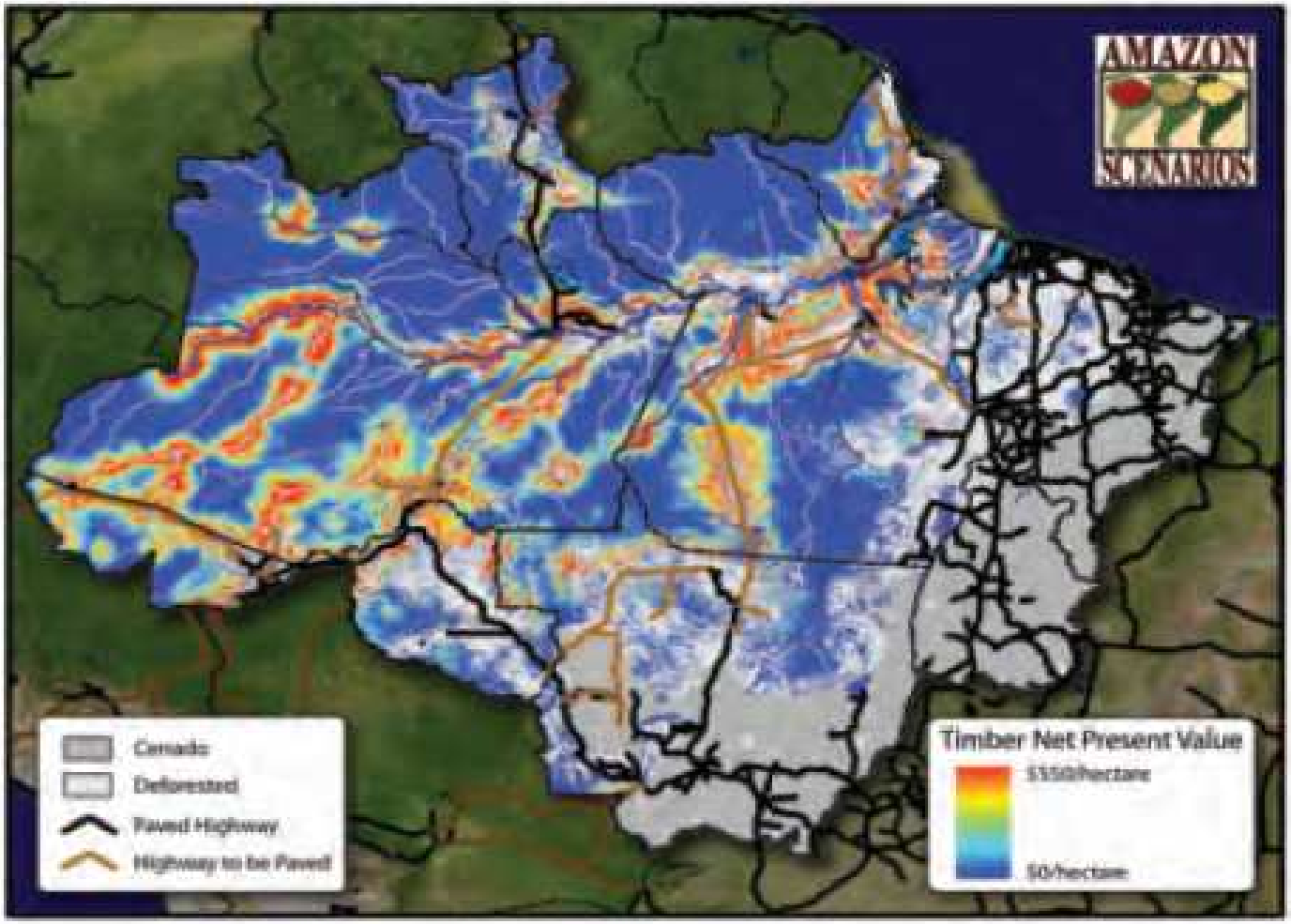


Figure 5. Potential net present value of sustainable timber production (2007–2037) for the forests of the Brazilian Amazon. Processing centers in this run of the timber rent model are restricted to annual harvests of 1/30th of the profitably harvestable timber stocks, thereby "forcing" the industry into sustainable, 30-year rotations. See http://.wbrc.org/Brazilcarbonsupplement for model description.

Net present value of cattle pasture
0 – 1150 USD/ha

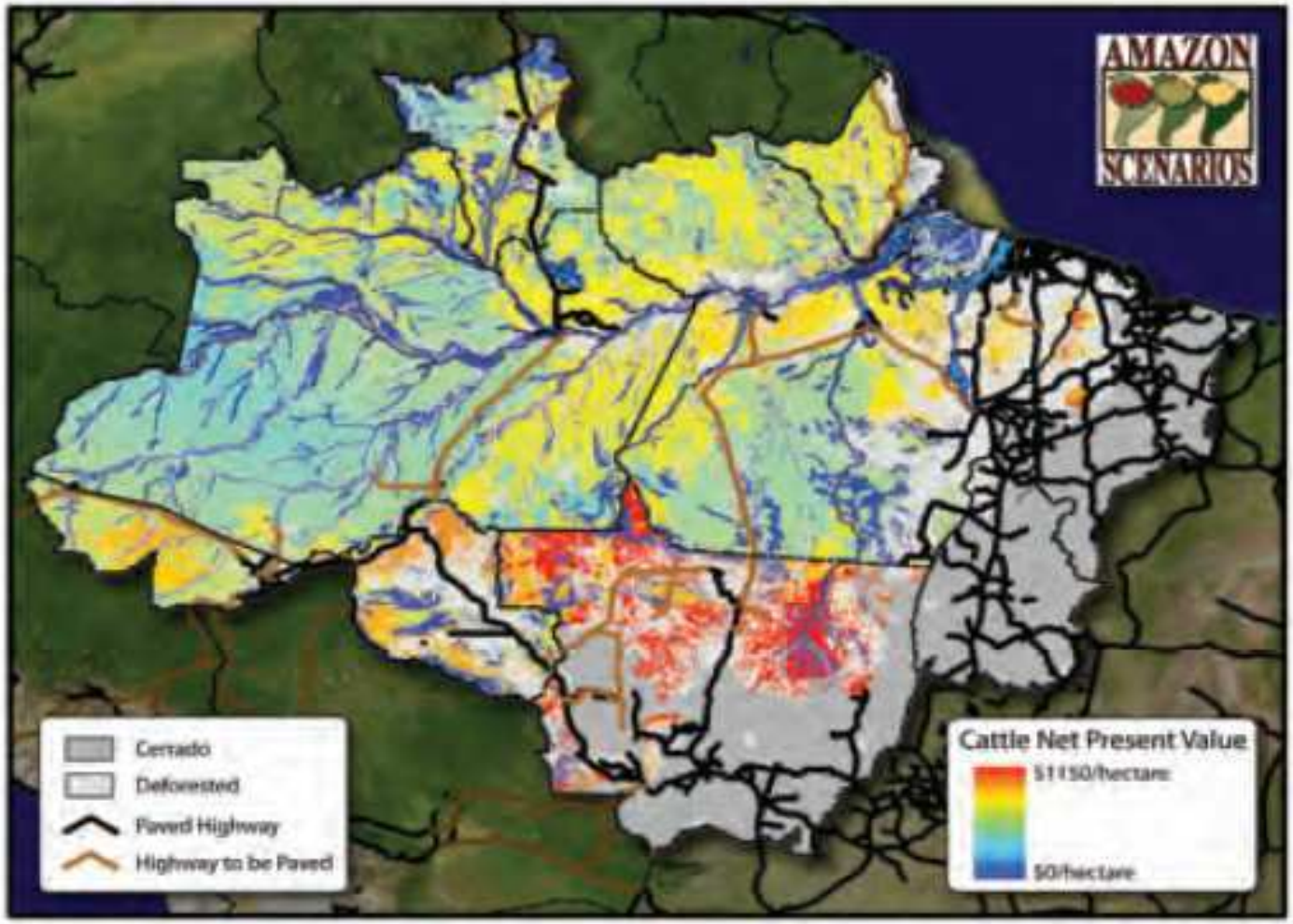


Figure 4. Potential net present value of cattle production (2007–2037) on the forested lands of the Brazilian Amazon. (http://whrc.org/Brazilcarbonsupplement).

Net present value of land for soy
0 – 12,000 USD/ha

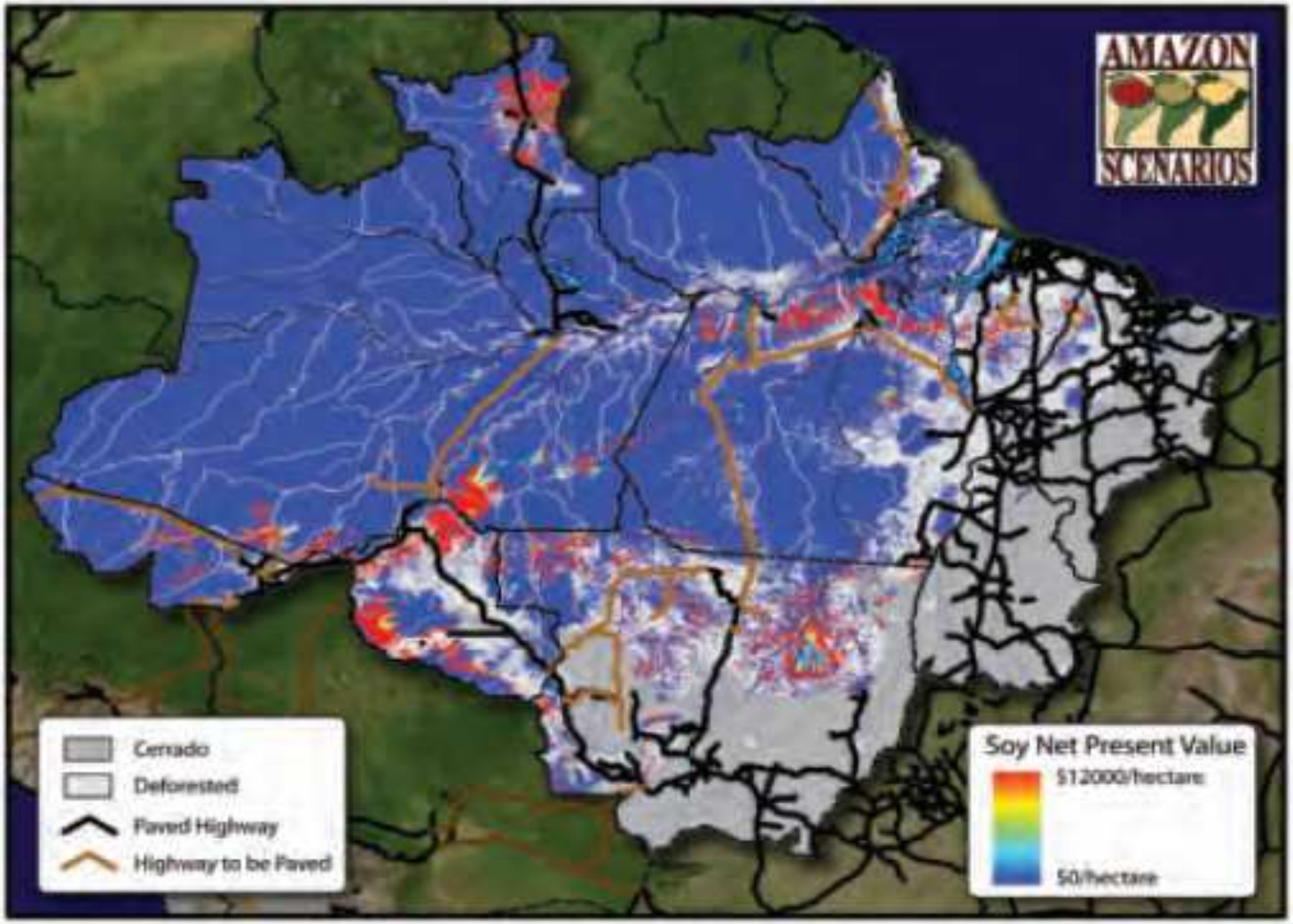


Figure 3. The potential net present value (2007 through 2037) of soy production on the forested lands of the Brazilian Amazon. (http://whrc.org/Brazilcarbonsupplement, Vera Diaz et al. 2007.)

Rational economic behaviour is driving deforestation

Source: WWF

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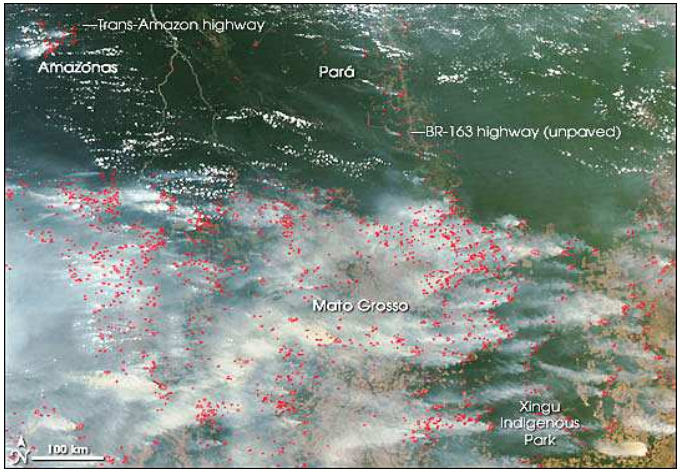
Reducing deforestation – four market based approaches

Reduced emissions from deforestation and degradation REDD

Increase the value of forest

Sustainable forest management



Farm produce certification

Reduce the value of agricultural land at the forest frontier

Increase crop performance in established areas

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Resource use- and eco-efficiency
The global environmental challenges for the poultry sector

- **Deforestation**
- **Concentration**
- **Nitrogen use**

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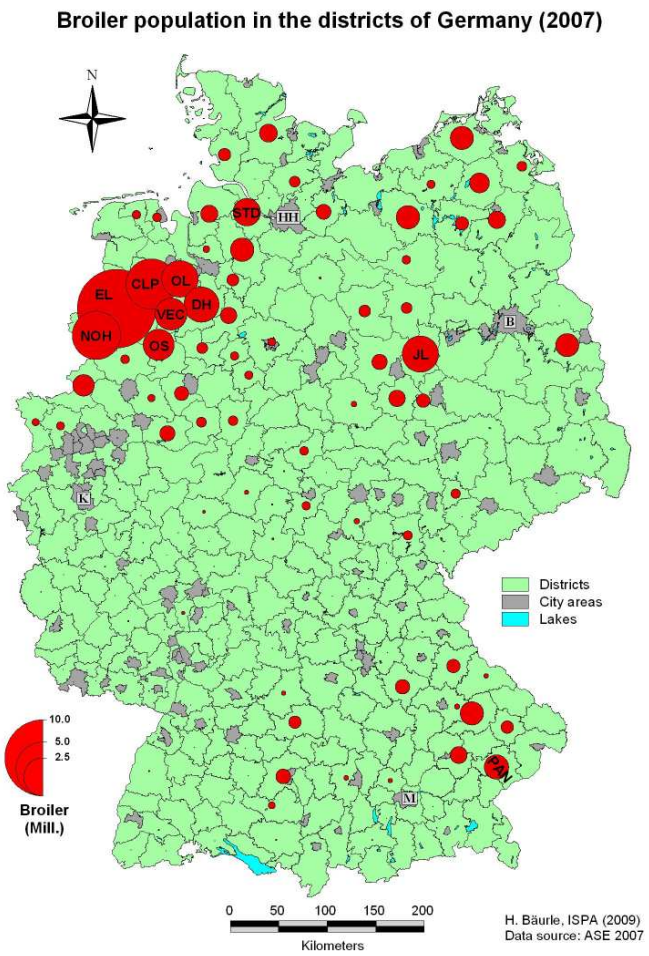
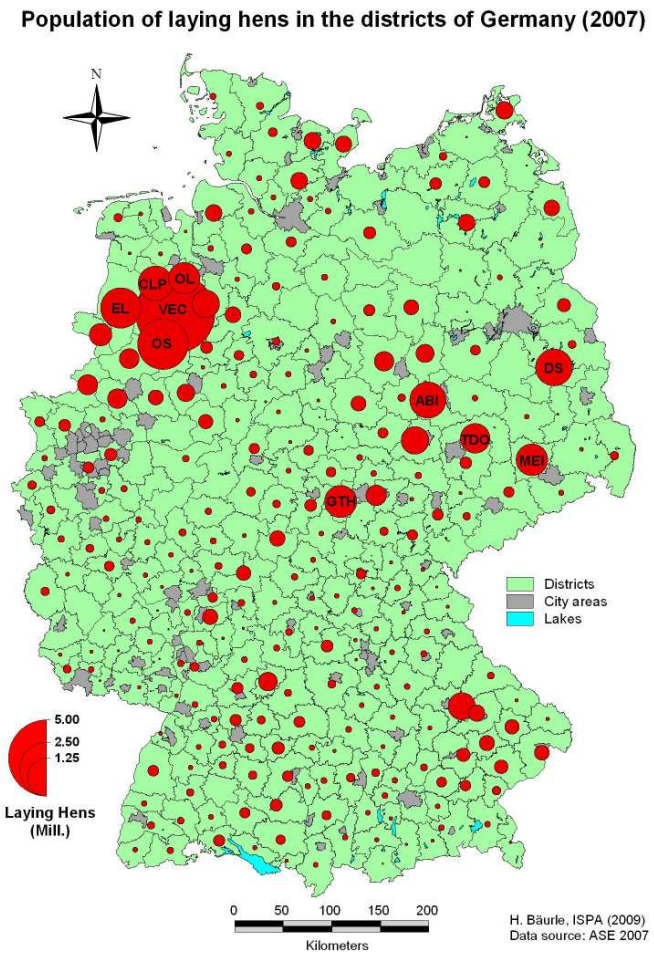
Concentration in Germany
An example - broilers



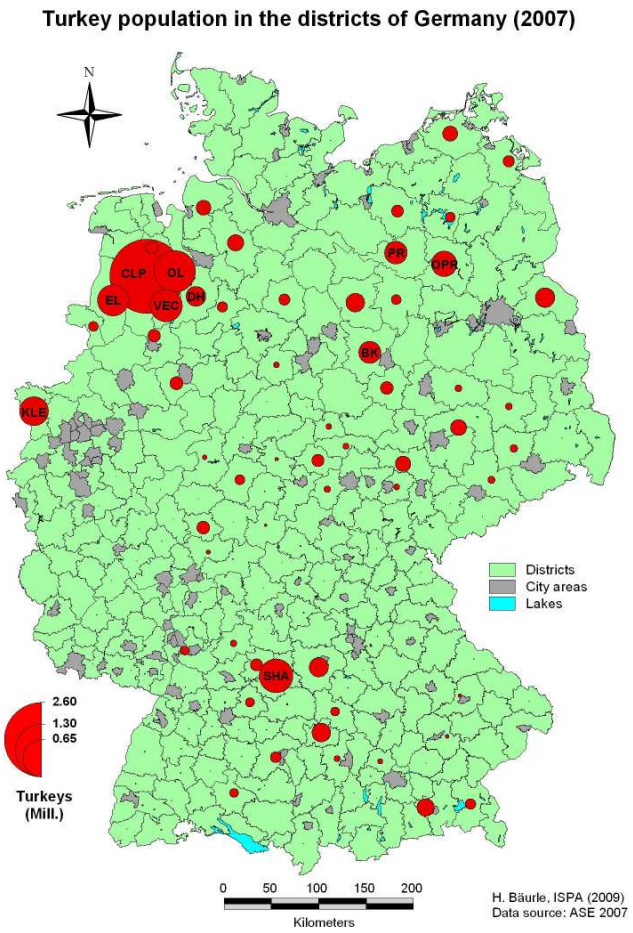
The Institute for Spatial Analysis and Planning in Areas of Intensive Agriculture (ISPA)

Concentration in Germany
Layers



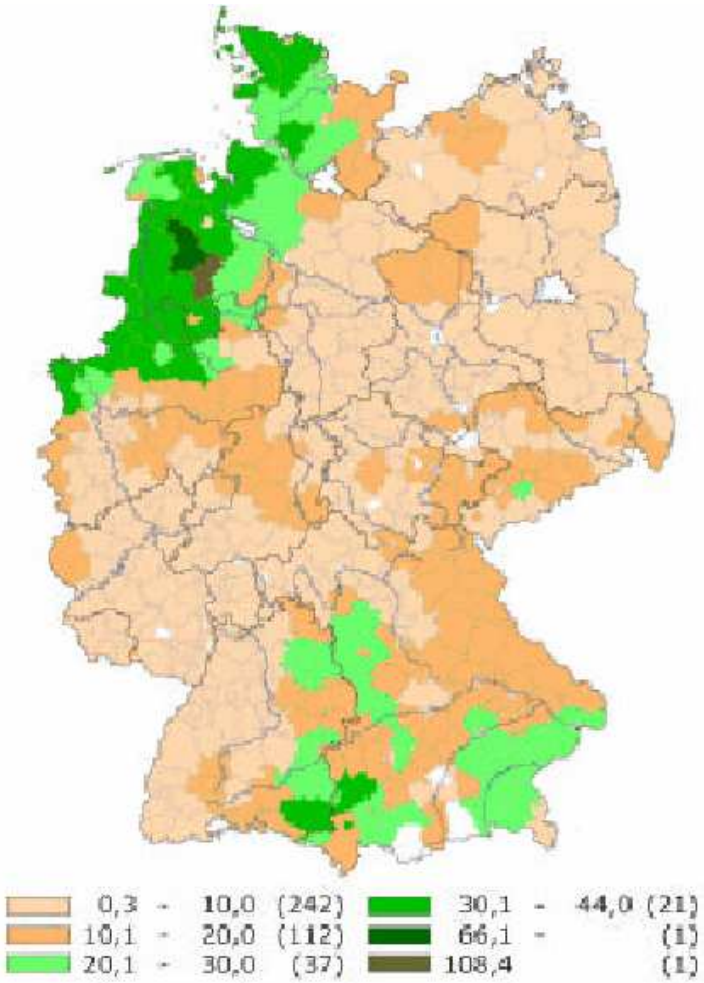
The Institute for Spatial Analysis and Planning in Areas of Intensive Agriculture (ISPA)

Concentration in Germany
- Turkeys



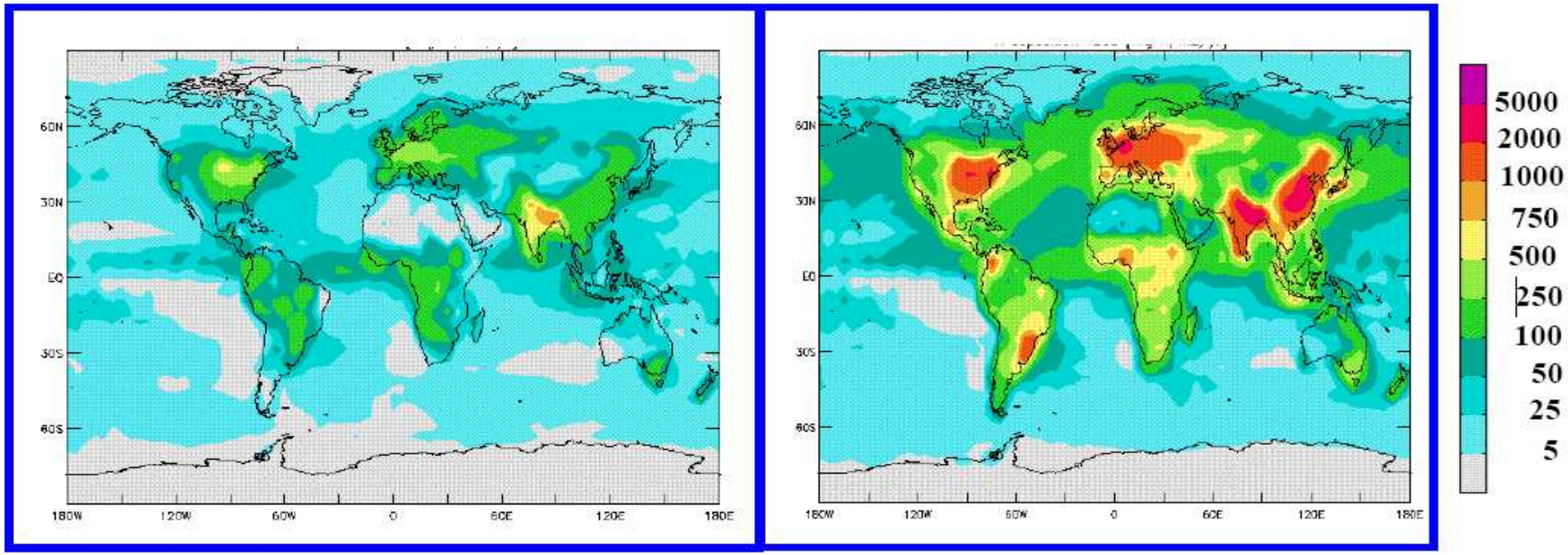
The Institute for Spatial Analysis and Planning in Areas of Intensive Agriculture (ISPA)

Concentration in Germany
Ammonia emissions



Nitrogen deposition

mg/m2/year



1890

1993

Source: Galloway and Cowling, 2002

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Concentration in Germany
Scientific support to development

The Institute for Spatial Analysis and Planning in Areas of Intensive Agriculture
(ISPA)

Hochschule Vechta University of Vechta · Germany

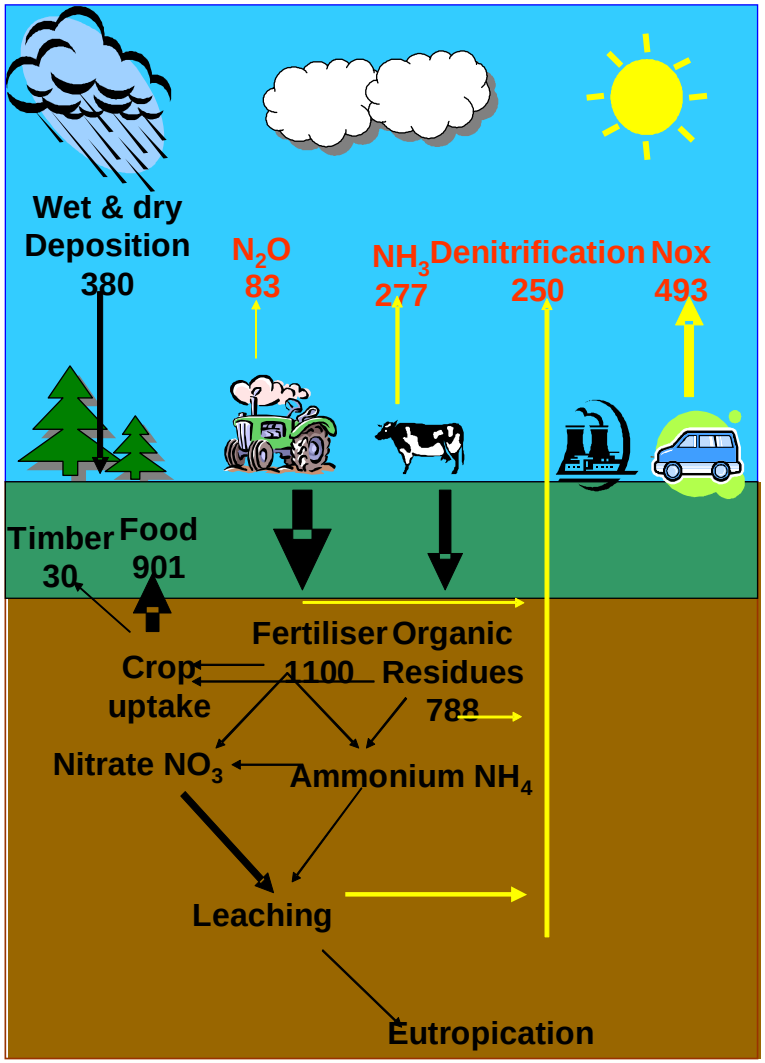
Concentration in engineering, technology, know-how

Concentration in Germany
co-location of intensive production and….

and a pleasant environment

Resource use- and eco-efficiency
The global environmental challenges for the poultry sector

- **Deforestation**
- **Concentration**
- **Nitrogen use**



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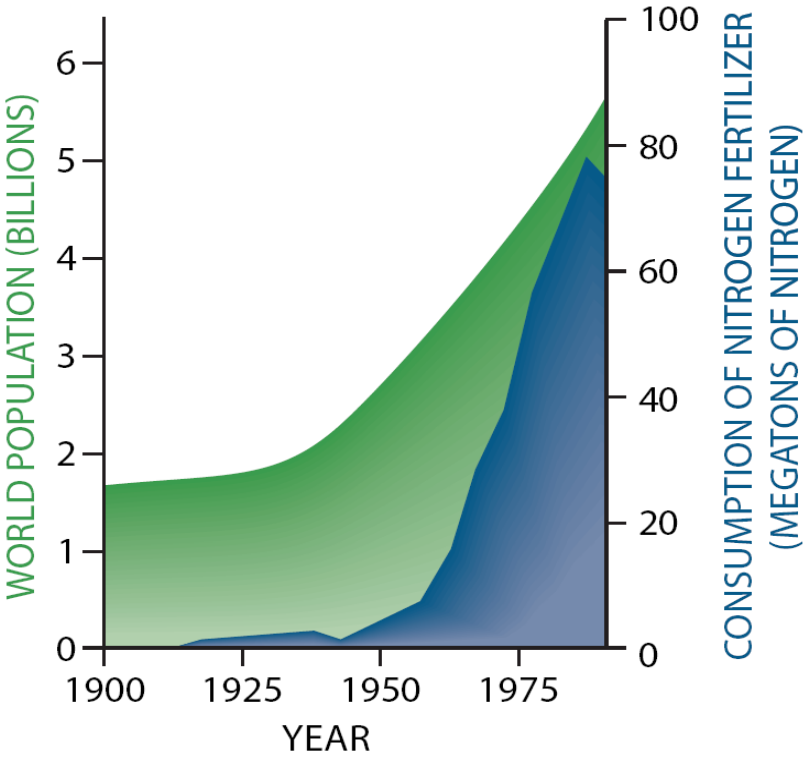
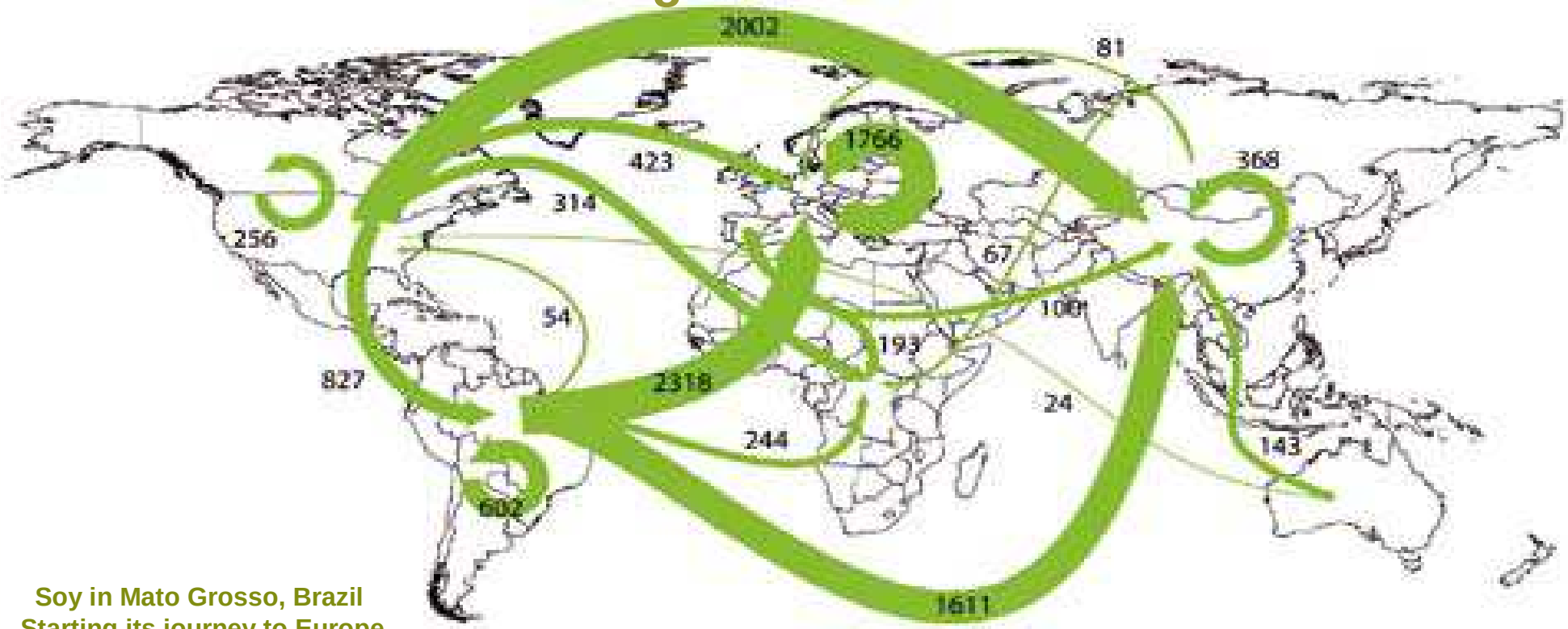
Mankind has doubled nitrogen fixation – mostly since 1945

"Currently at least two billion people are alive because the proteins in their bodies are built with nitrogen that came—via plant and animal foods—from a factory."



Smil, 1997. Global population and the nitrogen cycle. Scientific American, July 1997

Nitrogen contained in internationally traded crops
'Nitrogen miles'



Soy in Mato Grosso, Brazil
Starting its journey to Europe

Source: Lalo de Almaida for the New York Times

2004 data in thousands of tons of N; minimum requirement for drawing a line is 20,000 tons N. The total amount of nitrogen transferred in the trade of crop commodities was 11.5 million tonnes in 2004.
(From Braun, 2007).

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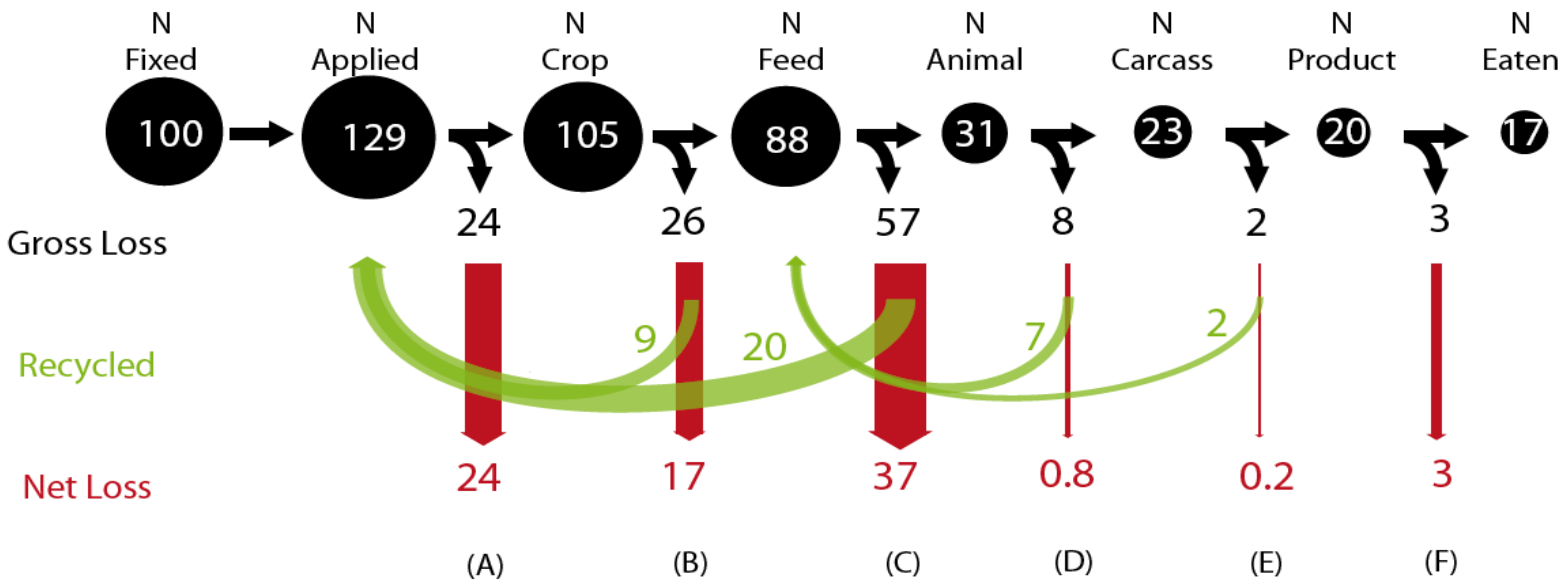
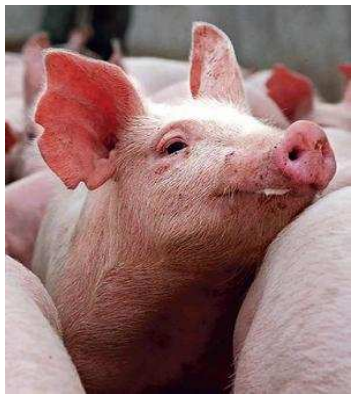
Fate of nitrogen entering the pigmeat production chain





Source: Galloway et al. cited by Braun (2007).

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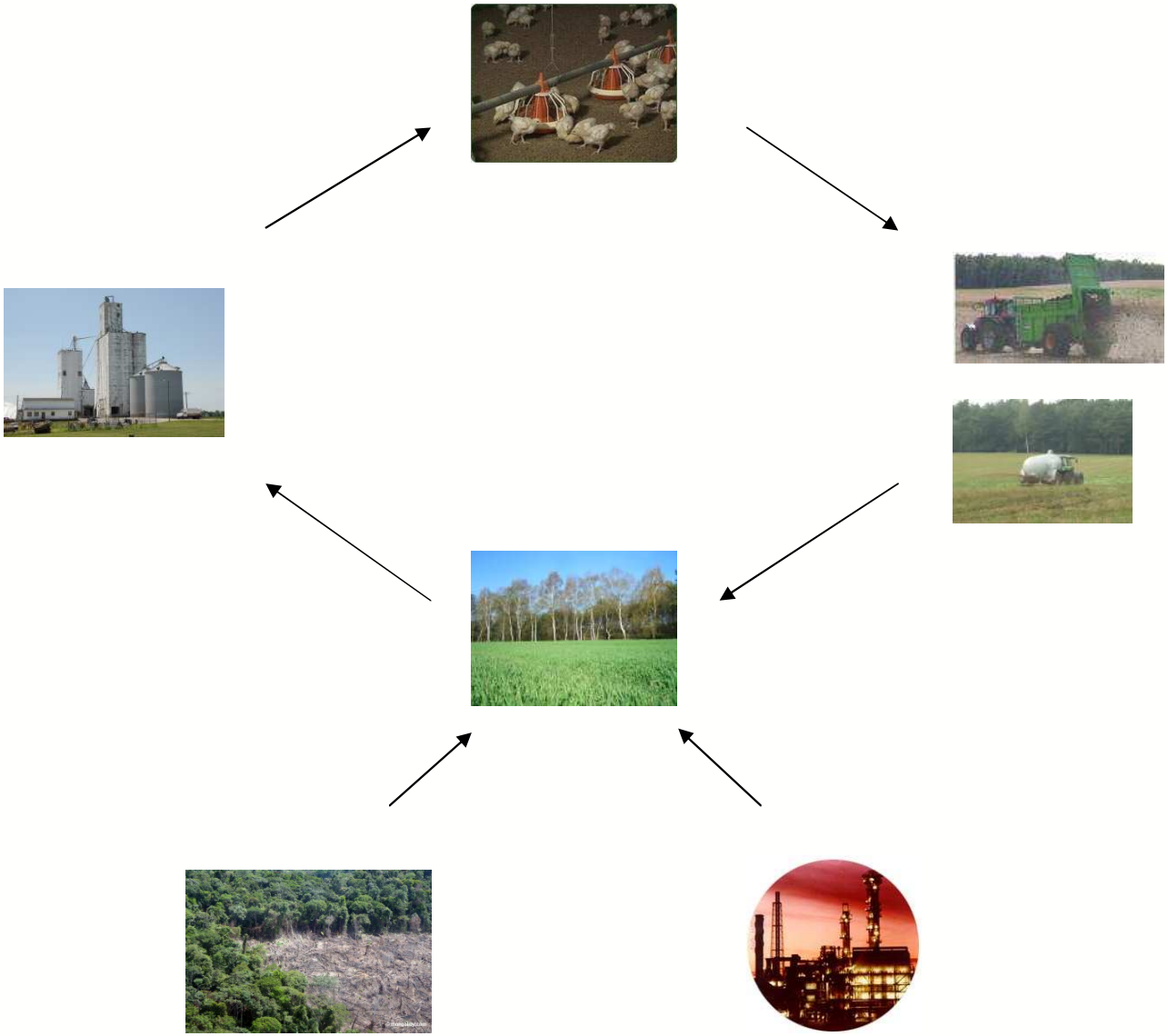
Key resource connections in poultry production



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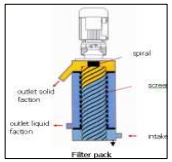
A strategic approach to nitrogen conservation

Ammonia capture

Precise protein
Feeding

Manure treatment



Lower protein
starch crops,
synthetic AA,
Lower soy inputs

Improved manure use

Reduced
deforestation

Reduced fertiliser
demand

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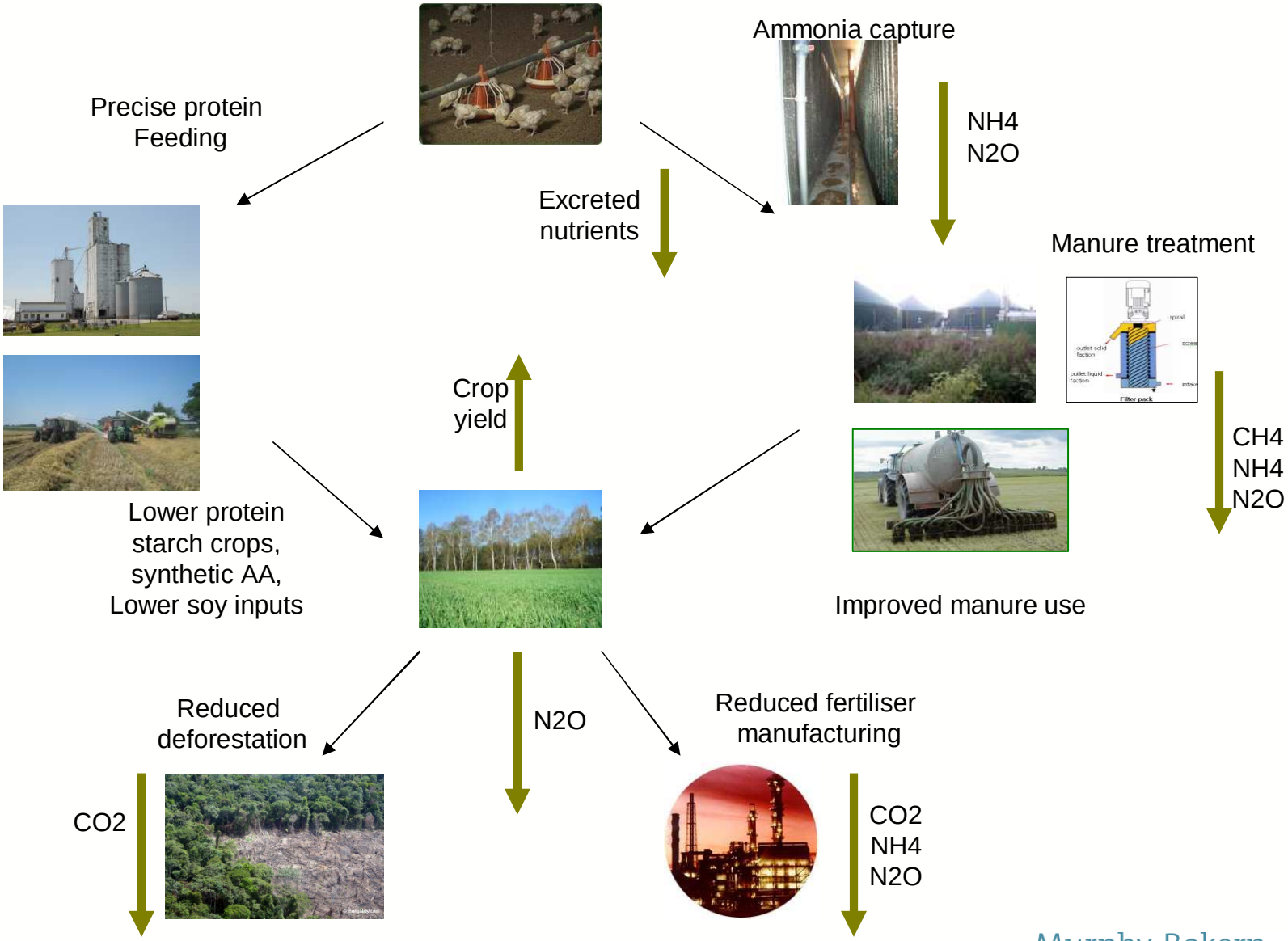
A strategic approach to nitrogen conservation



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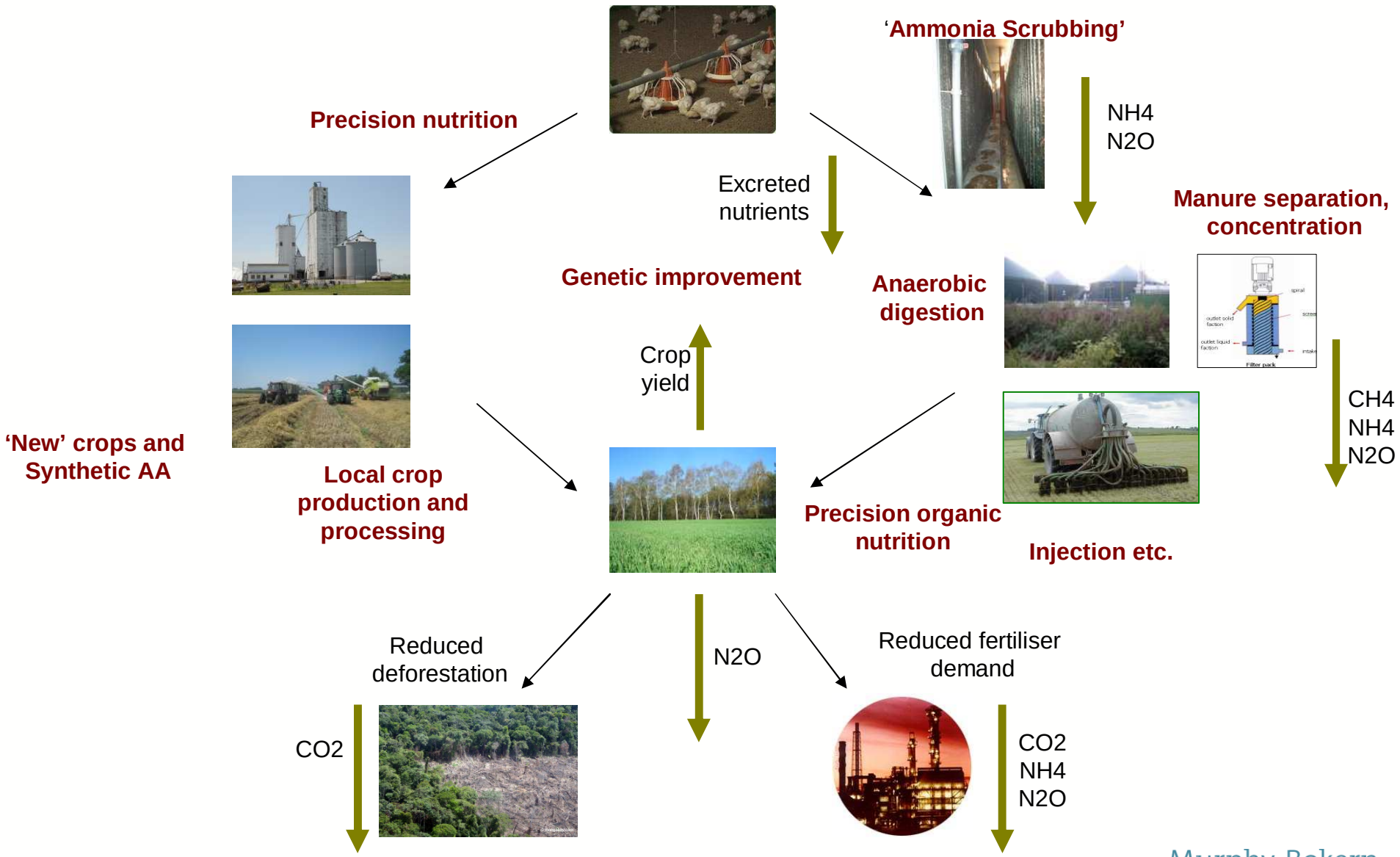
A strategic approach to nitrogen conservation - key technologies



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A strategic approach to nitrogen conservation - key technologies ammonia scrubbing

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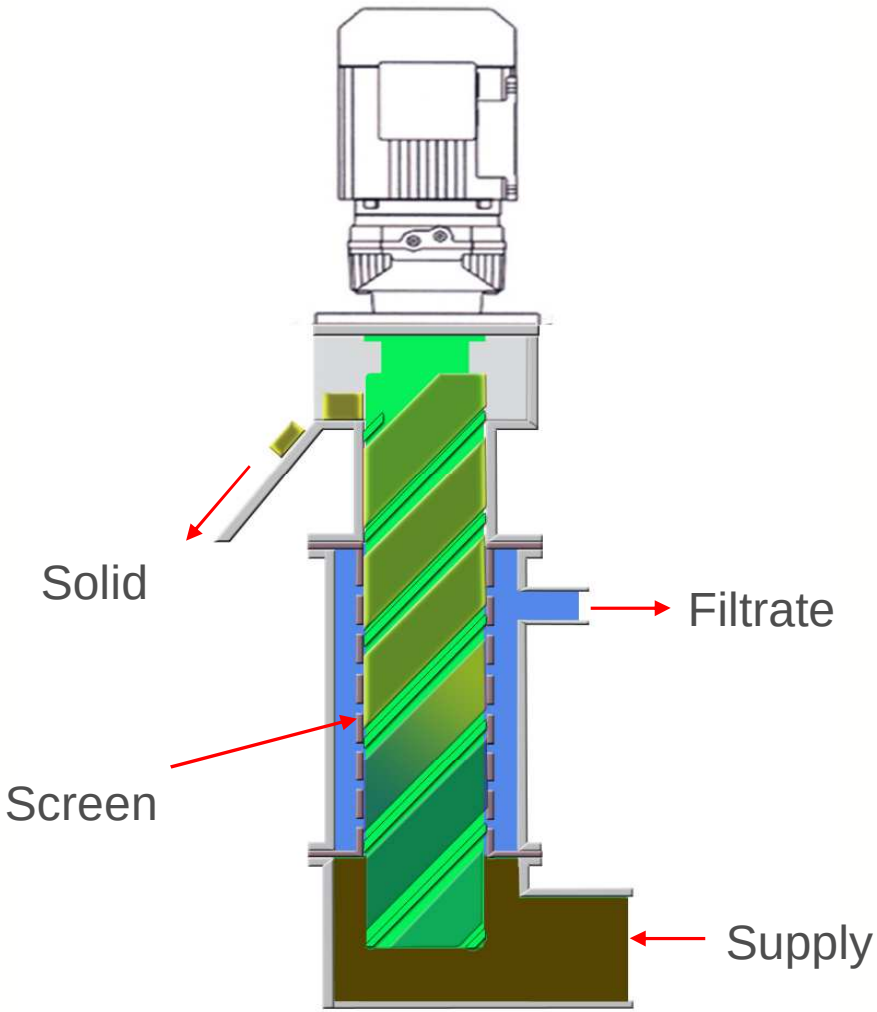
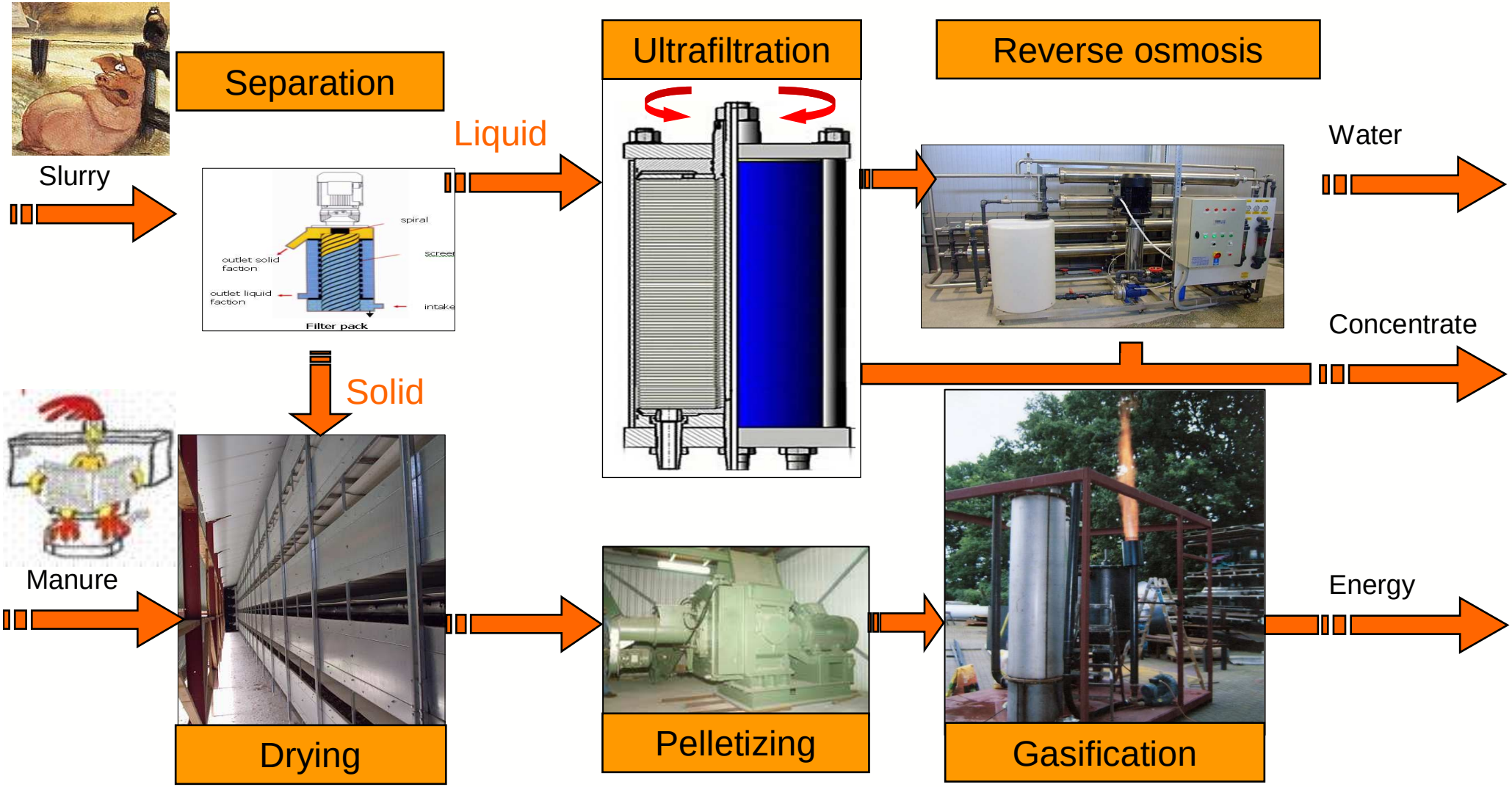
Separation

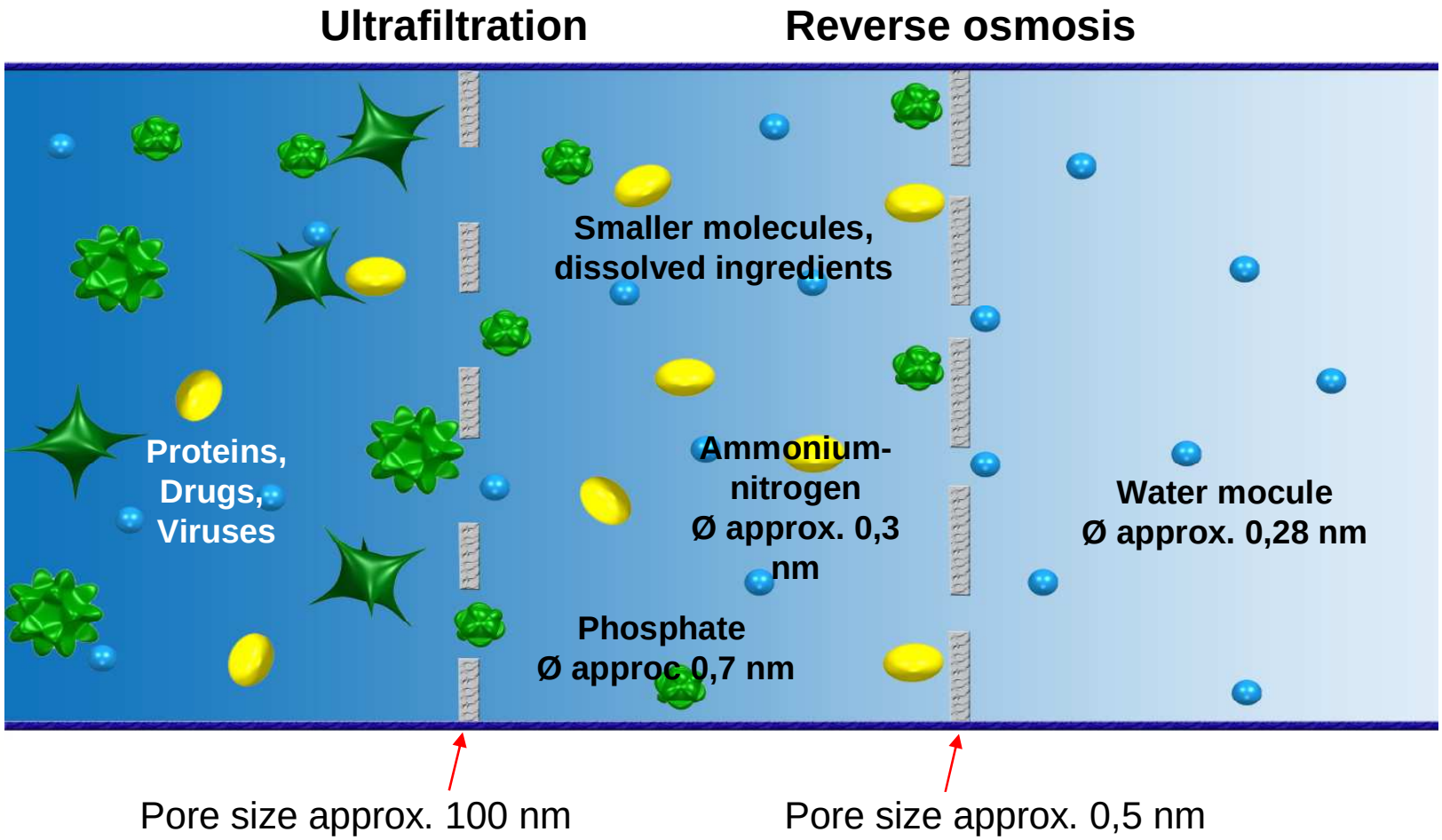


- 0,1 mm perforated strainer
- Stainless steel combined with abrasion-resistant plastics
- Modular, easy to adjust to local conditions (1 – 5 m³/h throughput)
- Screw drive 0,37 kW
- Suction pump 0,75 kW

The treatment system

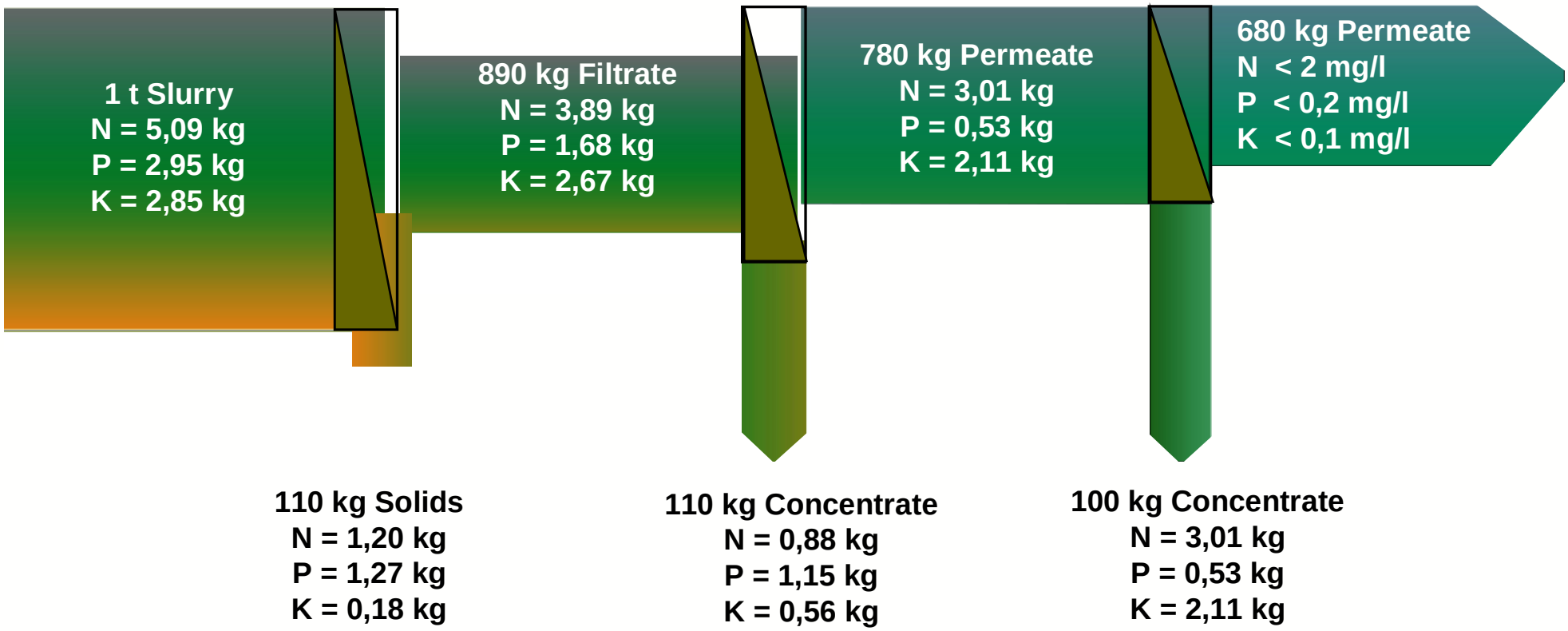


Membranefiltration



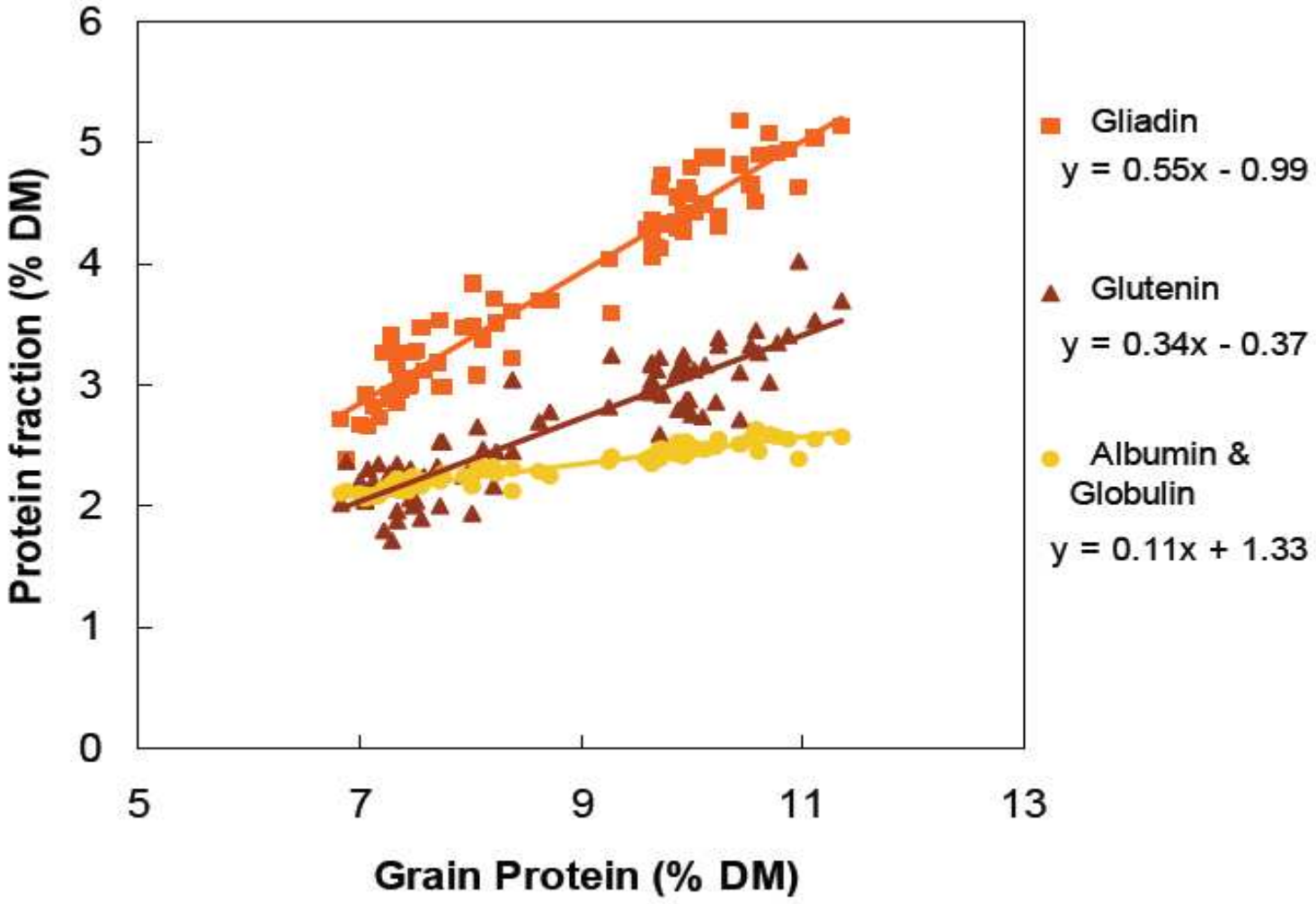
System performance

Example…



Data according to test results

Increasing the nitrogen use efficiency of cereal and oilseed based food chains



Source: The Defra and SEERAD sponsored Green Grain Project

Reconnecting plant and livestock production
Closing the nitrogen cycle

Harvesting and milling rye for feeding pigs in Kroge-Ehrendorf, Germany

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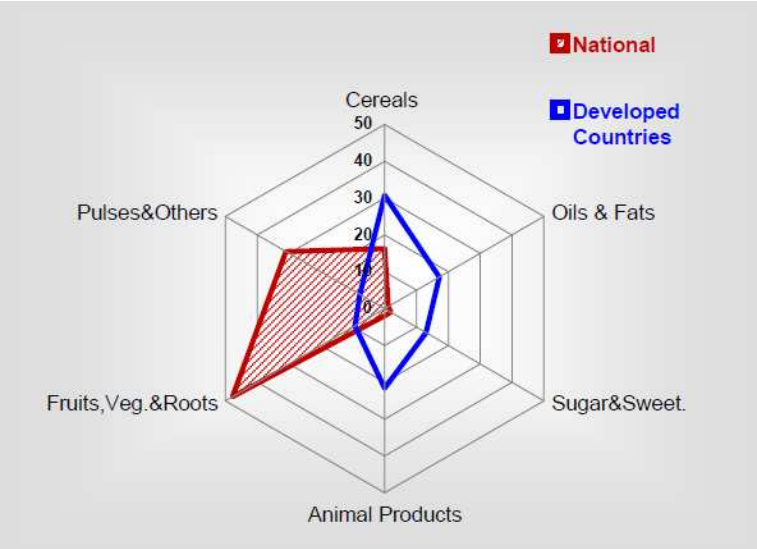
Conclusion



Sources of dietary energy % - Burundi

The poultry industry is on the front-line in raising human welfare.

The poultry sector is resource- and eco- efficient

Long-term success will be be linked to a strategic approach to

•Closing nutrient cycles

•Eliminating the role of agriculture in Land-Use Change

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Global environmental challenges and the poultry sector

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