



Human diets effects on land-use, Nr emissions and climate change

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Diets have huge effects on human health, the environment, climate change and abatement costs²

Dietary transition can save > 50 % of mitigation costs!



Nutrients contributed by animal products in human diets and their consequences of their deficiencies³

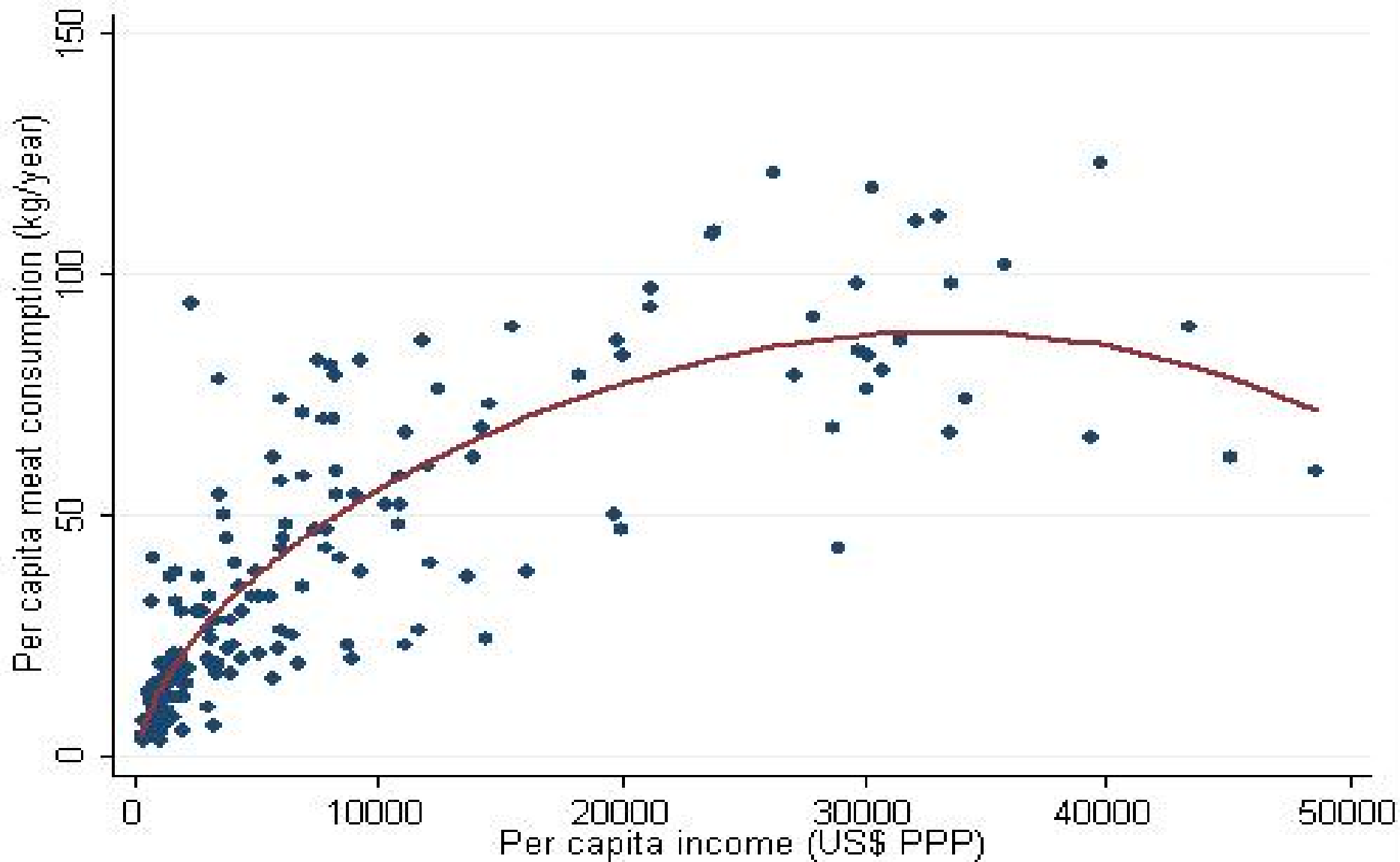
<i>Nutrients</i>	<i>Consequences of deficiency</i>
Vitamin A	Night blindness, corneal ulceration, loss of vision, growth faltering, increased risk of infection and mortality
Riboflavin	Skin lesions. Angular stomatitis, glossitis, cheilosis
Vitamin B12	Anaemia, neuropathy
Iron	Anaemia, impaired cognitive development, lowered work capacity and productivity in adults
Zinc	Dermatitis, poor growth and diarrhoea, growth faltering, impaired immune function, infections
Calcium	Nutritional rickets

Consequences of excess animal-source food intake

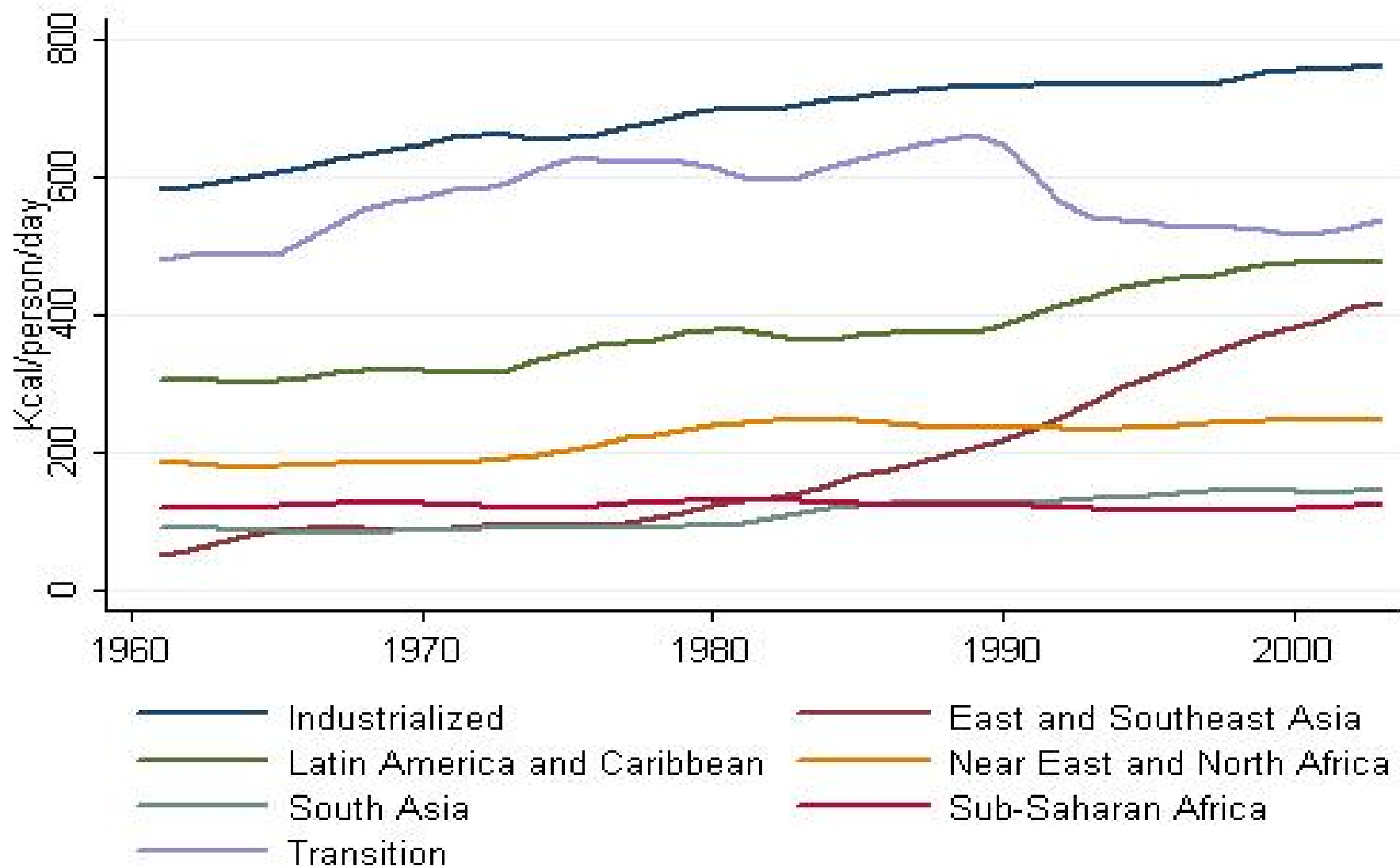
- Increased fat intake increases the risk of
 - Overweight and obesity
 - Heart diseases
 - Some cancers

- Recommendations for consumption of animal-source food show ranges:
 - < 300 g red meat per week (WCFR, 2008)
 - < 70 g meat per day
 - Total fat < 30% energy intake
 - < 300 mg cholesterol per day

Mean meat consumption and mean income per country in 2003 (FAO, 2009)



Consumption of livestock products by regions, 1960-2003 (FAOstat, 2009)

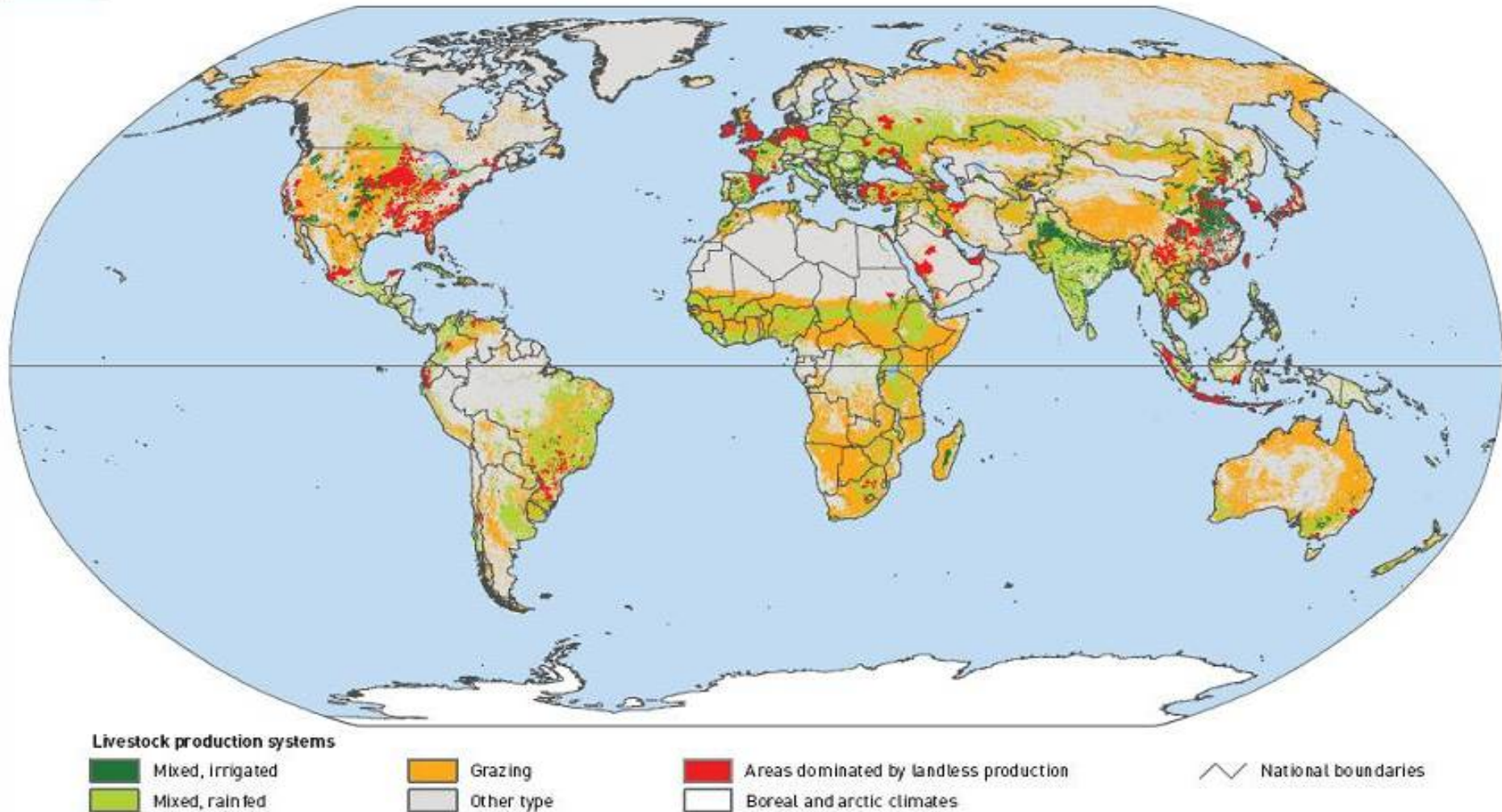


Consumption of animal-source products per year (FAO, 2009)

Region	Meat		Milk		Eggs	
	Per caput consumption		Per caput consumption		Per caput consumption	
	1979-81	2003-05	1979-81	2003-05	1979-81	2003-05
Developed	76	82	197	207	14	13
Developing	13	30	33	49	2	8
East and Southeast Asia	12	47	4	19	2	15
Latin America	41	61	96	107	6	8
South Asia	4	6	42	68	0	2
Near East & North Africa	18	27	87	82	3	6
Sub-Saharan Africa	14	13	33	30	1	2
World	30	41	76	81	5	9

Spatial distribution of livestock production

Map 13 Estimated distribution of livestock production systems



Source: LEAD. Based on methodology of Seré & Steinfeld, 1996. Of the land based system classes only the first classification level is displayed. This is based on land cover data (Global Land Cover 2000, available at www-gym.jrc.it/glc2000/) and irrigated areas (Global Map of Irrigated Areas, Version 2.1, Siebert *et al.*, 2001). Industrial (landless) production dominated areas refers exclusively to monogastric production. Land-based system held pig and poultry populations are estimated locally according to the approach of Gilbert *et al.* (2004), using total local animal population data (see Maps 16 and 17), national level land-based production estimates (Groenewold, 2004), national human agricultural populations (FAO, 2006b) and a global rural population density grid (LandScan, 2003). Areas dominated by industrial production systems are sub-national administrative areas in which the aggregated land based system populations produce less than half of the areas total production, accounting for the higher productivity of industrial systems.

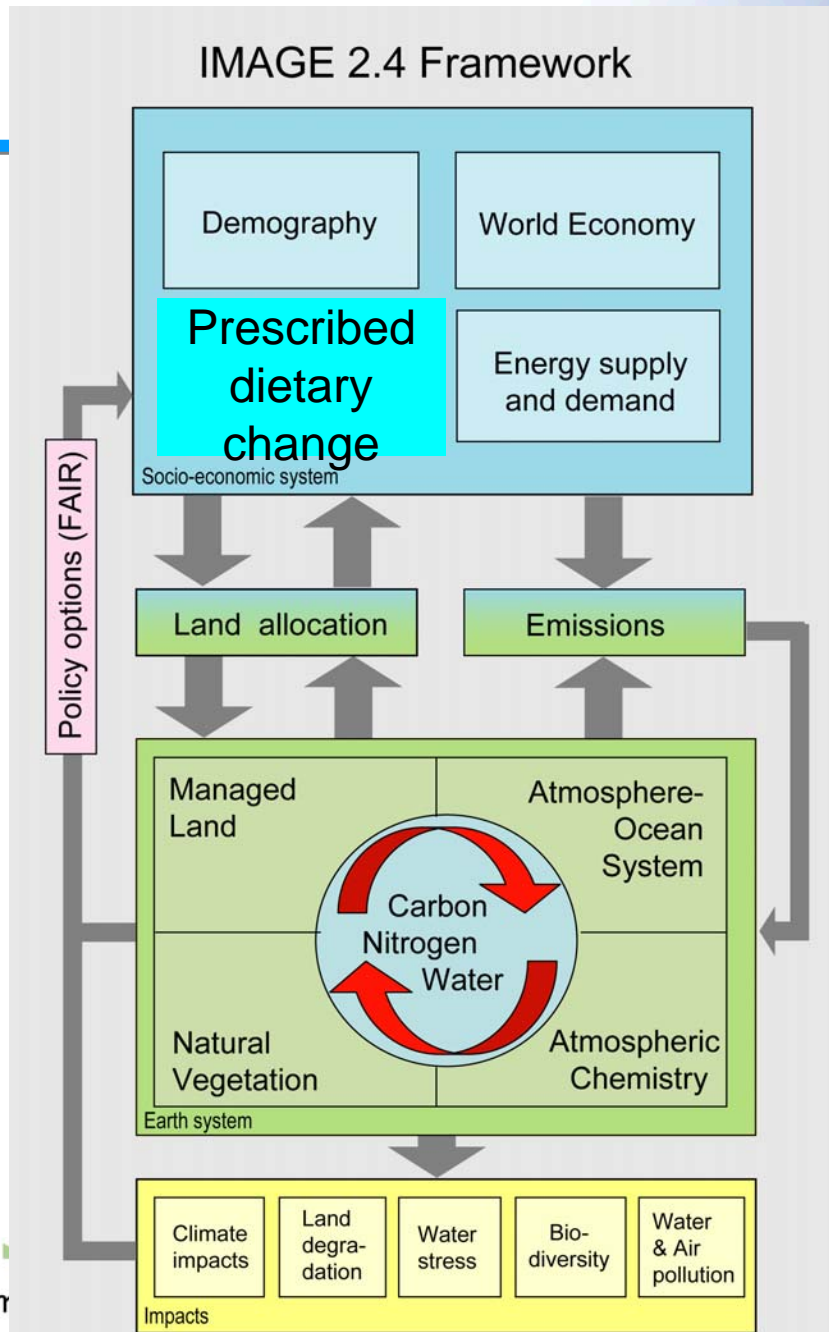
Meat consumption & climate change

- FAO: livestock sector biggest contributor to CC
- Dominant trend in scenarios: strong growth in animal product consumption (here: doubling to 2050)
- Research questions:
 - Relationship between animal protein in diets and GHG emissions
 - Breakdown into different animal product groups and their relative importance
 - **Potential for diet change to mitigate climate change and the costs of climate policy**

Approach

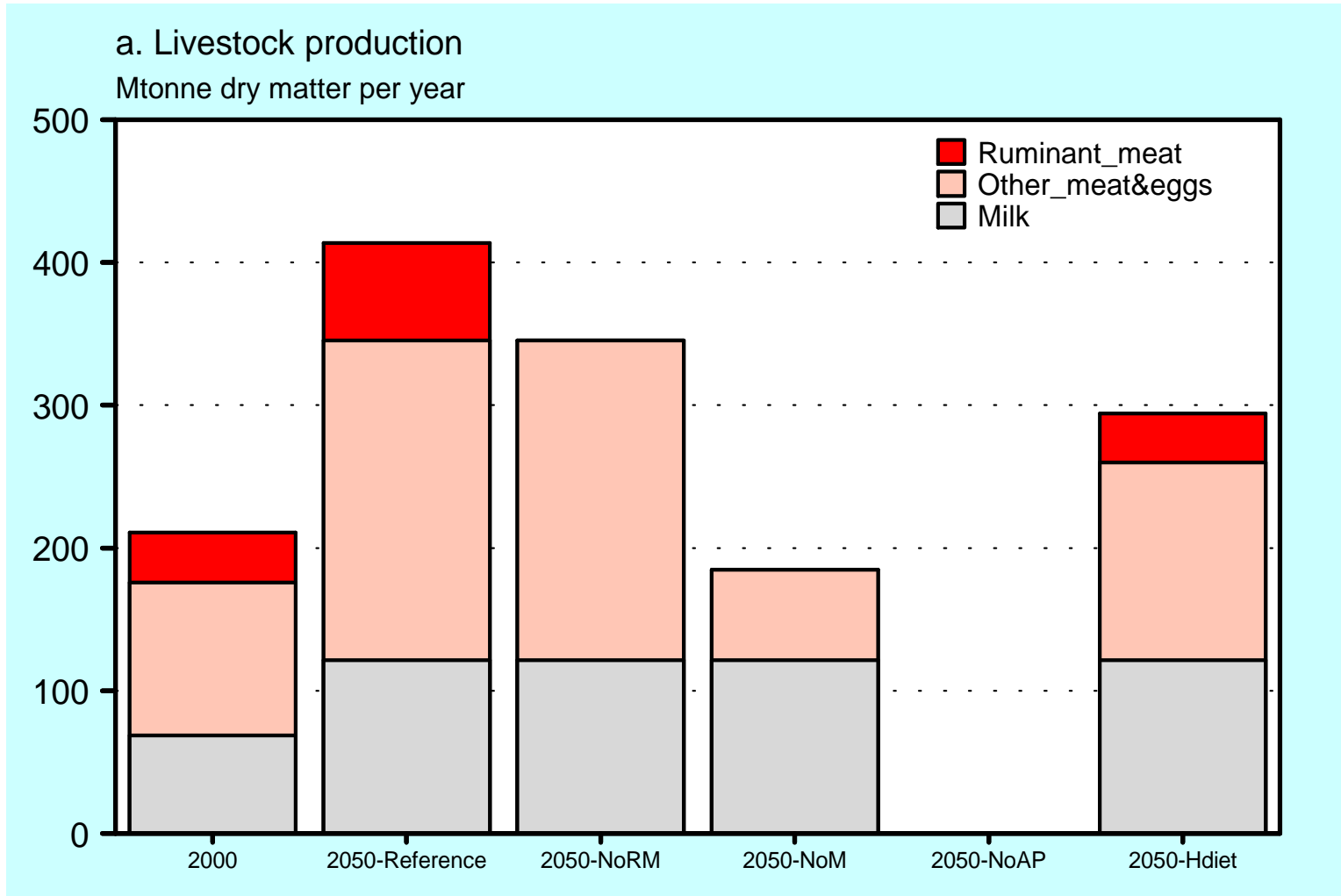
- Reference scenario (based on FAO, OECD)
- 4 dietary scenarios:
 - NoRM: no ruminant meat (beef, goat, sheep, etc)
 - NoM: no meat (also no poultry, chicken, etc|)
 - NoAP: no animal products (also no dairy products)
 - HDiet: reduced, mixed meat consumption (derived from Willett, Harvard Medical School: 'Healthy Diet')
- Protein supply as in baseline, replaced by pulses
- Global diet shift from Baseline (2010-2030)
- Only volume changes considered, all other parameters as in baseline
- All scenarios without and with climate policy for 450 ppm CO₂ eq., until 2050

Method



www.pbl.nl/image

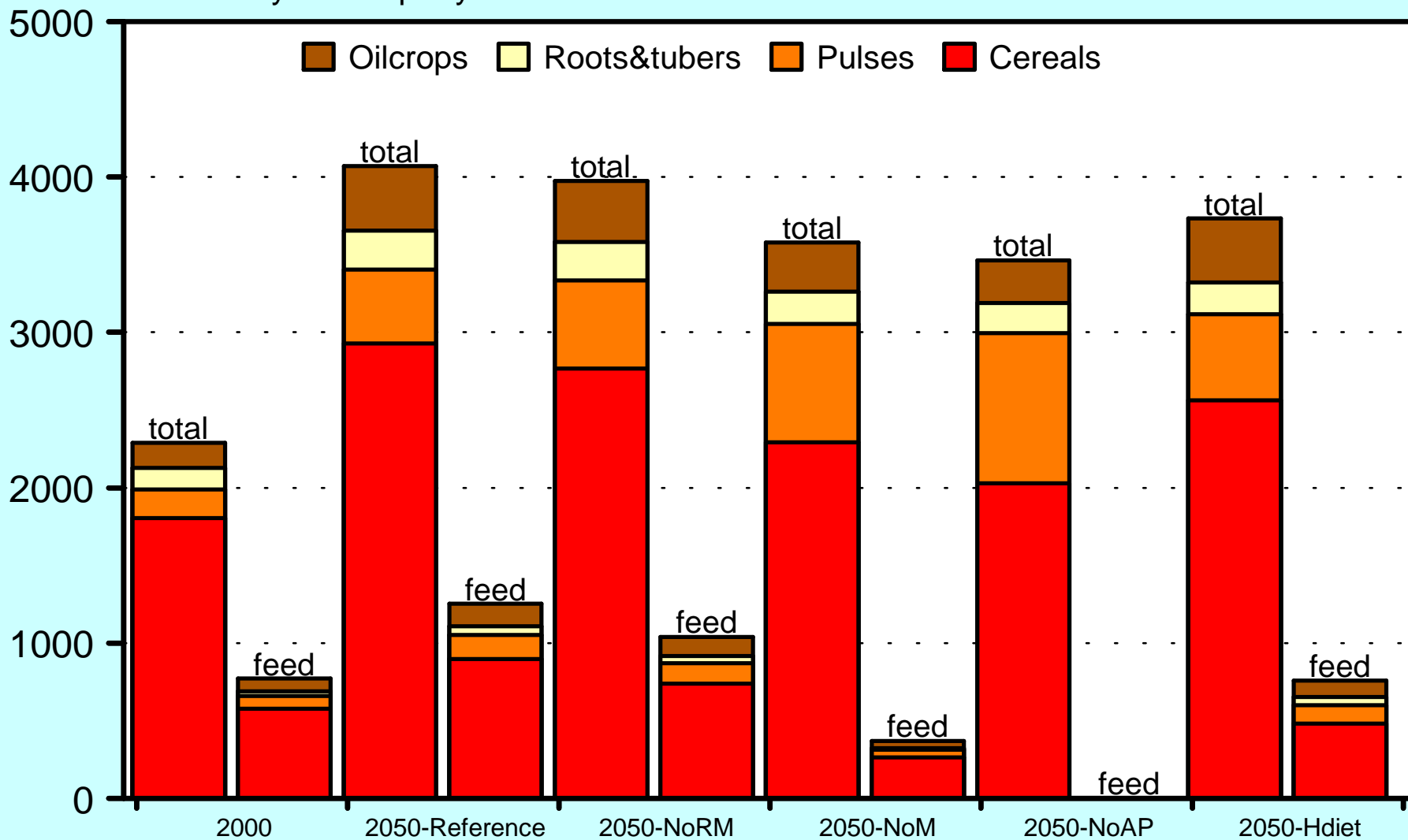
Livestock Production



Crop Production

c. Crop production

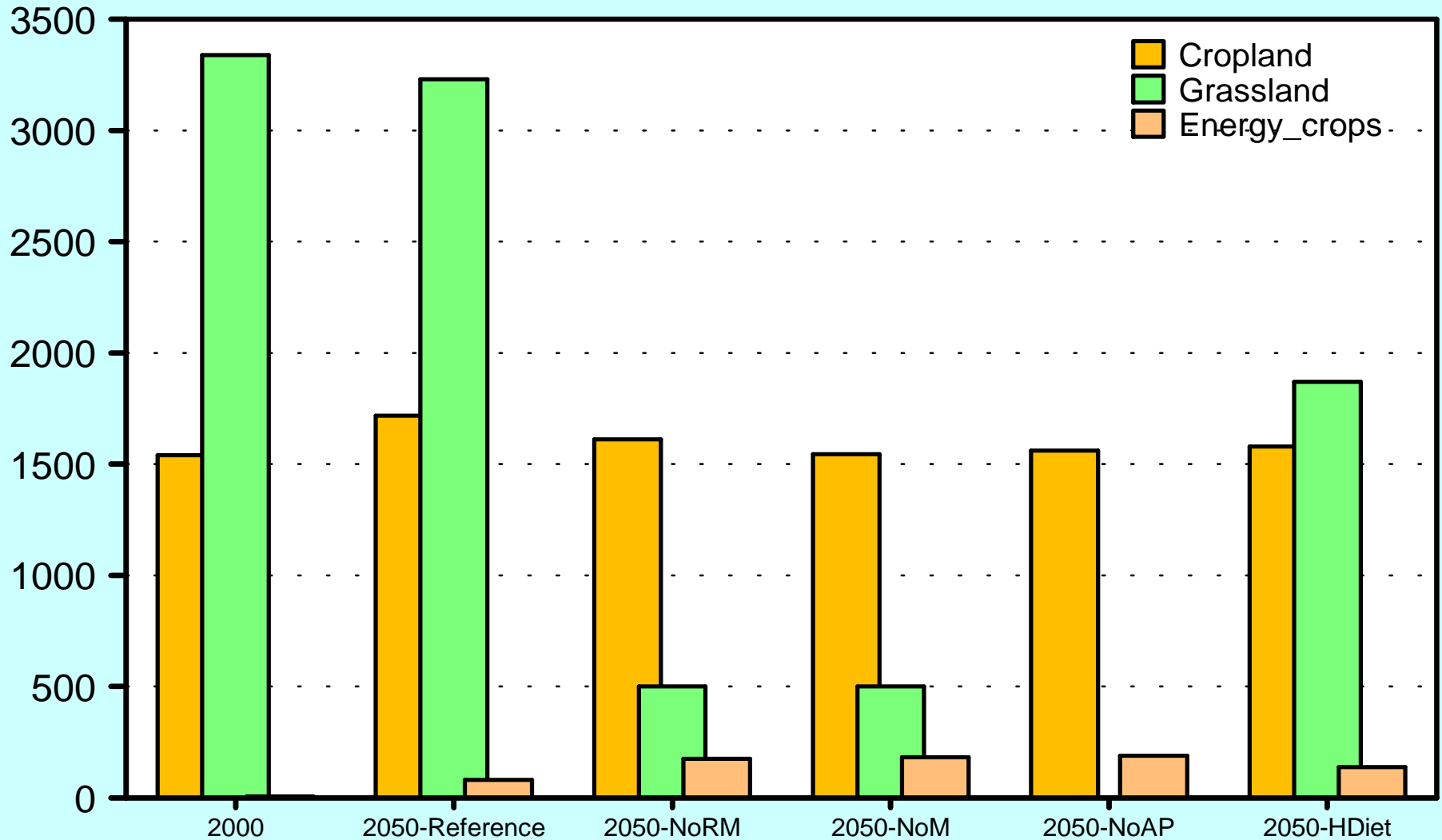
Mtonne dry matter per year



Land Use

b. Land use

Million ha

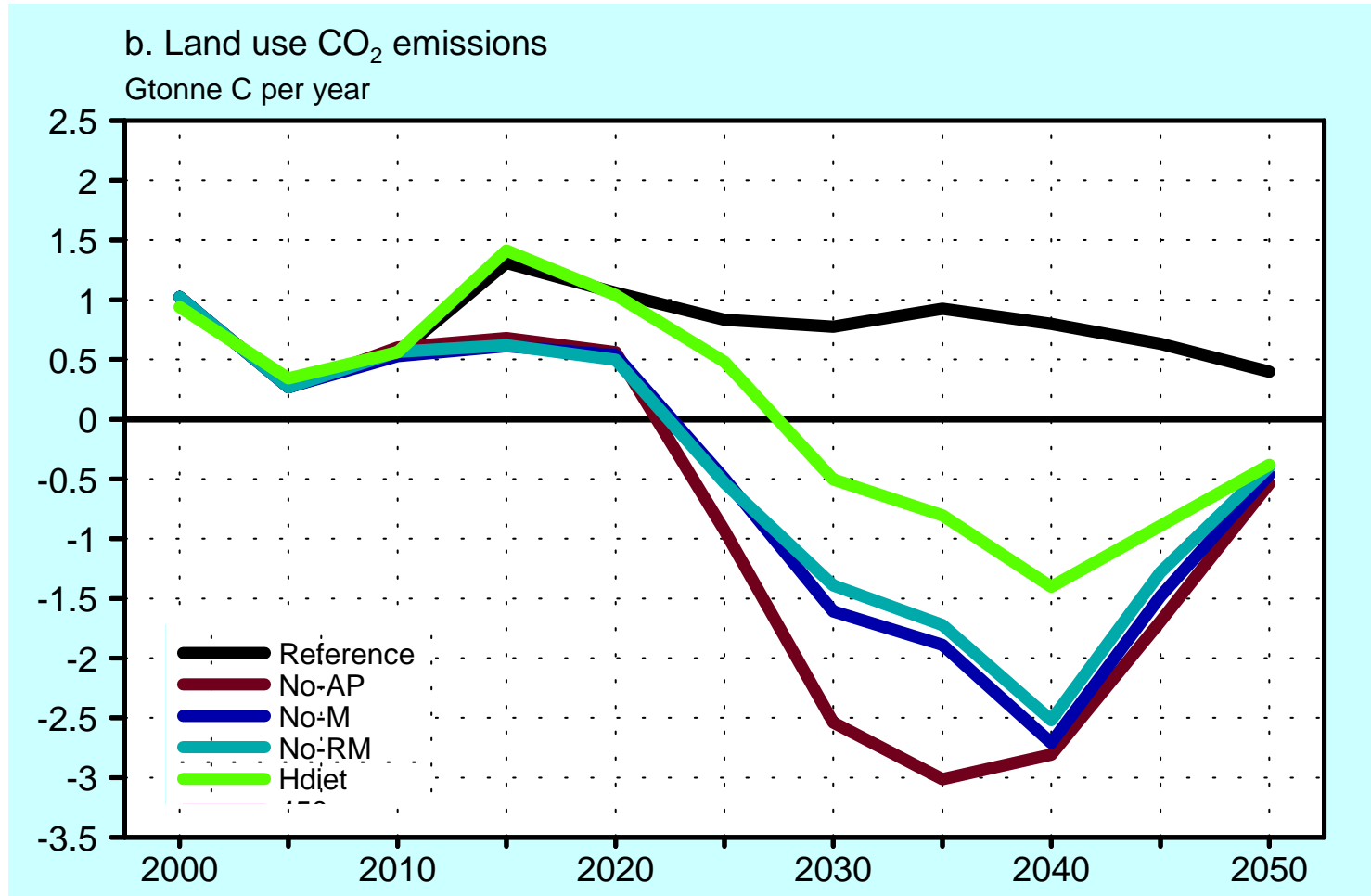


Abandonment of pasture

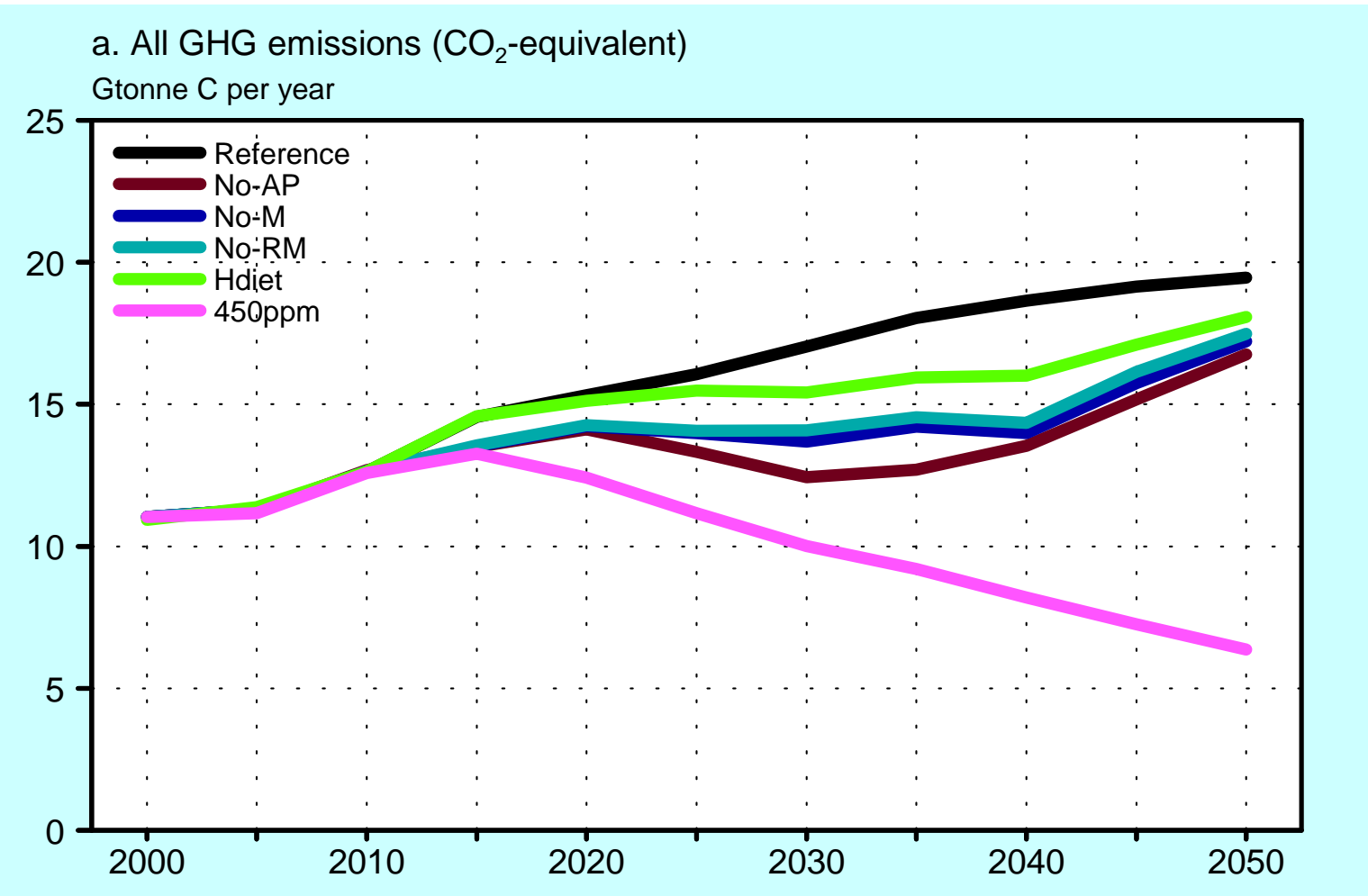
Potential natural vegetation types as a percentage of the global pasture area in 2000 [%]

Tundra	2
Wooded tundra	1
Boreal forest	2
Grassland/steppe	27
Cool coniferous forest	1
Temperate mixed forest	3
Temperate deciduous forest	4
Warm mixed forest	7
Hot desert	18
Scrubland	13
Tropical woodland	5
Savanna	15
Tropical forest	3

Land-use CO₂ Emissions and Uptake



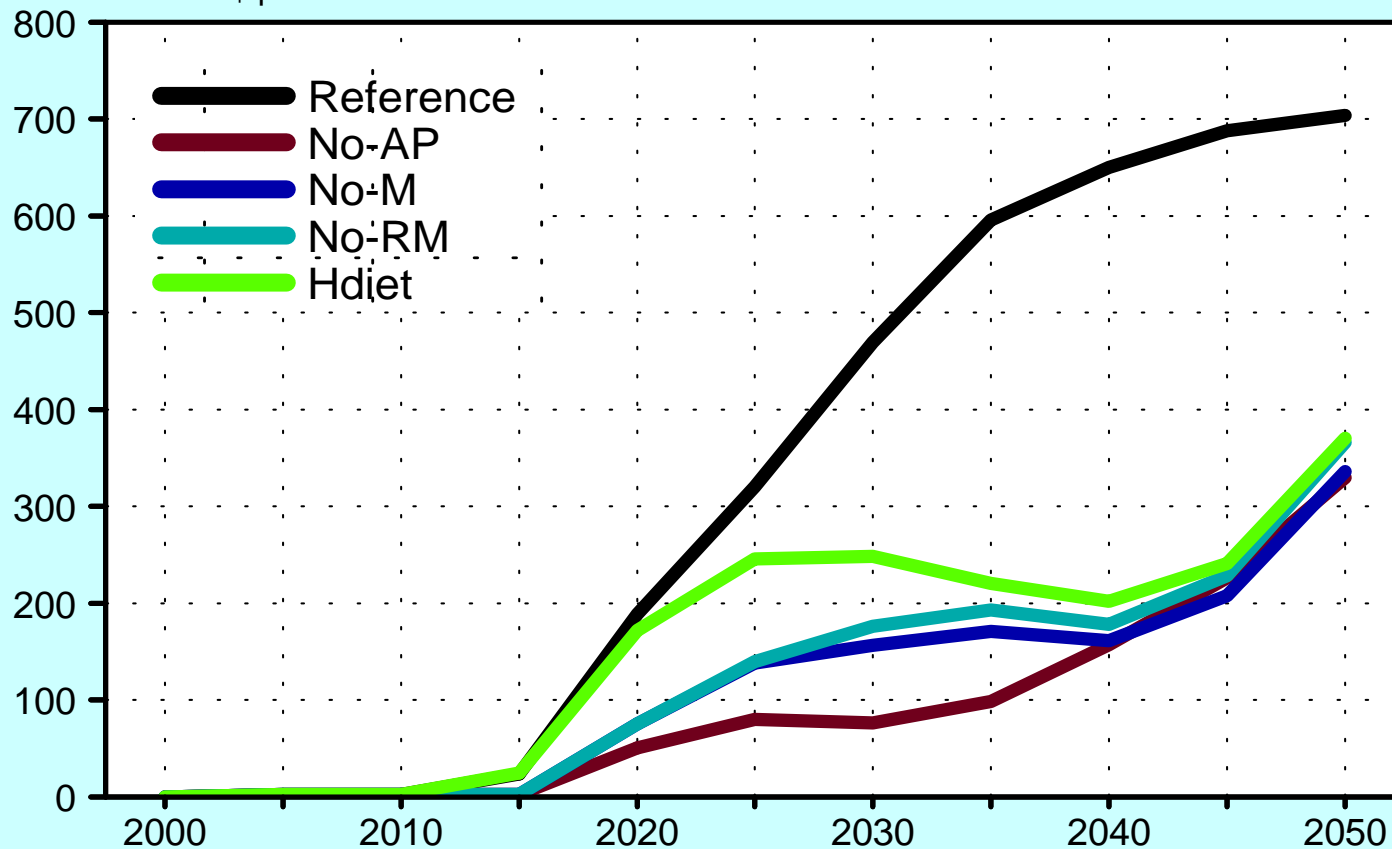
All GHG Emissions and stabilization target



Carbon Price under 450 ppm Stabilization

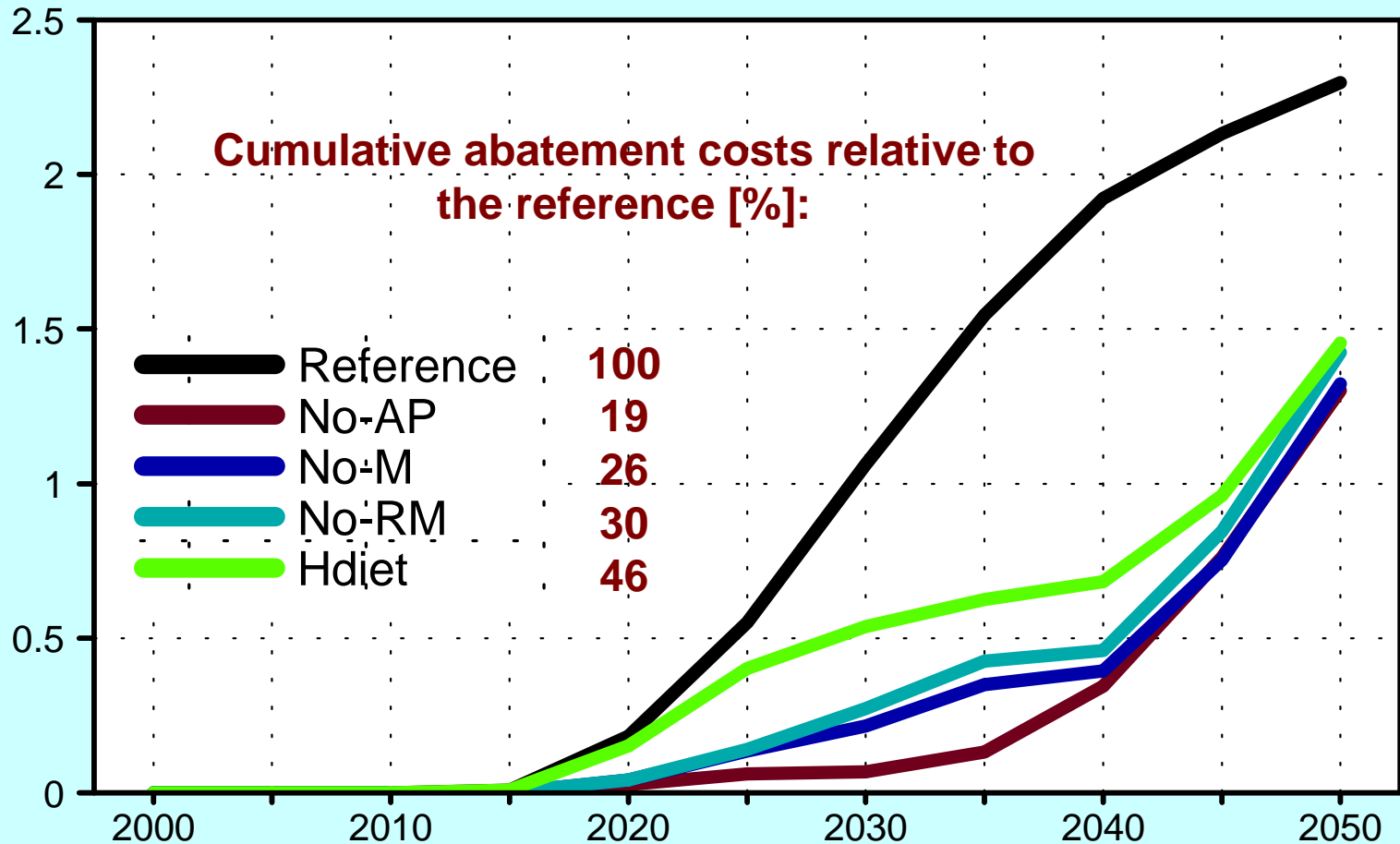
c. Carbon price under the 450 ppm stabilization pathway

1995 US\$ per tonne



Mitigation Cost under 450 ppm Stabilization

d. Mitigation costs under the 450 ppm stabilization pathway
 10^{12} 1995 US\$



Main findings

- Strong effect of diets on land use, biodiversity, Nr use and GHG emissions.
- Changing diets has may decrease mitigation costs by up 80%
- For “Healthy Diet” still 50% cost reduction

Thank you!

Paper published in Climatic Change

www.pbl.nl/image



Proposal for Expert Panel on Nitrogen and human food (EPFOOD)

Objectives

- To analyze the relationships between human diets and N use and N losses in agriculture (and food processing), notably the effects of plant-derived protein versus animal-derived protein;
- To increase the understanding of factors influencing the choice of diets by humans
- To provide (policy) options for improving the nitrogen use efficiency in the whole



EPFOOD

Lead:

➤ ...

➤ Henk Westhoek (NMP)

Meat Intake and Consumption in the *HealthyDiet* variant

Aggregated group	Intake [g/pers/day]	Total consumption at retail ^a [g/pers/day]	Total consumption ^b [g/capita/day]
Ruminant Meat	10.0	11.6	17.1
Pork	10.0	11.6	15.5
Poultry and Eggs	46.5	57.3	69.3
Fish	23.5 ^c		

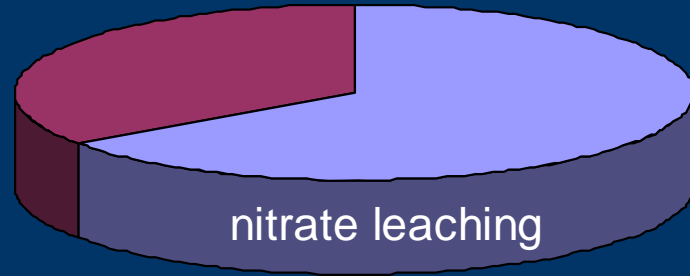
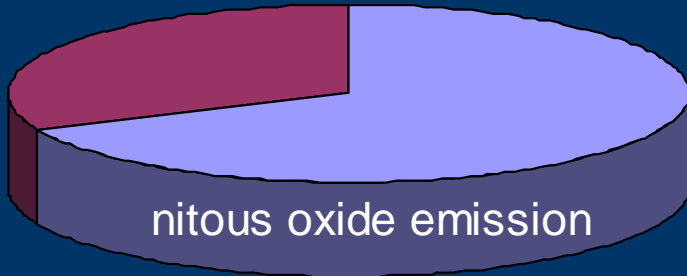
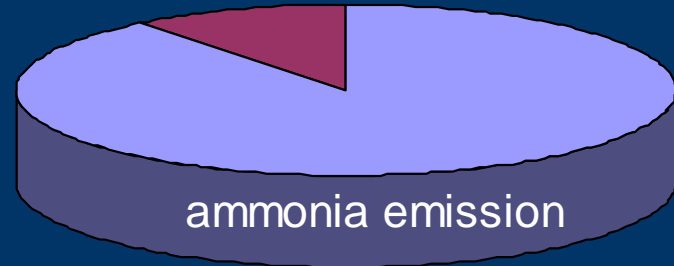
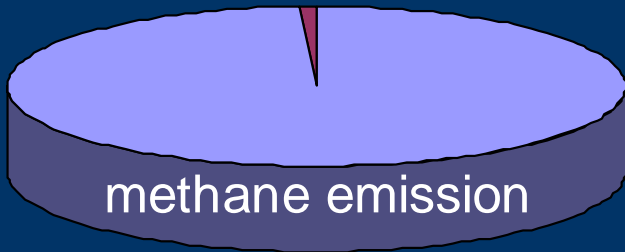
**Reduction by 2/3 for NL
(70%, 90%, 20% per
product category)**

livestock production

systems

	Livestock production system				Total
	Grazing	Rainfed mixed	Irrigated mixed	Landless/industrial	
Population (million head)					
Cattle and buffaloes	406	641	450	29	1526
Sheep and goats	590	632	546	9	1777
Production (million tonnes)					
Beef	14.6	29.3	12.9	3.9	60.7
Mutton	3.8	4.0	4.0	0.1	11.9
Pork	0.8	12.5	29.1	52.8	95.2
Poultry meat	1.2	8.0	11.7	52.8	73.7
Milk	71.5	319.2	203.7	-	594.4
Eggs	0.5	5.6	17.1	35.7	58.9

Most NH₃ emissions from animal agriculture



NH₃ emissions from animal manures in EU-27

