COST Action 869
Mitigation options for nutrient reduction in surface water and groundwaters
WG – 3 Workshop in Devon / UK on 27-29th November 2007

Protection spheres / goods / and setting there aims / nutrient standards for C, N, P, S with special reference to the anthroposphere within the nutrition system and human health

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OVERVIEW

A) INTRODUCTION: Protection goods, protection aims, drivers, pressures

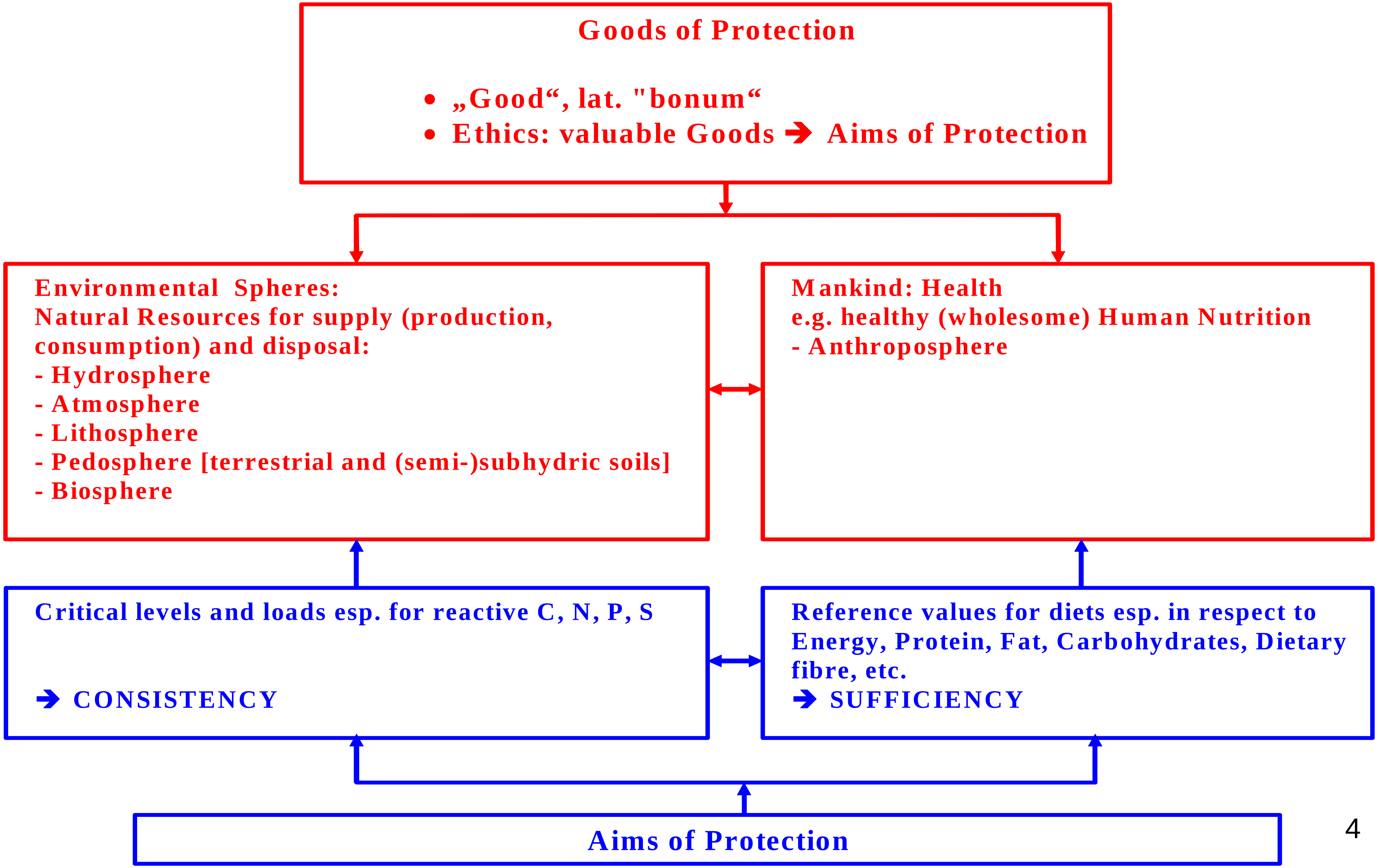
B) RESULTS, CONCLUSIONS, DISCUSSION:

1. **Anthroposphere**
2. **Pedosphere**
   - **2.1 Soil organic matter (SOM)**
   - **2.1 Inorganic Phosphorus**
3. **Hydropshere**
   - **3.1 Critical levels**
   - **3.2 Critical loads**
4. **Atmosphere: Gases relevant to climate change, acidification and eutrophication**
5. **Lithosphere**
6. **Biosphere**
7. **Assessment: Needs for Life Cycle Analysis (LCA´S)**
8. **Driving and preventing forces to meet the protection aims and to implement a sustainable nutrition system**
9. **(Non-)sustainable legislation**
10. **Activities: Integrated and adaptive management of water**
    - **10.1 not only of agriculture, but of nutrition and land use,**
    - **10.2 not only under climate change, but under environmental change and health referring to the nutrients C, N, P, S**

C) ABSTRACT

A) INTRODUCTION: Protection goods, protection aims, drivers, pressures

Fig.1 : Goods and Aims of Protection with special Reference to the Nutrition System of Agriculture with Plant Nutrition and Animal Nutrition, Human Nutrition and Waste as well as Wastewater Management



Tab. 1: Environmental and health aspects of greenhouse gases CH_4, NMVOC, NH_3, N_2O, NO, (N_2) and fine dust (CPM) (Symbols: - not relevant ; + relevant)

Environmental esp. health aspects	CO_2	CH_4	NMVOC	NH_3 ➔ NH_4^+	N_2O	NO ➔ NO_2	(N_2)	CPM (PM_{10}+$PM_{2.5}$)
1. Eutrophication (soil, water)	+	-	-	+	-	+	-	-
2. Acidification (soil, water)	+	-	-	+	-	+	-	-
3. Climate change	+	+	+ (indirectly)	+	+ (indirectly) + Ozone depletion stratosphere	+ (indirectly)	-	+
4. Decline of biodiversity (flora, fauna)	+	+	+	+	+	+	-	+
Threatening of human health	-	-	-	+	-	+	-	+

Fig. 3: Warmer seas bring algal bloom explosion (23 August 2006)

Toxic algal blooms are flourishing across Europe's coastal waters, fuelled by this summer's hot weather and fertilized by human-induced pollution - a phenomenon that is likely to become a common sight in a warmer Europe, the European Environment Agency has warned.

Algae blooms in coastal waters pose an increasing health risk

Tab. 2: Soil degradation:
The main 10 threats both on (semi-)terrestrial soils (TS) and (semi-)subhydric soils (SS) also in the EU, …of them:
I) 9 main threats (X) are caused essentially also by the system nutrition: Agriculture with plant and animal nutrition, human nutrition, waste and waste water management
II) 7 main threats (X) with direct impacts on nutrient dynamics in river basins and oceans (100%) the last one globally representing estuaries (0,4%), shelf (15,2%) and sea (84,4%) respectively
[Isermann and Isermann (2004), Robert and Nortcliff (EUROSOIL 2004, Montanarella 2004)]

A) SOIL CHEMISTRY:

1. **(X) (X) Soil organic matter (SOM): a) Decline (TS + SS)**[1)] ➔ Emissions ("Release") C, N, P, S
2. **(X) (X) Eutrophication: b) Enrichment (TS+ SS)** ➔ Sequestration / Accumulation ("Retention") C, N, P, S
3. **(X) (X) Acidification /Leaching of nutrients (TS):** C, N, S, Ca, Mg, K, (Na) [1)]
4. **(X) Salinisation (TS):** Accumulation of soluble salts of Na, Mg, Ca [1)]
5. **(X) Contamination: Local and diffuse (TS+SS):** Heavy metals and xenobiotics

B) SOIL PHYSICS:

6. **Soil sealing by infrastructure and housing (TS)**
7. **(X) (X) Compactation (TS)**
8. **(X) (X) Erosion and sedimentation by water and wind (TS+SS)** [1)]
9. **(X) (X) Floods and landslides (TS+SS)** [1)]

C) SOIL BIOLOGY:

10. **(X) (X) Decline in soil biodiversity (TS+SS)** [1)]

[1)] **6 main threats triggered also by climate change and ozone depletion caused by reactive compounds of C, N and S**

Tab. 3: Sustainable resp. Clean(er) production and use of biomass products [according to WCED 1987)(Brundtland Report); Smit and Smithers 1994; Xunlong and Smit (1994)]

(less important: (X); important: X;)

Biomass	**Production**			**Use**		
Spheres	**Providing services (industries)**	**Agriculture: Plant production (Plant nutrition)**	**Agriculture: Animal production (Animal nutrition)**	**Processing transport, storage, sales preparation**	**Consumption**	**Waste(water)-management => recovery => recycling**
Products : 1. Food	(X)	X	X (also Fishery)	Human nutrition		=> nutrients, energy
2. Feeds	X	X	X (also Fishery)	Animal nutrition		=> nutrients, energy
3. Raw materials (like fibre etc.)	**--**	X (also Forestry)	X	X	X	=> nutrients, energy
4. Bio-Energy	(X)	X (also Forestry)	--	X	X	=> nutrients

Demands to sustainability: clean(er) production and use of biomass products	A) Generally: development that meets **the needs** (and not the "demands" not tolerable higher than the needs; => affluence, surplus) of the present without compromising the ability of the future generations to meet those of the future => **need oriented production and use** B) Especially: To produce and use biomass over the long term in such a way that simultaneously: a) the natural resource base is not damaged (ecological component), => **Consistency** b) that the **basic needs** of the producers (existence of economic returns which are sufficient to adequately reward producers (economic component) => **Efficiency** c) and that the **basic needs** of the consumers can be met (social component => **Sufficiency** => **(Re-)Integration of the ecological, economic and social components of a sustainable economy and life style**

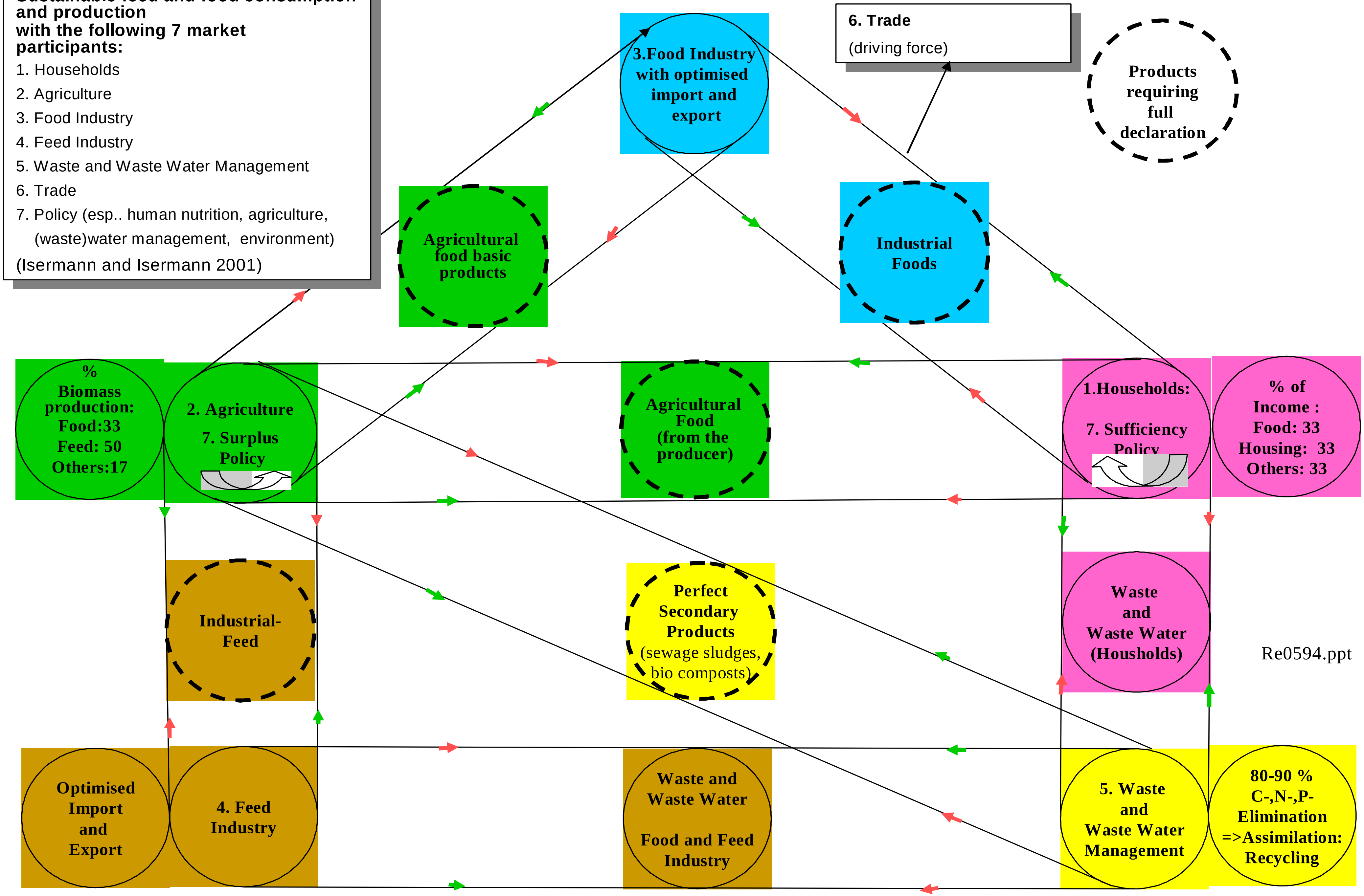


Fig. 4: FEED, FOOD AND WASTE 21

Sustainable feed and food consumption and production with the following 7 market participants:

1. Households
2. Agriculture
3. Food Industry
4. Feed Industry
5. Waste and Waste Water Management
6. Trade
7. Policy (esp.. human nutrition, agriculture, (waste)water management, environment)

(Isermann and Isermann 2001)

B) RESULTS, CONCLUSIONS, DISCUSSION:

Protection Aims

With a holistic approach protection aims / nutrient standards are set here as critical C, N, P, S levels and loads as well as for healthy human nutrition for all environmental spheres of anthroposphere, pedosphere, hydrosphere, lithosphere and biosphere respectively, because they are a necessary prerequisite for cause oriented and sufficiently mitigation and adaptation options and measures done simultaneously with special reference to the nutrition system and land use.

1. Anthroposphere: Human Nutrition and Human Health – Consistency with sufficiency

Tab. 4: Average daily dietary intake of energy, nutritious matters and meat of males and females in Germany (1993) compared with the recommendations (reference values)

(Nutrition report DGE 2000)

Energy Nutritious matters Meat	Recommendation = Reference value [1)]	Actual Situation (1993) (n= 38 924)		Compare % Reference value 1985 / 89
		Units · capita^{-1}	% reference value	
Energy (kcal ·d $^{-1}$)	2025 (2079)	2295	**114**	99
Protein (g ·d $^{-1}$)	46,2 (49) (0,8 / kg weight)	76,6	**166**	**155**
Fat (g/d)	70	94,2	**136**	**127**
(% Energie)	30	36,3	**121**	**-**
Carbohydrates (g ·d $^{-1}$)	275	257	**94**	83
Dietary fibre (g ·d $^{-1}$)	(30)27,3	20,1	**74**	**65**
Meat (Net)				
1) German Cancer Aid (2000)[1)]				
a) (g ·d $^{-1}$)	80	172,1	**215**	**229**
b) kg ·a^{-1}	29,2	62,8		
2) German Nutrition Society (DGE 2000) [1)]				
a) (g ·d $^{-1}$)	64 (43-86)	172,1	**268**	**286**
b) (g ·w $^{-1}$) (6 meals x75g =)	450 (300-600)	1205		
c) kg ·a^{-1}	23,4 (15,7-31,4)	62,8		

Re0543

[1)] **German Cancer Aid and German Nutrition Society (DGE) : Ø = 72g/d = 504g/w = 26,3 kg/a**

Tab. 5: Shares of nutrition associated cases of death on total death cases

(Mortality Statistic Germany 1997) and Nutrition Report 2000 (DGE 2000)

Causes of death	Cases of death: numbers	Cases of death: %
1. Total	**860 389**	**100**
2. ...off them: nutrition associated	**666 829***)	**[78]**
...off them:		
2.1 Circulatory troubles	415 800	(48)
2.2 Cancer	210 053	(25)
2.3 Hepato-cirrhosis	18 617	(2)
2.4 Diabetes mellitus	22 359	(3)
3. ...off them:		
a) Car accidents	**8 100**	(1)
b) Tobacco	**125 000**	(15)
c) Alcohol	**42 000**	(5)

Risk factors of nutrition associated causes of death

Causes of death nutrition associated	Risk factors (++= probable; += possible; - = not clear): Total fat	Animal fat	Saturated fatty acids	Red meat
Cardiac infarctation [1)]	++	-	+	-
Breast cancer[2)]	-	-	-	+
Prostatic cancer[3)]	+	+	+	+
Lung cancer[4)]	+	+	+	+
Stomage cancer[5)]	-	-	-	(+) grilling
Colon cancer[6)]	+	+	+	++ Grilling,Roasting, meat products+

[1)] also: Coffee **(++)**
[2)] also: Alcohol and overweigth **(++)**
[3)] also: Alcohol **(+)**
[4)] also: Alcohol **(+) only limited nutrition associated**
[5)] also: Salt preserves **(++)**: Nitrosamines, Frying, Pickling, Smoking **(? !)**
[6)] also: Alcohol **(++),** Eggs, Sugar **(+)**

*) **without lung cancer (37 240): 629 589 (73)**

re0544

Tab. 6:

	High-income countries	Low-income countries
Current approximate total meat consumption (g per day per person)	200–250	25–50
Change in		
Heart disease*	– – –	+
Stroke	No substantial effect	– – –
Colorectal cancer	– – –	++
Breast cancer	– –†	+
Childhood growth stunting	No substantial effect	– – – –
Overweight/obesity	– –	(+)

Risk shifts refer only to the effect of a change in meat consumption. Other associated dietary changes are not considered. *Attributable mainly to saturated fat content. †Less certain than for bowel cancer.

***Table 3*: Direction and likely extent of change in risk of health outcomes in response to future achievement (proposed for 2050) of a proposed international target of 90 g per day per person in all countries**

McMichael et al. (2007

re0888

Tab. 7: Nitrate and human health

[T.M. Addiscott [1)] and N. Benjamin (2004):
Soil Use and Management 20, 98-104]

Abstract

1. Nitrate is widely and mistakenly perceived to threaten human health by causing methaemoglobinaemia in infants and stomach cancer in adults, but it does cause environmental problems

1.1 **Methaemoglobinaemia** is a side-effect of gastroenteritis and is not caused by nitrate but by nitric oxide, which is produced I a defensive reaction stimulated by gastroenteritis. The latter may be caused by a bacterium or a virus. The association of methaemoglobinaemia with nitrate may have arisen because early cases of the condition were often associated with wells polluted with bacteria, and the same pollution increased the nitrate concentration.

1.2 Four epidemiological studies sought a link between **stomach cancer** and nitrate but did not find one. The incidence of this cancer has also declined during the last 30 years, while nitrate concentrations in water have increased.

2. Nitrate preserves, rather than threatens, health

2.1 It is reduced by microbes on the tongue to nitrite, which generates nitric oxide when acidified in an antibacterial defence mechanism vital to our well-being. This mechanism **acts with great effectiveness in the stomach against *Salmonella, Escherichia coli* and other organism that cause gastroenteritis**.

2.2 It also **acts in our mouths against dental caries and even on our skin against fungal pathogens such as *Tinea pedis* (athlete´s foot).** This mechanism is the basis of the centuries-old practice of adding nitrate or nitric to stored meat to protect against botulism, caused by the most lethal toxin know to mankind.

Re0610

Tab. 8: Causes of Cancer and their shares:
- 63% of all cancers are caused by an unhealthy life style
- only 4% by inheritance
- and 0% by nitrate and nitrite
[European Prospective Investigation into Cancer and Nutrition (EPIC-Study 1992-2004)]

Causes of cancer	Shares (%)
1. (Over-)Nutrition	30
2. Smoking	30
3. Infections	15
4. Other factors (like medicine, radiation, immune-suppression, hormones, reproduction-factors)	13
5. Professional exposition	5
6. Inheritance	4
7. Alcohol	3
8. Nitrate and nitrite i.e. drinking water or added stored meat [1)]	0

[1)] Addiscott and Benjamin (2004): Annex I of D 3.3 re0642

Effects of dietary nitrite and nitrate on myocardial ischemia/reperfusion injury

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Edited by Louis J. Ignarro, University of California, Los Angeles, CA, and approved October 3, 2007 (received for review July 12, 2007)

Nitrite has emerged as an endogenous signaling molecule with potential therapeutic implications for cardiovascular disease. Steady-state levels of nitrite are derived in part from dietary sources; therefore, we investigated the effects of dietary nitrite and nitrate supplementation and deficiency on NO homeostasis and on the severity of myocardial ischemia/reperfusion (MI/R) injury. Mice fed a standard diet with supplementation of nitrite (50 mg/liter) in their drinking water for 7 days exhibited significantly higher plasma levels of nitrite, exhibited significantly higher heart levels of nitrite, nitroso, and nitrosyl–heme, and displayed a 48% reduction in infarct size (Inf) after MI/R. Supplemental nitrate (1 g/liter) in the drinking water for 7 days also increased blood and tissue NO products and significantly reduced Inf. A time course of ischemia–reperfusion revealed nitrite was consumed during the ischemic phase, with an increa nitroso/nitrosyl products in the heart and plasma. Mice fed a deficient in nitrite and nitrate for 7 days exhibited signific diminished plasma and heart levels of nitrite and NO metabolite a 59% increase in Inf after MI/R. Supplementation of nitrite ir drinking water for 7 days reversed the effects of nitrite defici These data demonstrate the significant influence of dietary n and nitrate intake on the maintenance of steady-state tissue plasma nitrite/nitroso levels and illustrate the consequences of n deficiency on the pathophysiology of MI/R injury. Therefore, n and nitrate may serve essential nutrients for optimal cardiovas health and may provide a treatment modality for cardiovas disease.

re0928

Tab. 9: The repressive role of nitrite and nitrate on cardiac infection

A) Recommended nitrite / nitrate level in drinking water

1. **Nitrite / Nitrate deficiency: 59% increase infarct size**
2. **50 mg nitrite· l^{-1}: 48% reduction infarct size**
3. **1000 mg nitrate/l (supplemental): significantly reduction infarct size**

B) Threshold values for nitrate in drinking water

1. **Animal nutrition: 300 mg NO_3^- · l^{-1}**
2. **Human nutrition: 40/50 mg NO_3^- · l (? ? ?)**

Tab. 10:Shares of costs and cases of death associated with nutrition, tobacco, alcohol and illegal drugs in Germany

	Yearly costs			Cases of death	
	Mrd €	**€ · capita $^{-1}$ 1)**	**%**	**Mio ·yr^{-1}**	**%**
Total public health	(1993): 168 (1995): 194 (1997): 204 (1999): 214 (2001): 226 (2003):	2049 2366 2488 2610 2756	100	860 400 (ca. 1% of the population:82 Mio) (statistics of mortality 1997)	100
…off them associated with **1. Nutrition (overnutrition)**	Wolfram (1998): **51** DGE (2000): **66** GfED/BMG (2004): **77**	**622** **804** **939**	**ca. 30**	**666 800** (statistics of mortality 1997) [630 000 without lung cancer]	**78** [77]
2. Tobacco [2)] (Dt. KFZ 2002)	(1993): 27-44	329 – 536	16-26	(1993):125 000	15
3. Alcohol (Robert Koch Institut 2002)	(1995): 20	244	10	(1995): 42 000 [+Tobacco: 74 000]	5 [7]
4. Illegal drugs (BMG 2002)	k. A.	k.A.	k.A.	(2001): 2000	< 1

1) Compare: Average old age pension ca. 8 700 € · captita^{-1} · yr^{-1} re0542

2) Conservative: without smoker, consultation, research, weaning, prophylaxis

Tab. 11: Yearly net monetary values of food production and consumption (without waste and waste water management) in Germany [Mrd. €]

	Food production: Agriculture and Feed Industry	Food consumption: Households and Food Industry	Total: Food production and Consumption
1. Gross ("Net") values [BMVEL 2001]	Ø 1996/2000: 12	1999: 23	35
2. Minus external costs	Environmental damages (-37) (UPI: 1995; Isermann and Isermann 1999) and subsidies (-14) (BMVEL 2001) Total: **-51**	Health damages: **- 66** (DGFE 2000) [GfED/ BMG 2004: - 77]	**-117**
3. Net monetary values	**- 39**	**- 43**	**- 82**

Re0545

Tab. 12: Linkage between sustainable and healthy human nutrition with animal food and corresponding needed sustainable animal production of agriculture exemplarily shown for Germany in 2000 (BMVEL 2001)

Animal food	**Sustainable / Healthy human nutrition**		**Corresponding needed animal production of agriculture with 0.1 AU $\cdot$ cap^{-1} = 50 kg life weight**
	Needed animal food (kg $\cdot$ cap^{-1} $\cdot$ yr^{-1}) ➔ Tab. 12	**Milk equivalents (kg $\cdot$ cap^{-1} $\cdot$ yr^{-1})**	
Milk and milk products	**Milk: 45.6 (4.2% fat)** **Butter: 2.9 (80% fat)** **Cheese: 7.3** (i.e. Emmentaler: 8 kg cheese = 100 kg milk)	46 55 91 **Total: 192**	Milk cows: 1 AU = 6127 kg milk $\cdot$ yr^{-1} 32% of animal stock = 16 kg life weight with **196 kg milk $\cdot$ cap^{-1} $\cdot$ yr^{--1}**
Meat	**23.4**		50 kg life weight x 49% efficiency of meat yield **= 24.5 kg meat $\cdot$ cap^{-1} $\cdot$ yr^{-1}** **➔ Tab. 21**
Eggs	**3.7** **= 60 eggs with 62 g $\cdot$ egg^{-1}**		**60 eggs x 276 eggs $\cdot$ laying hen^{-1} $\cdot$ yr^{-1}** **= 0.22 laying hens $\cdot$ cap^{-1} $\cdot$ yr^{-1}**

Re0604

Tab. 13: Food livestock production, energy, climate change, and health
Mc Michael et al. (2007)

Key messages

- Greenhouse-gas emissions from the agriculture sector account for about 22% of global total emissions; this contribution is similar to that of industry and greater than that of transport. Livestock production (including transport of livestock and feed) accounts for nearly 80% of the sector's emissions
- Methane and nitrous oxide (which are both potent greenhouse gases and closely associated with livestock production) contribute much more to this sector's warming effect than does carbon dioxide
- Halting the increase of greenhouse-gas emissions from agriculture, especially livestock production, should therefore be a top priority, because it could curb warming fairly rapidly. However, livestock production is projected, on current trends, to increase substantially over the next four decades, mainly in countries of low or middle income
- Available technologies for reduction of emissions from livestock production, applied universally at realistic costs, would reduce non-carbon dioxide emissions by less than 20%. We therefore advocate a contraction and convergence strategy to reduce consumption of livestock products, mirroring the widely supported strategy proposed for greenhouse-gas emissions in general. Contraction of consumption in high-income countries per head would then define the lower, common, ceiling to which low-income and middle-income countries could also converge

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- Assuming a 40% increase in global population by 2050 and no advance in livestock-related greenhouse-gas reduction practices, global meat consumption would need to fall to an average of 90 g per person per day just to stabilise emissions from this sector. Such a decrease would require a substantial reduction of meat consumption in industrialised countries and constrained growth in demand in developing countries, especially of red meat from ruminant (methane-producing) animals
- A substantial contraction in meat consumption in high-income countries should benefit health, mainly by reducing the risk of ischaemic heart disease (especially related to saturated fat in domesticated animal products), obesity, colorectal cancer, and, perhaps, some other cancers. An increase in the consumption of animal products in low-intake populations, towards the proposed global mean figure (convergence), should also benefit health
- The resultant gains in health and environmental sustainability should help to offset any (initial) discomforts from restrictions on some popular foods and altered dietary customs. Replacing ruminant red meat with meat from monogastric animals or vegetarian-farmed fish would reduce methane production and lower the pressures on wild fisheries as sources of fishmeal for aquaculture
- Climate change will, itself, affect food yields around the world unevenly. Although some regions, mostly at mid-to-high latitude, could experience gains, many (eg, in sub-Saharan Africa) are likely to be adversely affected, with impairment of both nutrition and incomes. Compensating vulnerable populations for this and other climate-mediated harm caused by other populations should be an important element of global climate change policy
- Global population growth is continuing, although slowing. The eventual peak size is not predetermined: it can be lowered by education, leadership, and wider contraceptive availability. Slower population growth will help achieve the Millennium Development Goals and will limit population size, climate change, and the environmental effects of food production

re0880

Tab. 14: Food livestock production, energy, climate change, and health
Mc Michael et al. (2007)

Key indicators

Strategy for reduction of agriculture-related greenhouse-gas emissions

National and international climate change policies all accept a target that greenhouse-gas emissions from agriculture in 2050 should be limited to no more than their 2005 levels. This acceptance recognises that this target would necessitate a reduction in the projected globally aggregated demand for animal products to an average (and more evenly shared) per-head intake of, at most, 90 g meat per day. Not more than 50 g of this should come from red meat from ruminant animals. Acceptability of this policy should be enhanced by the expected health gains, both for current high-consuming populations, as their consumption reduces, and for low-consuming populations, as their consumption increases to an agreed, globally shared, but modest, level. This proposal could well prove to be too conservative, but has been formulated with the aim of furthering debate in this largely overlooked area of climate-change mitigation policy.

Short term: 2015

High-income countries should develop incentive structures and educative measures to be introduced between now and 2015, to initiate substantial contractions in the effects of the production and consumption of animal products on climate change. All countries should provide incentives for research and development for technologies to reduce greenhouse-gas emissions per unit of food product, plus incentives to fully deploy available mitigation technologies.

Medium term: 2030

Countries that were already above target in 2005 should be half-way from 2005 baseline to the target of 90 g per day per person. In countries in which consumption in 2005 was rising rapidly, increases in consumption should have slowed or halted, converging towards the target level. Countries with low consumption in 2005 should be increasing levels of consumption towards the target. All countries should have in place incentive structures to induce widespread adoption of mitigation techniques, together with research and development towards greater mitigation at acceptable cost.

Long term: 2050

All countries should have met the minimum acceptable emissions target. This target should have been achieved mainly by constraining emissions from livestock production. Restricting the intake of red meat from ruminant animals to 50 g per person per day, along with technical advances in livestock production, could reduce total livestock-related emissions below the 2005 level.

re0881

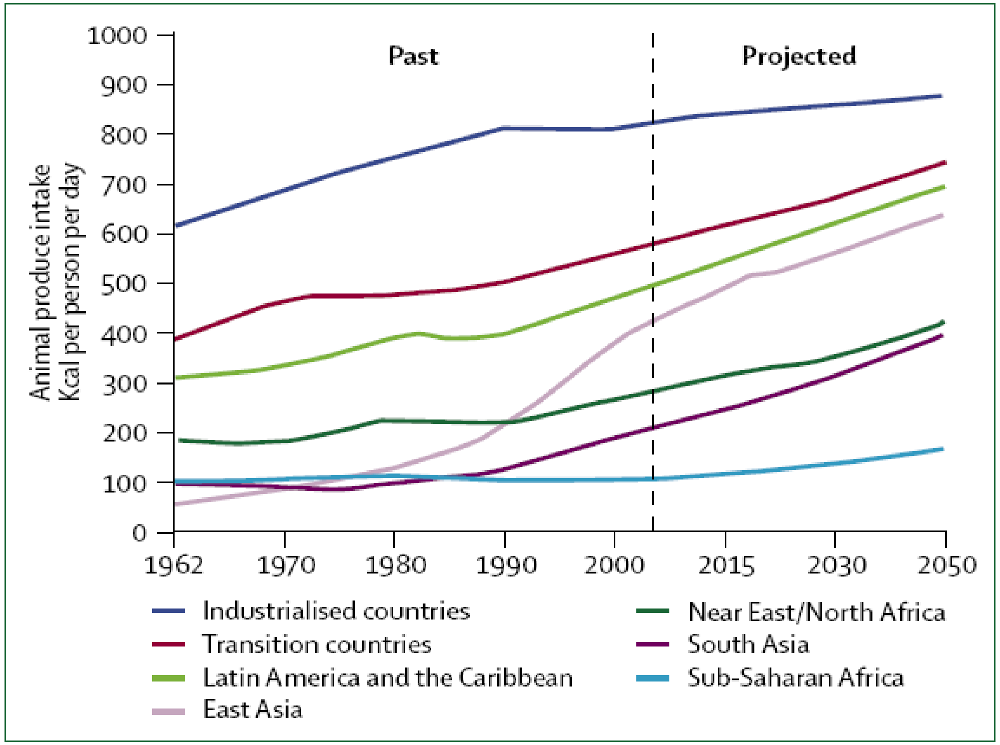


Figure 1: **Trends in consumption of livestock products per person (milk, eggs, and dairy products, excluding butter)**

The projected trends assume no policy-induced change from present consumption. Note the rapid recent increase in east Asia, dominated by China, where per-head meat consumption would reach European levels by mid-century. Cultural, agricultural, and political factors will determine how the composition of animal products intake actually changes in the future. For example, in the near east and in north Africa, higher intake of milk, eggs, and poultry are likely, whereas greater consumption of beef and poultry is expected to dominate the increase in Latin America.[43] Reproduced from FAO,[42] with permission.

re0883

Fig. 5: **McMichael et al. (2007)**

Tab. 14a: Contribution of:

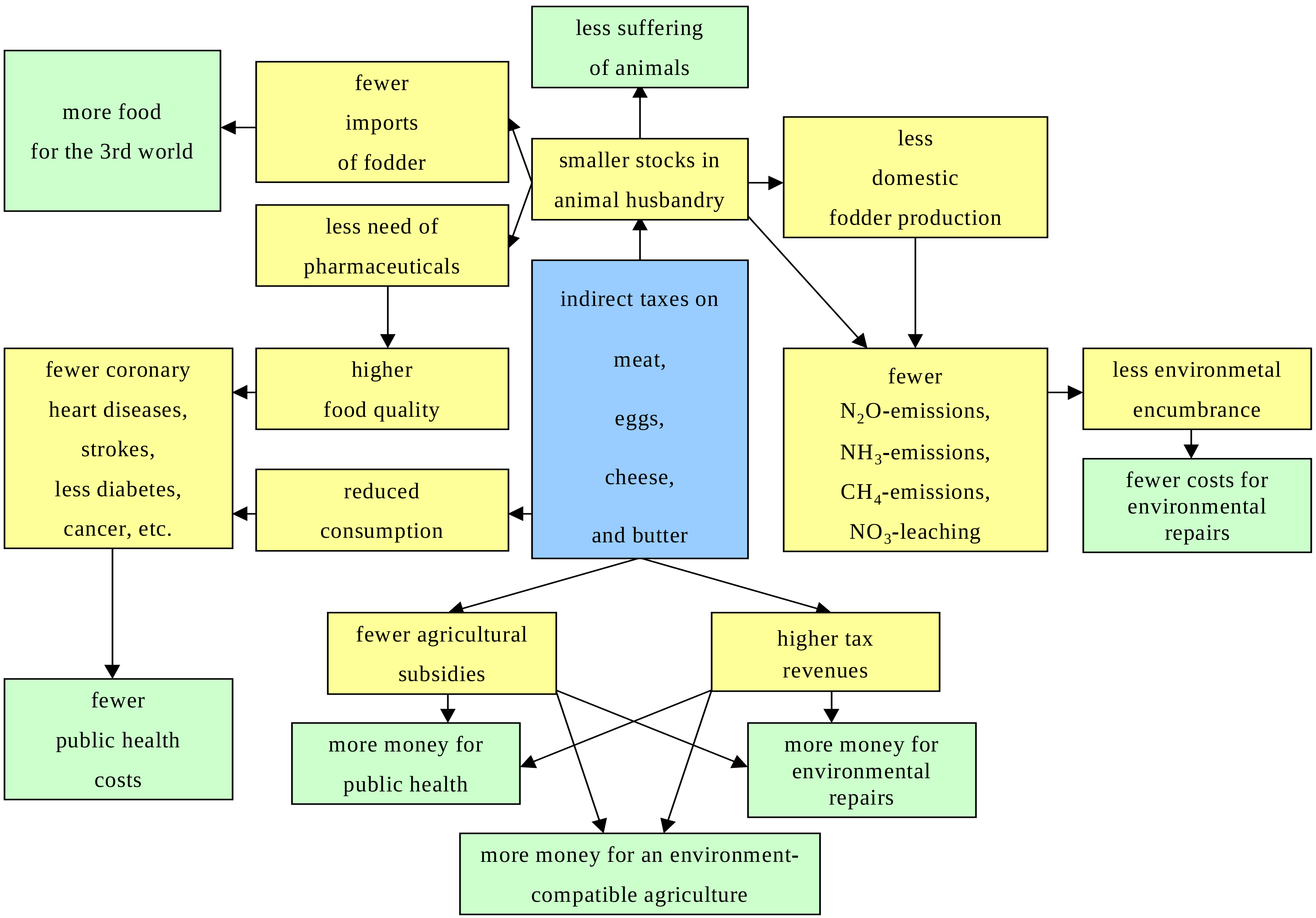
1. **the total system nutrition (agriculture with plant and animal production, human nutrition with plant and animal food consumption as well as waste and waste water management)**
2. **animal production and animal food consumption within the system nutrition**

to environmental changes / damages and threatening of human health in Germany

	% contribution	
	1. Total system nutrition	**2. Animal production and consumption within the system nutrition**
1. Eutrophication	**80**	**70**
2. Acidification	**40**	**90**
3. Climate change	**20**	**(60-) 80**
4. Decline of biomass (also consequences of 1.-3.)	**80**	**70**
5. Threatening human health	**30**	**80**

Re0931

Fig. 6: Tax Levy Model for Animal Products to Relieve the Environment and Public Health (van der Ploeg 2002) (re0530)



Tab.15Commission launches public consultation on Sustainable Consumption and Production and Sustainable Industrial/Nutritional Policy

The European Commission launched on 27 July a public consultation on actions the European Union could undertake to meet the challenges of Sustainable Consumption and Production and a Sustainable Industrial Policy. The aim of the internet-based consultation is to gather input from the public and stakeholders to help the Commission prepare Action Plans to address these challenges. The consultation will last until 23 September. (Brussels, August 6, 2007; IP/07/1215)

Putting consumption and production onto a sustainable path is a major global challenge that will require considerable technological innovation. Current patterns of consumption and production are leading to the rapid depletion or exhaustion of certain natural resources, such as oil reserves and fish stocks, as well as causing serious environmental degradation and pollution. The issue is a global one: several studies and assessments suggest that the current consumption and production already significantly exceeds what the planet can support in the long term.

The Commission aims to address these problems and turn environmental challenges into economic opportunities for EU industry, thereby reducing greenhouse gas emissions and improving efficiency in use of energy and natural resources.

By developing robust sustainable consumption and production policies, the EU can make an important contribution to sustainability worldwide since Europe is one of the biggest consumers at global level and products are traded globally. European standards to foster sustainable consumption and production will tend to become global benchmarks.

The public consultation explores actions under five headings: Leveraging Innovation, Better Products, Leaner and Cleaner Production, Smarter Consumption and Global Markets. The Commission intends to focus its action on key environmental issues: climate change and the creation of a low-carbon economy; sustainable and efficient use of natural resources, energy and materials; and hazardous substances.

The actions under consideration have a strong focus on products as recent Commission research confirms that a large proportion of environmental impacts in the EU are caused by consumer products throughout their 'life-cycle', in other words from the extraction of the raw materials used right through to the production, transportation, consumption and final disposal of the product.

The Action Plans would build on several existing EU policies related to products and resources, such as the Industrial Policy (as reviewed in July 2007), Integrated Product Policy, the Eco-design of Energy-Using Products, the Sustainable Use of Natural Resources strategy, the Energy Policy for Europe, Cohesion policy and other product legislation and labelling schemes.

Since the Action Plans would cover products, production and consumption, stakeholder engagement is crucial. The purpose of the consultation is to gather opinions on different policy actions and options. More information on the rationale behind the different actions and options is presented in a background document.
The general public and stakeholders are invited to give their views on the actions discussed by filling out the questionnaire at the following address:http://ec.europa.eu/yourvoice/ipm/forms/dispatch?form=SurveySIPSCP

Tab. 16: Necessary reduction of animal production and livestock of agriculture both in the countries of EU-25+2 and in the Federal lands of Germany on the basis of the actual capita-specific animal densities ($AU \cdot capita^{-1}$) in comparison with a maximum tolerable animal density of 0.1 AU= 50 kg life weight $\cdot$ $capita^{-1}$ (Isermann 1995/2006) **according to a healthy human nutrition with animal food, especially with meat [Net: max. 23,4 kg meat $\cdot$ $capita^{-1} \cdot year^{-1}$ (DGE 2000/01) instead of actually i.e. in Germany (2002):60 kg $\cdot$ $capita^{-1} \cdot year^{-1}$]**
[Actual animal stockings and densities according to EUROSTAT 2005]

Countries	Actual Animal densities ($AU \cdot capita^{-1}$)	Necessary Reduction Livestock (%)	Countries	Actual Animal densities ($AU \cdot capita^{-1}$)	Necessary Reduction Livestock (%)	Federal Lands of Germany	Actual Animal densities ($AU \cdot capita^{-1}$)	Necessary Reduction Livestock (%)
1.Ireland	1.606	-94	14. Hungary	0.263	-62	1. Schleswig-Holstein	0.466	-79
2.Denmark	0.846	-88	15. Bulgaria	0.254	-61	2. Niedersachsen	0.456	-78
3.France	0.390	-74	16. Estonia	0.241	-59	+Hamburg		
4.Belgium	0.382	-74	17. United kingdom	0.240	-58	+Bremen		
5.Netherlands	0.380	-74	18. Greece	0.238	-58	3. Mecklenburg-Vorp.	0.404	-75
6.Cyprus	0.359	-72	19. Finland	0.227	-56	4. Bayern	0.311	-68
7.Luxemburg	0.355	-72				5. Sachsen-Anhalt	0.252	-60
8.Spain	0.341	-71				6. Thüringen	0.232	-57
9.Lithuania	0.339	-71	**20. Germany**	**0.226**	**-56**	**Deutschland**	**0.226**	**-56**
10. Austria	0.308	-67	21. Portugal	0.226	-56	7. Sachsen	0.156	-36
11.Romania	0.304	-67	22. Czech.Republic	0.224	-55	8. Nordrhein-Westf.	0.154	-35
			23. Sweden	0.205	-51	9. Baden-Württemb.	0.140	-29
EU-15	**0.294**	**-66**	24. Latvia	0.197	-49	10. Brandenburg	0.130	-23
12.Slovenia	0.293	-66	25. Slovakia	0.177	-44	+Berlin		
13. Poland	0.292	-66	26. Italy	0.174	-43	11. Hessen	0.106	-6
EU-25+2	**0.290**	**-64**	27. Malta	0.123	-19	12. Rheinland-Pfalz +	0.094	+7
EU-10+2	**0.275**	**-64**				Saarland		

Re0785

Tab. 17: Sufficiency as a prerequisite for consistency and efficiency (Isermann / BSNLC 1990-2007; McMichael et al. 2007)

Sufficiency especially in animal food and feed as well as in bioenergy consumption and only corresponding production leads especially in the developed and industrialized countries with their tremendous over-nutrition to ca. 70 (60-80) % of the needed emission reductions of reactive C, N, P, S of the nutrition system flanked by “only” ca. 30 (20-40%) reductions with technical measures.

Re0935

2. Pedosphere

2.1 Soil Organic Matter (SOM / Humus):

Org. C, N, P, S

Tab. 18: Optimum soil organic matter conditions (SOM or C_{org} = humus) of groundwater-remote sandy and loamy soils under common arable farming and average climatic conditions in Europe derived from 26 long-term field trials in Western Europe (Average yearly temperatures: 6-10°C, average yearly precipitation: 400 –800 mm)

(Körschens 1995/1997, Schulz 1997, Körschens and Schulz 1999, Isermann and Isermann 1999, 2003a-b, Isermann und Körschens 2001, Isermann 2002, 2003, Benbi et al. 2003; completed)

Individual parameters	***Respective optimum conditions of SOM***
1. Contents / Quantities 1.1 Total SOM	Total SOC= C_{org}: 0.7 % (sandy soil) up to 2.5% (black soil) dependent on the clay content (0.7-21%) Total SON= N_{org}: 0.07% (sandy soil) up to 0.25% (black soil) dependent on the clay content (0.7-21%)
1.2 Decomposable $SOM_{dec.}$ Hot water soluble SOM_{hws} (SOM thickness: 30 cm)	Decomposable SOC= C_{dec}: 0.4 (0.2-0.6)% = 16 (8-24) $t \cdot ha^{-1}$ => C_{hws}: 25-30 $mg \cdot 100$ g soil $matter^{-1}$ Decomposable SON= N_{dec}: 0.04 (0.02-0.06) % =1.6 (0.8-2.4) $t \cdot ha^{-1}$
1.3 Mineralised SOM_{min} (e.g. Central Germany: 4% of SOM_{dec})	Mineralised SOC= C_{min}: 680 (320-960) $kg \cdot ha^{-1} \cdot a^{-1}$ Mineralised SON= N_{min}: 68 (32-96) $kg \cdot ha^{-1} \cdot a^{-1}$
2. Thickness **(tillage depth)**	<35 (e.g.: black soil) up to > 20 cm (e.g. sandy soil)
3. Qualities: 3.1 SOC/SON= C_{org}/N_{org} 3.2 SOC/SOS= C_{org} / S_{org} 3.3 SOC/SOP= C_{org} / P_{org}	 10/1 (> 8/1 up to < 12/1) 100/1 (> 70/1 up to < 140/1) 150/1 (> 100/1 up to < 200/1)
4. Types	raw humus ➔ moder ➔ mull
5. Maintenance of optimal SOM balance (Mineralisation = Immobilisation)	2 t reproduction-efficient organic susbtance (ROS) $\cdot ha^{-1} \cdot a^{-1}$ = stable manure / liquid manure of 2 t of dry matter / 10 t of raw mass farmyard manure from 1 gross weight unit (GWU) or 1 life weight heavy lifestock unit (LFU) of 500 kg life weight (LW) re0518

Tab.19: Balances of soil organic matter (SOM) for optimal economical and ecological conditions as well as corresponding needs for reproduction-efficient organic substances (ROS) and amounts for animal manure(AM) for arable soils derived from the results of 13 long-term field experiments of 9 locations in Germany (Optimal conditions: Both optimal mineral and organic fertilization)

[Standpoint VDLUFA / 8th April 2004; but additionally location Seehausen]

Locations	**Starting years**	**Optimal amounts of animal manure [$t \cdot ha^{-1} \cdot yr^{-1}$]**	**Balance values ROS [$t \cdot ha^{-1} \cdot yr^{-1}$] = animal manure (AM) [$t \cdot ha^{-1} \cdot yr^{-1}$]**
1. Bad Lauchstädt [1]	1902/1978	10	2.6 ROS = 13.0AM
2. Seehausen [2]	1966	12	2.4 ROS = 12.0 AM
3. Methau [3]	1966	10	2.6 ROS = 13.0 AM
4. Spröda [3]	1966	10	2.6 ROS = 13.0 AM
5. Müncheberg [4]	1962	8	2.6 ROS = 13.0 AM
6. Braunschweig [4]	1952	10	2.6 ROS = 13.0 AM
7. Groß Kreutz [5,6]	1967	10-15	2.6 ROS = 13.0 AM
8. Thyrow [7]	1938	10	2.0 ROS = 10.2 AM
9. Speyer [8]	1958/1983	15	2.5 ROS = 12.7 AM
1. – 9. Average	**c.o.**	**10.8**	**2.5 ROS = 12.5 AM** [2.0 ROS = 10.0 AM]

These average values correspond to an optimum (and maximum) input of animal manure of 1 Gross weight unit (GWU= LWU= AU) of 500 kg life weight (LW) per ha agricultural area, in respect to optimum C, N, P, K, Mg (and S) balances and sufficient for the healthy nutrition of 10 capita with animal food corresponding to 0.1 GWU $\cdot$ capita^{-1} (Isermann and Isermann 1999/2004)

[1] Körschens et al. (1994), [2] Leithold et al. (1996), [3] Albert (1999), [4] Rogasik (2003), [5] Asmus (1995), [6] Zimmer and Prystav (2003), [7] Lettau and Ellmer (1997), [8] Bischoff and Emmerling (2003) cited by Körschens (2002) and VDLUFA (2004), re0524

Tab. 20: Assessment of humus balances

(VDLUFA-Standpoint humus balances 2004)

Humus balance		Assessment
kg humus-C · ha^{-1} · yr^{-1} *)	Level - Group	
< -200	A very low	Negative consequences for soil functions and yields
-200 to -76	B low	Medium-time tolerable, especially on soils enriched with humus
-75 to 100	C optimum	Optimum in respect to safety of yields with low risk of losses long-term regulation of humus contents on locations (maintenance)
101 to 300	D high	Medium-term tolerable, especially on soils depleted of humus
> 300	E very high	Enhanced risks of N (C,S) losses (emissions), low N(S) efficiency

Re0622

*) Conversion constants:

a) 100 (300) kg humus-C ~ 0.5 (1.5) t reproduction efficient organic substance (ROS)
~ stable manure / liquid manure from 0.25 (0.75) AU of 500 kg life weight

b) 1 Humus equivalent (HE) ~ ca. 580 kg humus-C

Tab.21: Balance of the nutrients C, N, P, S and their efficiency in SOM incorporation by the input of organic matter (OM) e.g. by farmyard manure (FYM) (average values)

Balance	Nutrients (% or kg · ha^{-1} · yr^{-1})			
	C	N	P	S
A) Input of OM (e.g.FYM) into the soil	100[1)]	100[1)] (Excretion: 136)	100	100
B) Output with OM (e.g.FYM)	100	100	100	100
1. Yield (Net)	-	30	20 (long term<100)	4
2. Environment …off it:	**> 90**	**> 70**	**80 (long term > 0)**	**< 96**
2.1 Soil:				
2.1.1 % in organic fraction (Schröder 1969)	< 100	> 98	40 (25-60)	80 (60-95)
2.1.2 SOM: Efficiency of C, N, P, S incorporation	**< 10**	**< 10**	**32**	**< 8**
2.2 Atmosphere	> 90 (CO_2 >> CH_4)	20 [1)] (N_2> H_2O < NO)	< 0.5 (wind erosion)	< 1 (wind erosion)
2.3 Hydrosphere	< 1 (DOC)	40 (NO_3^->NH_4^+~ DON)	< 1 (Inorg. P>> DOP)	95 (SO_4^{2-}>>DOS)

[1)] Additional losses e.g. of N by volatisation of ca. 56 kg NH_3-N · ha^{-1} · yr^{-1} in housings, during storage and application of FYM

➔ - Only about 10, 10, 32 and 8% of C, N, P, S input with OM is incorporated in SOM respectively
- and about 90, 70, > 0 and 96% are lost / emitted to the environment respectively:
➔ Avoidance of not tolerable inputs of OM, especially of OM with close C:N:P:S relations , (straw better then FYM)

Tab. 22: Environmental aspects of SOM management of agricultural soils related to the nutrients C, N, P, S

Environmental aspects affecting natural (near) ecosystems	**Involved Nutrients**			
	C	**N**	**P**	**S**
1. Source aspects **1.1 Acidification:** a) **Terrestrial and (semi-) subhydric soils** b) **Groundwater and surface water**	**CO_2** Changes: ➢ Woodland ➔ grassland ➔ arable land (esp. fire clearing) ➢ Grassland ➔ arable land	**NH_3 > NO**	-	**SO_4**
1.2 Eutrophication: **a) Terrestrial and (semi-) subhydric soils** **b) Groundwater and surface water**	**CO_2** **-**	**NH_3 > NO** **NO_3**	**(In)Organic P**	-
1.3 Climate change ➔ **Tab. 12, Fig. 4**	**CO_2** **CH_4** **Reduced CH_4-Oxidation by NH_3**	**N_2O** **Indirectly:** **NH_3 > NO**	-	-
2. Sink aspects ➔ Tab. 9 **2.1 Sequestration** **2.2 "Retention", Retardation (Emission delays)**	**-** **SOM - C**	**-** **SOM - N**	**-** **SOM - P**	**-** **SOM-S**

Re0837

Tab. 23: SOM- and Biomass – C – Sequestration ➔ “Retention”, Retardation: From C-sink to C- source

Authors	Some aspects, results, conclusions
1. R. Valentini **University of Tusca/Italy** **[CarboEurope and CAMELS: Carbon Assimilation and Modelling of the European Land Surfaces]** **(2. – 5.)**	Possibly within the next 50 – 100 years SOM and Biomass (esp. woodland and grassland) will be a sink for CO_2 but:: 1. In the main only the labile decomposable SOM_{dec} increases or changes, but negligible in the stable inert C-fraction 2. The sink capacities for excess C then will be saturated 3. If C –and /or CO_2-Input decreases, SOM will be a net-source of CO_2 4. There will be more forest fires as an impact of global warming➔ More CO_2 from biomass and SOM 5. Global warming will increase, CO_2 emissions from SOM ➔ e.g. actual Net-C (and N) mineralisation in the tundra of Alaska
2. U. Franko **Centre for Environmental Research Leipzig-Halle/Germany** **[CAMELS]** **➔ personnel information (2007)**	From the model calculations in Bad Lauchstädt / Germany it follows that the turn-over of SOM of the arable soils have increased continuously of about 10% since about the last 100 years. These results are specific for Bad Lauchstädt
Conclusions	Reduction of the CO_2 –and of the other GHG-emissions have the only one priority and not their apparent Sequestration ➔ Retention, Retardation with emission delay. This is not only true for C, but also for N, P and S.

Pedosphere
2.2 Inorganic Phosphorus

Tab. 24: Definition of (optimal) P status for „plant available“ DL and CAL-Phosphorus in agricultural soils and P recommendations

A) new (Köster und Nieder 2004, Isermann 1997/ 2006)

B) at present (VDLUFA-P-Standpunkt 1997)

A) new: 3- classes system (u.a. Köster und Nieder 2004, Isermann 1997/ 2006)					B) at present: 5-classes system (VDLUFA-P-Standpoint 1997)				
Classes of P contents	Reference values [mg P/100g soil] ➔potential eutrophication surface waters	Fertilisation needs Input (I) ------------- Output (O)	Fertilisation effects		Classes of P contents	Reference values [mg P/100g soil] ➔potential eutrophication surface waters	Fertilisation needs Input (I) ------------- Output (O)	Fertilisation effects	
			Yield increase	Δ P-content of soils				Yield increase	Δ P-content of soils
A (too low)	< 3,0 (< 2,0) ➔ low	I= 2,0 x A	high	Increasing	**A (very low)**	< 2,0	I = 2,0 x O	high	Increasing obviously
					B (low)	2,1– 4,4	I = 1,5 x O	middle	increasing
B (aimed) 1)	**? 3,0 – 5,0 ➔ middle**	**I = O**	**low**	**constant**	**C (aimed)**	**4,5 – 9,0**	**I = O**	**low**	**constant**
C (too high)	> 5,0 (> 6,0) ➔ high + depletion of fossil mineral P resources	I = 0 x O	none	decreasing	**D (high)**	9,1 – 15,0	I = 0,5 x O	only with leaf plant	Decreasing slowly
					E (very high)	> 15,1	I = 0 x O	none	decreasing

1) **The main potential for P loss mitigation <u>and preserve mineral P resources</u> is to maintain soils at or near the lowest mean soil test P (STP) level compatible with good plant production (on soils subject to P loss in overland flow) and match inputs with outputs by yields**

[Compare Tunney, Foy et al. IPW5 (2007) : Recommendation for grassland]

re0936

Table 25: Phosphorus status in European agricultural soils (plant available P for each country using its standard and methodology for soil test phosphorus /STP) according to table 3) and actual Phosphorus Field balances (FB)

Countries	Years	References	Phosphorus status soils (% of area)			Actual Phosphorus Field Balances [kg P· ha^{-1}· yr^{-1}] (see table 3)
			Insufficient (very low + low)	Optimum (medium)	Over supplied (high + very high)	
1. Western Countries	1996	Sten (2000)				
- **Norway**			23	50	27	13.2 (2002)
- **Denmark**			6	42	52	13.0 (2002/3)[2]
- **Netherlands**			14	18	68	27.0 (2002)
- **Sweden**			15	40	45	21.0 (2003)
- **United Kingdom**			15	68	17	5.0 (1995)
- **Ireland**			16	32	52	11.8 (1997/98)
- **Greece**			20	40	40	7.3 (1989)
- **France**			24	37	38	n.d.
- **Germany**			28	40	32	38.0 (2003)
- **Austria**			30	45	25	5.9 (1992)
- **Finland**			52	35	13	8.2 (2002)
2. CEE Countries		Csatho (2002)				
- **Bulgaria**	1977-80		59	27	13	-2.3 (1992)
- **Czech Republic**	1983-95		26	51	23	7.8 (1992)
- **Hungary**	1977-81		16	36	48	-5.8 (1991/00)
- **Latvia** [1]	1980-85		52	29	19	n.d.
- **Poland**	1991-94		39	26	35	4.0 (2003)
- **Romania** [1]	1985		40	34	35	8.7 (1992)
- **Slovakia**[1]	1976-80		26	46	28	n.d.
- **Slovenia**[1]	199297		25	24	51	3.1 (1992)
- **Ukraine**	1977-80		59	27	13	11.7 (1992)

[1] Only arable land ; [2] Farm Gate Balance (FGB)

re0694

Table 25(Continued):Phosphorus status in European agricultural soils (plant available P for each country using its standard and methodology for soil test phosphorus /STP) according to table 3) and actual Phosphorus Field balance (FB)

Countries	Years	References	Phosphorus status soils(% of area)			Actual Phosphorus Field Balances [kg P· ha^{-1} · yr^{-1}] (see table 3)
			Insufficient (very low + low) (under-fertilized)	Optimum (medium)	Over supplied (high + very high) (over-fertilized)	
3. Newest datas						
- Netherlands	1999-2000	RIVM (2004)	4	29	67	26 (2003)[1]
a) arable land	1999	Oenema (2005)	0	20	80	
b) grassland	1999	Oenema (2005)	10	30	60	
- Denmark	2003	Pedersen (2004)	9	48	40	13 (2002/03)
- Norway	2004	Gronlund (2005)	14	52	35	13 (2002)
- Ireland	1998	EPA (2001)	17	34	49	12 (1997/98)
- Germany	2001	VDLUFA (2004)	26	38	36	1 (2001/03)
a) arable land			21	38	41	
b) grassland			41	35	24	
- Finland	1995-98	Yli-Halla (1999)	37	54	9	8 (2000/02)
- Poland	2004	Igras (2005)	38	n.d.	n.d.	4 (2003)
- Luxembourg	2002	Lioy (2005)	33	44	22	5 (2004)[1]
- Switzerland		Neyroud (2005)				
a) arable land		Declerck (2001)	41	27	32	6 (2003)[1]
b) temporary grassland	2002		41	22	27	
c) permanent grassland			45	27	28	
- England and Wales						
a) arable land	1969-73	Withers et al.	6	69	25	13 (1970)[1]
	1995-99	(2005)	3	80	17	5 (2003)[1]
b) grassland	1969-73		13	75	12	13 (1970)[1]
	1995-99		11	82	7	5 (2003)[1]
- Austria		Danneberg et al.				
a) Lower Austria	1986-1996	(1997)	46	39	15	6 (1992)
b) Upper Austria			64	24	12	
c) Burgenland			56	32	12	
d) Styria			73	16	11	
e) Tyrol			93	3	4	

[1] Farm Gate Balances (FGB)

Table 26:

Soil phosphorus status in some Central and Eastern European countries, as a percentage of the area in each supply category, 1960-2004.

(Csathó et al. 2007)

Country (red numbers: negative trends (1980/2000) in P status: reduced to poverty
green numbers: positive trends (1980/2000) in P status: reduced too high enrichments

	Phosphorus supply Low[a]			Phosphorus supply Medium			Phosphorus supply Good[b] and very good			Remarks	Reference
Period	1960s	1980s	2000s	1960s	1980s	2000s	1960s	1980s	2000s		
Albania	[c]*50*	33	*35*	*35*	42	*40*	*15*	25	*25*	Agricultural land	Lushaj et al., 2005; Csathó, 2005
Austria	*60*	30	*25*	*30*	45	*45*	*10*	25	30	Agricultural land	Steén, 1997; Csathó, 2005
Bulgaria	79	38	*60*	14	32	*30*	7	29	*10*	Arable land	Nikolov, 1998; Csathó, 2005
Czech Rep.	71	17	27	18	48	31	11	35	42	Arable land	Čermak, 2000; Čermák & Budňáková, 2003
Estonia	84	38	29	10	44	47	6	18	24	Arable land	Järvan et al., 1996
Hungary	43	14	30	57	29	30	0	57	40	Agricultural land	Stefanovits & Sarkadi, 1963; Kovács, 1984; Csathó, 2005
Latvia	83	22	37	12	35	35	5	43	28	Agricultural land	Karklins, 1998; Kublicka et al., 2004
Lithuania	79	62	63	12	22	20	9	16	17	[d]NI	Mazvila et al., 1996, 2004;
Poland	80	58	38	8	22	27	12	20	35	NI	Obojski & Straczynski, 1995 Lipiński, 2005
Romania	*50*	40	45	*40*	34	32	*10*	25	23	Arable land	Hera et al., 1998; Dimitru & Dimitru, 2005; Csathó, 2005
Serbia	73	26	39	14	56	48	13	18	13	Arable land	Nikolić, 1970; Bogdanović et al., 1993; Bogdanović, 2003
Slovakia	61	18	26	26	39	38	13	43	36	Arable land	UKSUP, 2000
Slovenia	*60*	*30*	25	*30*	*30*	24	*10*	*40*	51	Arable land	Leskošek, 1998; Csathó, 2005
Ukraine	*50*	21	*45*	*50*	51	*45*	*0*	28	*10*	Arable land	Nosko et al., 1994; Bentsarovsky & Datsko, 2004; Khristenko, 2005

[a]Very low + Low P supply categories; [b]Good + Very good P supply categories; [c]data in Italics are estimations, based on changes in P balances in the country;
[d]NI: no information

3. Hydrosphere:

C, N, P, S protection aims for surface water and groundwater

3.1 Critical levels

Tab. 2:Qualification of surface waters (? Groundwater/Draft EU-Groundwater Directive 2006) in respect to the nutrient levels C, N, P, S in Germany (LAWA / UBA 2006) (basis value: 90-percentile)

[http:// www. umweltbundesamt.de/wasser/themen/ow_s3_3.htm]

Nutrients	Unit	Chemical water quality categories regarding the nutrient levels, irrespectively of their loads						
		I	I-II	II[1)]	II-III	III	III-IV	IV
		Anthropogenic Levels						
		Not influenced	very low	moderate	obvious	increased	high	very high
		Geogenic background	½ aim	aim	up to 2x aim	up to 4x aim	up to 8x aim	up > 8x aim
		dark-blue	light-blue	green	light-green	yellow	orange	red
1. TOC	$mg \cdot l^{-1}$	<= 2	<=3	**<= 5**	<= 10	<= 20	<= 40	> 40
2. total N(TN)	$mg \cdot l^{-1}$	<=1	<= 1,5	**<= 3**	<= 6	<= 12	<= 24	>24
…of it:								
2.1 Nitrate-N	$mg \cdot l^{-1}$	<= 1	<= 1,5	**<= 2,5[2)] (drinking water:<11,3)**	<= 5	<= 10 (drinking water:<11,3)	<= 20	>20
2.2 Nitrite-N	$mg \cdot l^{-1}$	<= 0,01	<= 0,05	**<= 0,1**	<= 0,2	<= 0,4	<= 0,8	>0,8
2.3 Ammonium-N	$mg \cdot l^{-1}$	<= 0,04	<= 0,1	**<= 0,3**	<= 0,6	<= 1,2	<= 2,4	> 2,4
3. Total-P(TP)	$mg \cdot l^{-1}$	<= 0,05	<= 0,08	**<= 0,15**	<= 0,3	<= 0,6	<= 1,2	> 1,2
…of it:								
Ortho-Phosphate-P	$mg \cdot l^{-1}$	<= 0,02	<= 0,04	**<= 0,1**	<= 0,2	<= 0,4	<= 0,8	> 0,8
4. Sulfate	$mg \cdot l^{-1}$	<= 25	<= 50	**<= 100**	<= 200 (drinking water: = 240)	<= 400	<= 800	> 800

1) Demand up to 2010: strict observance on all measuring locations of LAWA

2) **Maximum tolerable for total life of adults (70 kg life weight, 2 l drinking water $\cdot$ d^{-1}): 2,9 mg NO_3-N $\cdot$ l^{-1}**

Re0784

Tab. 28: Background levels (BG: good-very good) and as possible aims orientation levels (OR: good-moderate) of the nutrients C, N, Pin surface waters (and groundwater) in Germany irrespective of the corresponding loads of running waters/rivers and necessary downstream protection especially of transition waters (estuaries) and coastal waters according to:
A) LAWA-AO-Rahmen Konzeption (RAKON /07.03.2007) in comparison with B) LAWA-AO-Rahmen Konzeption (RAKON /07.03.2007) (Isermann / BSNLC 2007)

Qualifica-tions	A) LAWA-AO-Rahmen Konzeption (RAKON /07.03.2007) (http://www.wasserblick.net/servlet/is/42489/?lang=de&highlight=rakon)							B) LAWA /EPA-Germany 2005/2006 (http://www.umweltbundesamt.de/wasser/themen/ow_s3_3.htm)		
Surface waters	LAKES [Vegeta-tion averages]	RUNNING WATERS [averages]		TRANSITION AND COASTAL WATERS: Running waters flowing into coastal waters <u>with retention</u> (→Remobilisation?) Calculated with MONERIS				SURFACE WATERS (AND GROUNDWATER) [3)] [90-percentile]		
				North Sea resp. ( ) German Bight		Baltic Sea resp. ( ) Arkona Sea				
Nutrient levels	BG	BG	OR	BG	OR =1.5 BG	BG	OR =1.5 BG	BG (I)	½ Aim (I /II)	Aim (II) (moderate)
TOC (mg/l)	-	5 -10	7 - 15	-	-	-	-	← 2	← 3	← 5
TN[1)] (mg/l)	-	in preparation	in preparation	0.21-0.35 (0.17) [year]	0.42-0.70 (0.34) [year]	0.14 (0.14) [year]	0.21 (0.21) [year]	← 1	← 1.5	← 3
DIN (mg/l)	-	-	-	0.13-0.24 (0.13) [winter]	0.26-0.48 (0.26) [winter]	0.08-0.11 (0.030-0.035) [winter]	0.15-0.17 (0.040-0.050) [winter]	-	-	-
NO_3-N (mg/l)	-	in preparation	in preparation	0.10-0.18 (0.090) [winter]	0.20-0.36 (0.180) [winter]	0.04-0.07 (0.030-0.035) [winter]	0.06-0.11 (0.040 -0.050) [winter]	← 1	← 1.5	← 2,5
NO_2-N (mg/l)	-	-	-	-	-	-	-	← 0.01	← 0.05	← 0.10
NH_4-N (mg/l)	-	0.02-0.04	0.10 – 0.30	-	-	-	-	← 0.04	← 0.10	← 0.30
TP[2)] (µg/l)	6-86	50-100	100-300	10-30 (20) [year]	20-50 (40) [year]	9-19 (14) [year]	25-28 (28) [year]	← 50	← 80	← 150
PO_4-P (µg/l)	-	10-20	70 -200	4-8 (8) [winter]	8-16 (16) [winter]	4-18 (8-9) [winter]	12-24 (12-14) [winter]	← 20	← 40	← 100

[1)] TN: 1µ mol/l= 0.014 mg/l; [2)] TP: 1µ mol = 0.031 mg/l

[3)] The level of protection against new discharges, emissions and losses must be at least comparable to that for surface water of good chemical status (Amendment 3, Recital 1a, European Parliament Legislative Resolution on the Council → Draft EU-Groundwater Directive, June 13, 2006)

re0882a

Tab. 29: TP, PO_4-P and Chl-a limits in systems for evaluating the water quality of rivers, lakes and seas

(Csathó et al. 2007)

Water bodies	Measured properties	Units	Quality classes (I is the best)				
			I	II	III	IV	V
Rivers	**TP**	**(mg l^{-1})**	**<0.1**	**0.1-0.2**	**0.2-0.4**	**0.4-1**	**>1**
	PO_4-P	**(mg l^{-1})**	**<0.05**	**0.05-0.1**	**0.1-0.2**	**0.2-0.5**	**>0.5**
	Chl-a	**(µg l^{-1})**	**<25**	**25-50**	**50-100**	**100-250**	**>250**
Lakes	**TP**	**(mg l^{-1})**	**<0.005**	**0.005-0.01**	**0.01-0.03**	**0.03-0.1**	**>0.1**
	PO_4-P	**(mg l^{-1})**	**-**	**-**	**-**	**-**	**-**
	Chl-a	**(µg l^{-1})**	**<2.5**	**2.5-8**	**8-25**	**25-75**	**>75**
[a]Seas	**TP (summer)**	**(mg l^{-1})**	**<0.0145**	**0.0145-0.0231**	**0.0231-0.0386**	**0.0386-0.1157**	**>0.1157**
	PO_4-P (winter)	**(mg l^{-1})**	**<0.0125**	**0.0125-0.02**	**0.02-0.0333**	**0.0333-0.1**	**>0.1**
	Chl-a	**(µg l^{-1})**	**<1.29**	**1.29-2.06**	**2.06-3.43**	**3.43-10.29**	**>10.29**

a: based on the reference conditions and 50 % acceptable deviation given in HELCOM (2005c)

re0850

Tab. 30: EC Groundwater Directive (Strasbourg, June 13, 2006)

1/2

European Parliament legislative resolution on the Council common position for adopting a directive of the European Parliament and of the Council on the protection of groundwater against pollution

[12062/1005 – C6- 005/2006 – 2003/0210(COD)]

➔ **Important amendments of the European Parliament to the Council common position, especially in respect to nitrate (NO_3^-):**

1. **The text voted on by Parliament leaves EU countries free to define threshold values for pollutants in groundwater except for pesticides and nitrates used in agriculture**. However, it does seek to harmonise the methods used to measure to pollutants.

2. **For nitrates, residue levels are limited at 50 mg per litre**, according to the next wording. "The protection of groundwater may in some areas require a change in farming or forestry practices, which could entail a loss of income," for farmers the text reads. To make up for potential losses, MEPs suggested providing farmers with aid under the reformed common agriculture policy (CAP)

3. **Amendment 4 [Recital 1b (new)]:** (1b) Groundwater must be protected in such a way that good quality drinking water can be achieved by simple purification, as specified in the objectives set out in Article 7(1) and (3) of directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for community action in the field of water policy.

   ➔ **Residue levels are limited at 50 mg nitrate (11.3 mg NO_3-N) per litre in spite of nitrate preserves, rather than threatens human health by causing methaemoglobinaemia in infants and stomach cancer in adults** [Addiscott, T.M. and N. Benjamin (2004): Nitrate and human health. Soil use and management 20, 98-104].

But:

4. **Amendment 3 Recital 1a (new) (1a):** Groundwater is the most sensitive and the largest body of freshwater in the European Union and in particular also the primary source of public drinking water supplies. **The level of protection against new discharges, emissions and losses must be at least comparable to that for surface water of good chemical status.** Pollution or deterioration frequently gives rise to irreversible damage.

   ➔ **LAWA-Quality classification for running waters: Residue levels (class II): 3 mg total N/l and ca. 2.5 mg NO_3^-N/l ? 11 mg NO_3/l** Note: The actual "baseline concentrations" i.e. German main streams are "only" between

2/2

ca. 2-7 mg Total N/l and 1,8-6,3 mg NO_3^- -N/l. An only 50% reduction leads to 1.0-3.5 mg Total N/l and 0,6-3,1 mg NO_3^- -N/l !

➔ **Amendment 3 replaces Amendment 4**

1. **Amendment 44, Article 1, paragraph 2, subparagraph 1a (new): This Directive shall not prevent individual Member States from maintaining or introducing stricter protection measures**

2. **Amendment 15, Article 3, paragraph 1, subparagraph 1a (new): The Groundwater quality standards and threshold values applicable to good chemical status shall be based on the human and ecotoxicological criteria underpinning the definition of pollution in Article 2(33) of Directive 2000/60/EC – WFD**

3. Amendment 12, Article 2, point 4a (new): “deterioration” means any slight, anthropogenically induced and persistent increase in concentrations of pollutants in relation to the status quo in groundwater.

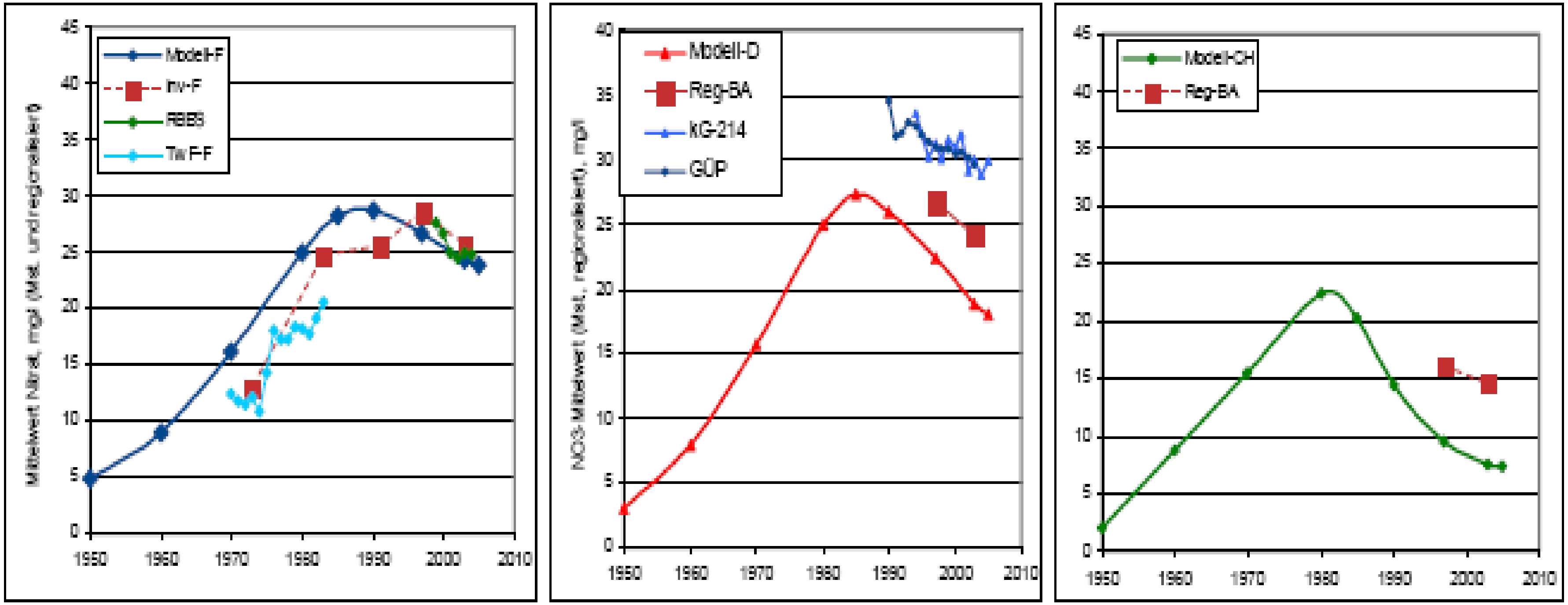
4. Amendment 13, Article 2, point 4b (new): 4b “background concentration” means the concentration of a substance in a groundwater body corresponding to no, or only very minor, anthropogenic alterations to undisturbed conditions.

5. Amendment 14, Article 2, point 4c (new): (4c) “baseline concentration” of a substance in a groundwater body means the average concentration measured during the reference years 2007 and 2008 on the basis of the monitoring programmes established under Article 8 of Directive 2000&60/EC. – WFD

10. Amendment 2, Recital 1 (1) Groundwater is a valuable natural resource and as such must be protected from deterioration and chemical pollution. This is particularly important for groundwater-dependent ecosystems and for the use of groundwater in water supply for human consumption

11. Amendment 6, Recital 6a (new): (6a) The protection of groundwater may in some areas require a change in farming or Forestry practises, which could be addressed when the rural development plans under the reformed common agricultural policy are drawn up.

Re0741



Vergleich Rechnung -Messung für Mittelwerte (F/D/CH)
Comparaison calcul – mesure pour les moyennes (F/D/CH)

re0743

Fig. 7: Nitrate levels in the groundwater of the upper Rhine River Basin (Strele-Grimm 2006)

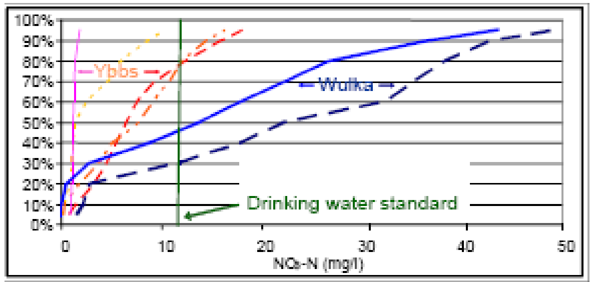
Hydrosphere

3.2 Critical loads

From concentrations to loads – diffuse nitrogen inputs into groundwater in the context of the protection of coastal zones

M. Zessner

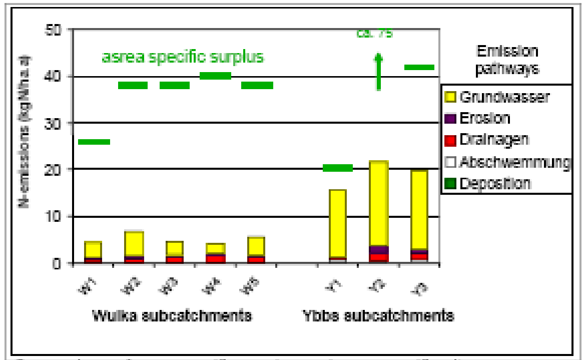
EVK 1-CT-2000-00051 (http://danubs.tuwien.ac.at)



Cumulative distribution function of nitrate-nitrogen concentrations in subcatchments of the rivers Wulka and Ybbs (Zessner et al., 2005)

From concentrations to loads

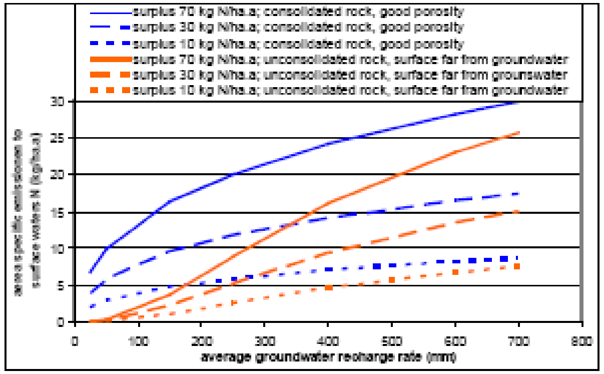
Up till now measures for reduction of nitrate losses from agriculture to groundwater focus on areas with high nitrate concentrations in groundwater (e.g. nitrate directive). In respect to nitrogen emissions to surface waters this strategy will fail! Areas with low concentrations in groundwater tend to be of high importance in respect to loads transported towards the Black Sea as it is shown for the examples of the Wulka and the Ybbs in the figure on the left and on the right. High nitrate concentrations in groundwater of the Wulka catchment go along with low nitrogen emissions to surface waters via groundwater.



Comparison of area specific surplus and area specific nitrogen emissions via different pathways in subcatchments of the rivers Wulka and Ybbs (Zessner et al., 2005)

Nitrate degradation in groundwater

The reason for the above mentioned paradox is that the same surplus on (agricultural) areas leads to lower concentrations in groundwater in areas with high groundwater recharge rates. Under these circumstances the conditions for nitrate degradation in groundwater (denitrification) tend to be unfavourable (lower residence times, unfavourable DOC/O_2/NO_3 relation). An example for a quantitative assessment of this relation based on the MONERIS approach (Behrendt et al., 1999) is shown on the right. The same surplus on agricultural area leads to increasing area specific emissions to surface water with increasing ground water recharge rates.



Area specific nitrogen emissions via groundwater to surface waters for two geological categories in dependency of area specific surpluses on catchment area and average groundwater recharge rates

Consequences for management strategies

A management strategy for reduction of nitrate emissions only for those areas with high nitrate concentrations in groundwater will fail in respect to protection of surface waters as the coastal zones. Development of best agricultural practice is decisive in respect to reduction of nitrogen losses, independent of the location of an area, because of:

- Groundwater protection
- Protection of coastal zones
- Resource protection (nitrogen – energy)
- Protection from air pollution (N_2O and NH_3 – emissions)

Partners in the daNUbs project:

Institute for Water Quality and Waste Management, TU Vienna, AUSTRIA; CO-ORDINATOR; Danube Delta National Institute for Research and Development, Tulcea, ROMANIA; Stichting Waterloopkundig Laboratorium, Delft Hydraulics, Delft, NETHERLANDS; Bureau of Sustainable Agriculture, Hanhofen GERMANY; Institute of Fisheries and Aquaculture - Varna, BULGARIA; Institute for Freshwater Ecology and Inland Fisheries, Berlin, GERMANY; Institute of Hydraulics, Hydrology and Water Resources Management, TU Vienna, AUSTRIA; Institute for Land and Water Management, Petzenkirchen, AUSTRIA; Institute for Marine Research, University Kiel, GERMANY; National Centre for Marine Research, Athens, GREECE; National Institute for Marine Research and Development "Grigore Antipa", Constanta, ROMANIA; Institute for Water Pollution Control, Vituki Budapest, HUNGARY; Department of Sanitary and Environmental Engineering, Budapest, HUNGARY; Institute of Public Finance and Infrastructure Policy, TU Vienna, AUSTRIA; Department of Meteorology and Geophysics, University of Sofia, BULGARIA; Institute of Water Problems, Bulgarian Academy of Sciences, Sofia, BULGARIA; Department of Systems Ecology, University of Bucharest, ROMANIA

Tab. 31: [Zessner, M. (2007): Proc. International conference: Diffuse Inputs into groundwater: Monitoring-Modelling-Management. Graz, January 29-31, 2007]

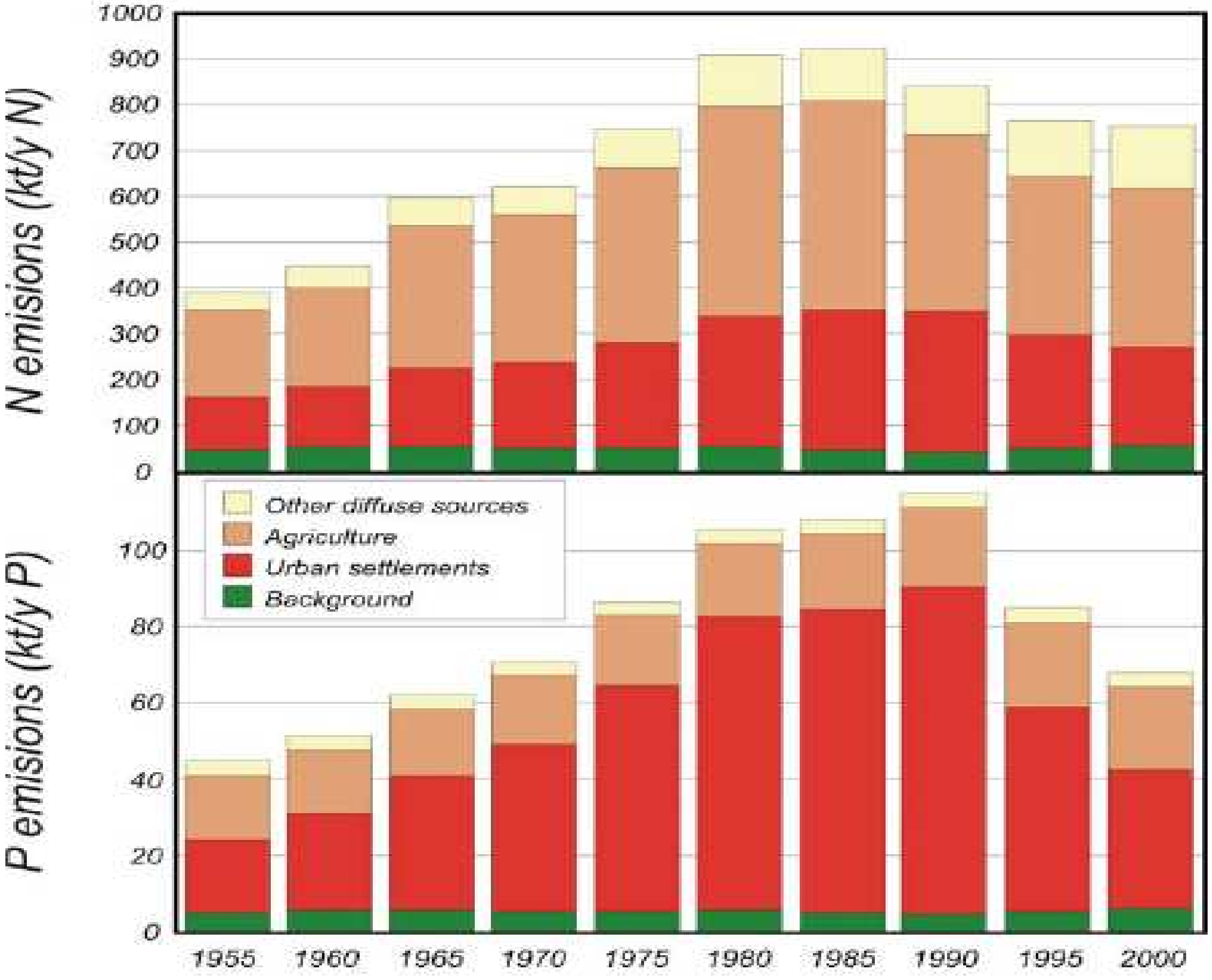


Fig. 8: Changes of nitrogen and phosphorus emissions into the river system of the Danube from 1955 to 2000

re0786

4: Atmosphere: Gases relevant to climate change, acidification, eutrophication and directly for human health

Tab. 32: Environmental and health aspects of greenhouse gases
CH_4, NMVOC, NH_3, N_2O, NO, (N_2) and fine dust (CPM)
(Symbols: - not relevant ; + relevant)

Environmental esp. health aspects	CO_2	CH_4	NMVOC	NH_3 ➔ NH_4^+	N_2O	NO ➔ NO_2	(N_2)	CPM (PM_{10}+$PM_{2.5}$)
1. Eutrophication (soil, water)	+	-	-	+	-	+	-	-
2. Acidification (soil, water)	+	-	-	+	-	+	-	-
3. Climate change	+	+	+ (indirectly)	+	+ (indirectly) + Ozone depletion stratosphere	+ (indirectly)	-	+
4. Decline of biodiversity (flora, fauna)	+	+	+	+	+	+	-	+
5. Threatening of human health	-	-	-	+	-	+	-	+

A) Actual emissions of climate relevant gases (CO_2, CH_4, N_2O, PFC, HFC, SFG) of selected countries in 2004

B) Corresponding emission reduction demands (Limitation global warming: 2°C compared with the pre-ind ustrial level)

B1) Sustainable: Demands based individually on the emissions per capita and year of the individual countries (BSNLC 2007)

B2) Non sustainable: Intentionally misleading demands based on the flat rate of -50% for each country and year according to German and EU Policy on the G 8-Summit on June 6-8, 2007 in Heiligendamm/Germany

Tab.33:

Countries … there from [G 8]	A) Emissions in 2004 (UNFCCC-Report 2006) [CO_2-Equiv.]		B) Emission reduction demands: B1) Sustainable emission reduction up to 2020 to: (BSNLC 2007) [CO_2-Equiv.]			B2) Non Sustainable emission reduction up to 2050 according to German and EU Policy (G 8 Summit /June 6-8, 2007, Heiligendamm) to: [CO_2-Equiv.]		
	$Mt \cdot yr^{-1}$	$t \cdot cap^{-1} \cdot yr^{-1}$	$t \cdot cap^{-1} \cdot yr^{-1}$ 3)	%	$Mt \cdot yr^{-1}$	$t \cdot cap^{-1} \cdot yr^{-1}$	%	$Mt \cdot yr^{-1}$
1. Australia	**529**	**26.3**	**3**	**-88.6**	**60 (100)**	**13.2**	**-50**	**265 (442)**
2. USA [G 8]	**7,068**	**24.1**	**3**	**-87.6**	**875 (100)**	**12.1**	**-50**	**3,534 (403)**
3. Canada [G 8]	758	23.7	3	-87.3	96 (100)	11.9	-50	379 (395)
4. Russia [G 8]	2,024	14.1	3	-78.7	431 (100)	7.1	-50	1,012 (235)
5. Germany [G 8]	**1,015**	**12.3**	**3**	**-75.6**	**248 (100)**	**6.2**	**-50**	**508 (205)**
6. Japan [G 8]	1,355	10.6	3	-71.7	383 (100)	5.3	-50	678 (177)
7. Great Britain [G 8]	670	11.2	3	-73.2	180 (100)	5.6	-50	336 (186)
8. Italy [G 8]	583	10.1	3	-70.3	173 (100)	5.1	-50	292 (169)
9. France [G 8]	**563**	**9.3**	**3**	**-67.7**	**182 (100)**	**4.7**	**-50**	**282 (155)**
10 PR China	**ca. 5,650 1)**	**4.3**	**3**	**-30.0**	**3,943 (100)**	**2.2**	**-50**	**2,825 (72)**
11. India	**ca. 1,354 2)**	**1.2**	**3**	**+ 150.0**	**3,385 (100)**	**0.6**	**-50**	**677 (20)**
Total (1-11) (n= 3261 · 10^6 cap)	21,569	6.6	3	-54.5	9,957 (100)	3.3	-50	10,785 (108)
World	**29,645**	**4.7**	**3**	**-36.2**	**18,914(100)**	**2.4**	**-50**	**14,823 (78)**
Industrialized Countries (n = 41) 4)	**17,932**	**14.3**	**3**	**-79.0**	**3,766 (100)**	**7.2**	**-50**	**8,966 (238)**
EU-15 (2004)	**3,942**	**10,3**	**3**	**-70,9**	**1,147 (100)**	**5.2**	**-50**	**1,971 (172)**
EU-25 (2004)	**4,288**	**9.4**	**3**	**-68.1**	**1,368 (100)**	**4.7**	**-50**	**2,144 (157)**
(2005)	**4,970**	**10.9**	**3**	**-72.5**	**1,367 (100)**	**5.4**	**-50**	**2,485 (182)**

1) PR China: 4,707 (Energy) + 20% = 5,650 $Mt \cdot yr^{-1}$; 2) India : 1128 (Energy) + 20%= 1,354 $Mt \cdot yr^{-1}$ (IEA 2006)

3) 3 $t \cdot cap^{-1} \cdot yr^{-1}$ corresponds to 6,300 Mio capita in the world (2004) equivalent to burning of 1000 l fuel oil, but 2 $t \cdot cap^{-1} \cdot yr^{-1}$ corresponds to 9,450 Mio capita in the world (2050)! equivalent to burning of 670 l fuel oil ; 4) Annex I Parties

Tab. 34: Shares of the Total System Nutrition (3.1) and especially of Nutrition with animal food (3.2) on:
A) the total emissions of climate relevant gases [GHG(2)] compared with
B) their maximum tolerable (inhabitant specific) total emissions of 3 t CO_2-Equiv · cap^{-1} · yr^{-1} (4)
of Germany, EU-15 and the total world

GHG Emissions (Reference years)	Germany (2003)	EU-15 (2004)	World (2004)
1. **Inhabitants [M cap]**	82	380	6 300
2. Total Emissions [Mt CO_2-Equiv · yr^{-1}]	994 [100]	4,213 [100]	29,645 [100]
3. …Shares Nutrition emissions **3.1 Total Nutrition**	-	-	(Agriculture: Inclusive fire clearing: 18%; exclusive CO_2 by fossil energy)
a) [%] (Agriculture + Food Supply + Waste and Waste Water Management)	[8.6 + 10 + 1.4 = **20]** (UBA 2005, Koerber 2007)	[12 + 15 + 3 = **30**] (EEA 2004)	[32 + ca. 10 + 3= **45**] (IPCC 2007)
b) [Mt CO_2-Equiv · yr^{-1}]	199	1,264	13,310
c) [t CO_2-Equiv · cap^{-1} · yr^{-1}]	**2.4 (80)**	**3.3 (110)**	**2.1 (70)**
3.2 Shares only animal food **a) [%]**	**12**	**16**	**18**
b) [Mt CO_2-Equiv · cap^{-1} · yr^{-1}]	119	674	5,336
c) [t CO_2-Equiv · cap^{-1} · yr^{-1}]	**1.5 (50)**	**1.8 (60)**	**0.8 (27)**
4. Maximum tolerable inhabitant specific total emission [t CO_2-Equiv · cap^{-1} · yr^{-1}]	**3,0 (100)**	**3,0 (100)**	**3,0 (100)**

➔ The maximum tolerable total GHG emission of 3,0 t CO_2-Equiv · cap^{-1} · yr^{-1} (=100%) is already explored:
- **only by the system nutrition in the world, Germany and EU-15 by 70, 80 and even by 110% respectively**
- **and especially with animal food by 27,50 and 60% respectively**!

Re0831

Tab.35: Protection aims for gases relevant to climate change (GHG´s), eutrophication and acidification

1. **A) At present: 3 t CO_2-equivalents · person^{-1} · year^{-1} with 6 300 Mio. persons**

   B) In 2050: 2 t CO_2-equivalents · person^{-1} · year^{-1} with ca. 9 450 Mio. persons

   With a worldwide limitation to 18 900 Mt CO_2-equivalents · yr^{-1} to limit global warming to 2° C compared with the pre- industrial level

2. **These limitations will also solve the problems of the same eutrophying and acidifying gases CO_2, NH_3 ➔ NH_4, NO ➔ NO_2, if especially the indirect climate relevant gases NH_3 and NO are additionally involved in these mitigation options to reduce GHG´s cause-oriented and sufficiently.**

3. **If not, the emissions of NH_3-N and NO-N must be reduced to those amounts, that the atmospheric deposition of NH_y-N and NO_x-N i.e. in forest is lower than their critical load of (5+5=) 10 kg N·ha^{-1}·yr^{-1}**

Re0932

5. Lithosphere

Tab. 36: Protection aims for Lithopshere

1. End of the mineral P-resources:
ca. 30 years: Cd poor; ca. 90 years: Cd rich: ca. 90 years

Protection aims:

1.1 Maintain soils at or near the lowest mean soil test P (STP) level compatible with good plant production on soils <u>also not vulnerable to P losses</u>: Match input with outputs by yields

1.2 No P inputs on soils with too high P contents

1.3 No surplus crop and animal production

2. End of fossil carbohydrate like oil or natural gas: ca. 30 ? years ➔ end of mineral N-fertilizers

Protection aims:

2.1 Technical N-fixation by Hager-Bosch process: coal and water instead of fossil carbohydrates

2.2 Alternative: biological N-fixation

Re0934

6. Biosphere

Tab. 37: Protection aims for biosphere: flora and fauna

➔ **Impacts by meeting the protection aims for:**

anthroposphere
pedosphere
hydrosphere
atmosphere

re0933

7. Assessment: Needs for Life Cycle Analysis (LCA´S)

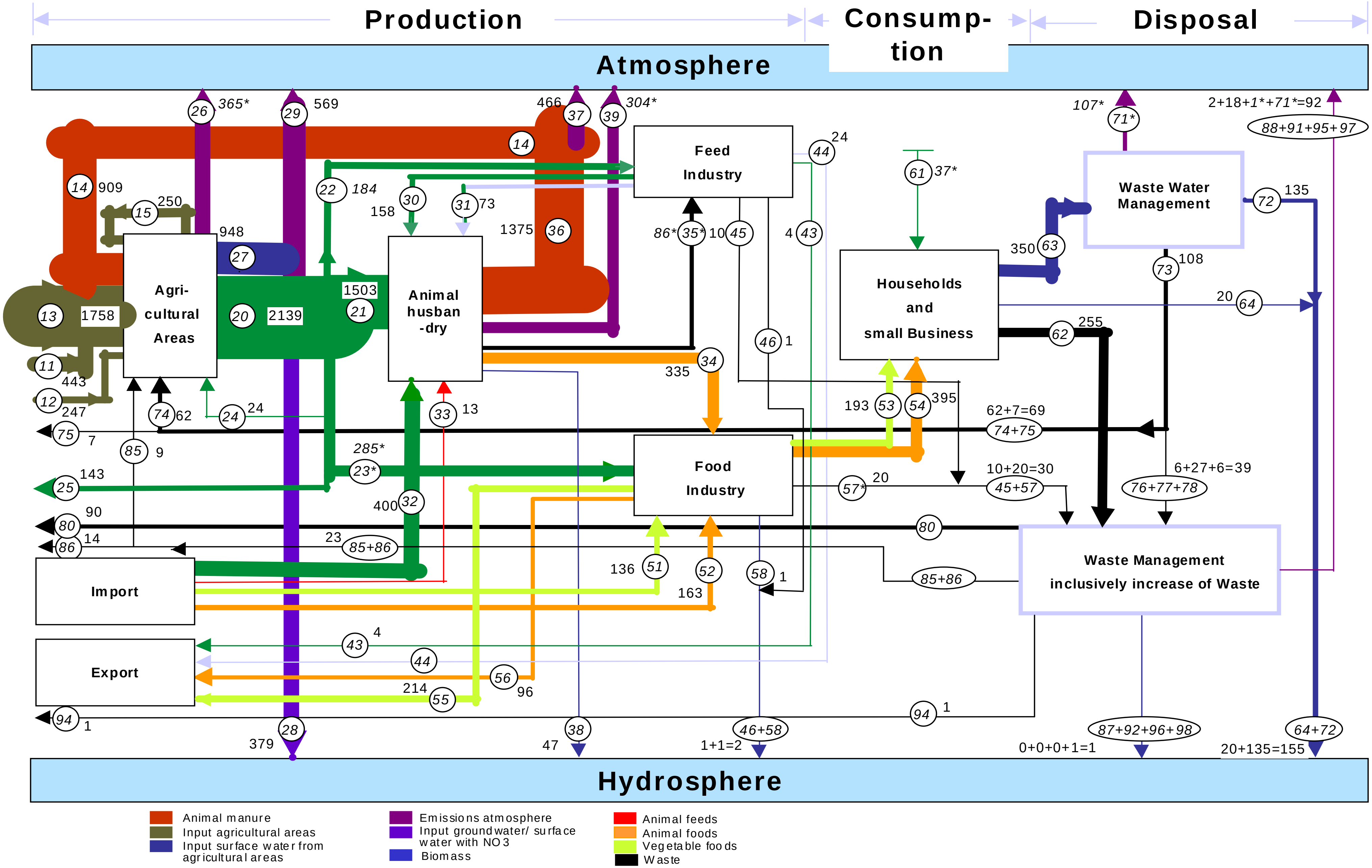


Fig.9: Nitrogen balance of Germany [ktN· yr-1]: Agriculture, Feed-and Food-Industry/Business, Waste and Waste Water Management (Reference years 1995/1998) [ATV/DVWK 2001] re0548

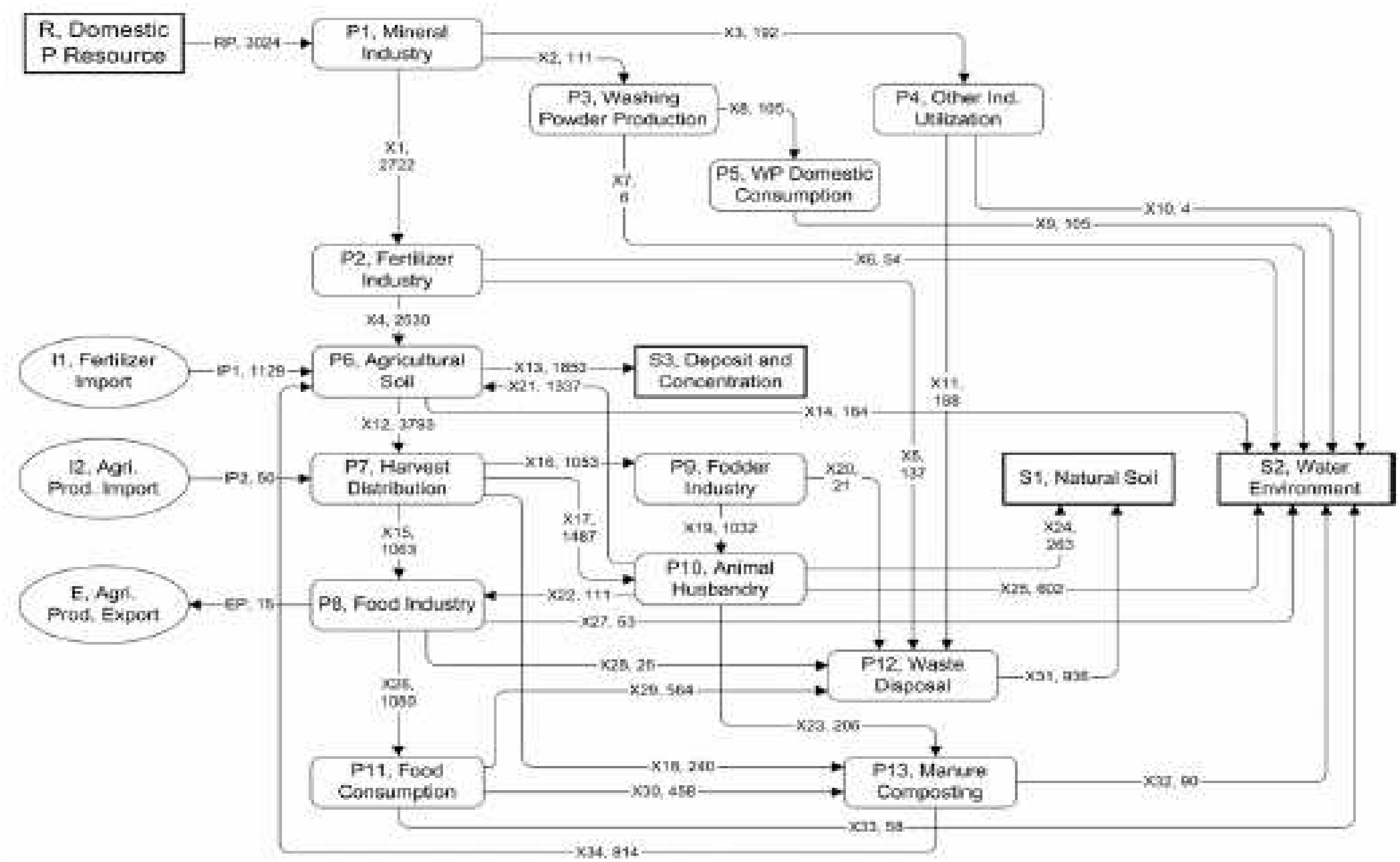


Figure 3.1 National static SFA model of China: the phosphorus flows in 1996 in thousands of metric tons (kt). Variables are explained in Table 3.2.

Fig. 10: Phosphorus flows in PR China in 1996 [kt metric tons](Liu 2005)

8. Driving and preventing forces to meet the protection aims and to implement a sustainable nutrition system

Tab. 38:
Driving and preventing forces in the development / implementation of a sustainable nutrition system i.e. in Germany

Sectors of Sustainability ➔ Aims	**Development / Implementation of a sustainable nutrition system** **Driving forces** **➔ otherwise collapse feedback**
Social conditions ➔ Sufficiency [needed food]	**Overnutrition associated human diseases (morbidity) and causes of death (mortality)** e.q. to 77 billions € · yr^{-1} (2004) representing ca. 78% of total cases and 30% of total medical costs **➔ collapse of both (public) health and pension insurance systems**
Environment ➔ Consistency [of natural-near ecosystems and natural nutrient resources (esp. N and P)]	1. **Needed ca. 80% reduction of the emissions esp. of reactive C,N,P (S) to environment** esp. by agriculture, human nutrition > waste and waste water management **➔ collapse by environmental disasters** like eutrophication, acidification, climate change (=> globalisation needed), change and decline of biosphere 2. **Exhaustion of nutrient resources like N (fossil energy) and mineral P** **➔ Collapse of N and P resources**
Economy ➔ Efficiency [optimization output / input = food / nutrients]	1. **Win / win situations** 1.1 Agricultural products not cheap but worth their prices socially, environmentally and economically implemented by tax levy esp. for animal food 1.2 No further subsidies for agriculture 1.3 Reduction (public) health costs by overnutrition 1.4 Reduction environmental costs 1.5 More food for the Third Word 1.6 Decreased cruelty to animals 2. **Best available techniques (BAT)** **➔ Collapse economically, esp. of agriculture**

Tab.39: Driving and preventing forces in the development / implementation of a sustainable nutrition system i.e. in Germany

<table>
<tr><td rowspan="2">Sectors of Sustainability
➔ Aims</td><td colspan="2">Development / Implementation of a sustainable nutrition system</td></tr>
<tr><td colspan="2">Preventing forces
(Inter-)National Lobbies ➔ Lobbyism ➔ Corruption</td></tr>
<tr><td>Social conditions
➔ Sufficiency
[needed food]</td><td>1. Instead pf Net economic growth Cross economic growth (Cross national product /GNP) vs. Sufficiency
2. Apparent efficiency vs. sufficiency (Best) Available Techniques vs. Sufficiency
3. Ignorance of overnutrition</td><td rowspan="3">1. Widespread (inter-)national corruption, esp. in respect to legislation, jurisdiction and execution referring to production, trade, consumption, esp. of animal food and environmental problems, mainly by:
▫ Farmers organisations
▫ Organisations of: Fertilizer-, Feed-, Food-, Industries and Trade
▫ Waste and Waste Water Authorities together with
▫ Governmental institutions like ministries
2. No ratification of the UN conventions against corruption in Germany:
Corruption of governmental members are tolerated and not punished
Main sectors and institutions involved in corruption in Germany (Rank 16):
▫ Political parties
▫ Parliament
▫ Business
▫ Justice
▫ Police
▫ Tax offices
▫ Information systems (anti-Transparency)
▫ Public Health System
▫ (Military)
▫ Education System [Transparency International (2006), Friedrich-Ebert-Foundation, 2006), Hoefken (2006)]</td></tr>
<tr><td>Environment
➔ Consistency

[of natural-near ecosystems and natural nutrient resources (esp. N and P)]</td><td>Ignorance of:
1. environmental problems i.e. global climate change
2. Exhaustion of natural/nutrient resources i.e. of N (fossil energy) and mineral P</td></tr>
<tr><td>Economy
➔ Efficiency

[optimization output / input = food / nutrients]</td><td>1. Price dumping i.e. of agricultural products/food, esp. EU/WTO ➔ Globalisation
2. Low Taxation and Subsidy policy (agriculture and food)
3. Unfair trade
4. Illegal (shadow) economy: i.e. Germany most important economic sector with 15% of GNP (2006) ➔ increasing tendency
➔ Index of Sustainable Economic Welfare (Cobb and Cobb 1990)</td></tr>
</table>

Tab. 40: The Nitrate Directive of the EU (1991) and its implementation by the German Düngeverordnung (2007) after 16 years: a shameful anachronism of the 21th century as legal options/measures maintaining oreven increasing P and N emissions into the surface water, groundwater and atmosphere (compare Csathó here)

1. **Only incomplete total field balances, no farm gate balances, no individual field/ plot balances, therefore:**
   1.1 Compension of (too) high with (too) small N and P plot surpluses
   1.2 Neglecting "small" inputs of 50 and 30 kg/ha ·yr of N and P_2O_5 resp.
   1.3 Neglecting N inputs i.e. by atmospheric deposition, late N for cereals and to straw

2. **Tolerated P surpluses of 20 kg P_2O_5/ha · yr of P hypertrophied soils (38%)**

3. **Ca. 50% too high maximum of tolerated (reactive) gaseous N emissions of 45% (grazed grassland 75% !) from animal excretions**

4. **No best available techniques (BAT) for reducing gaseous N emissions are required**

5. **4-5fold too high "tolerable" maximum farm gate N surpluses of 175-245 kg N/ha· yr for arable crops / grassland between 2008 and > 2011**

6. **2fold too high "tolerable" N surpluses of max. 160 kg N/ha · yr for vegetable crops**

7. **Promoting industrial (3,3-4,3 AU/ha instead of agricultural animal production (< 1.0 AU/ha) with P surpluses of 61-79 kg P_2O_5 ha · yr, also by EU subsidies => ca. 8% increase of animal stockings till 2010, ca. 140% more animals than needed for a healthy human nutrition with animal food**

8. **Too short prohibition times for N and P fertilization of only 3.0 (arable land) and 2.5 (grassland) months during winter times instead of 6.0 months**

9. **No humus/C-balances => EC No 1782/2003 (Cross compliance / modulation)**

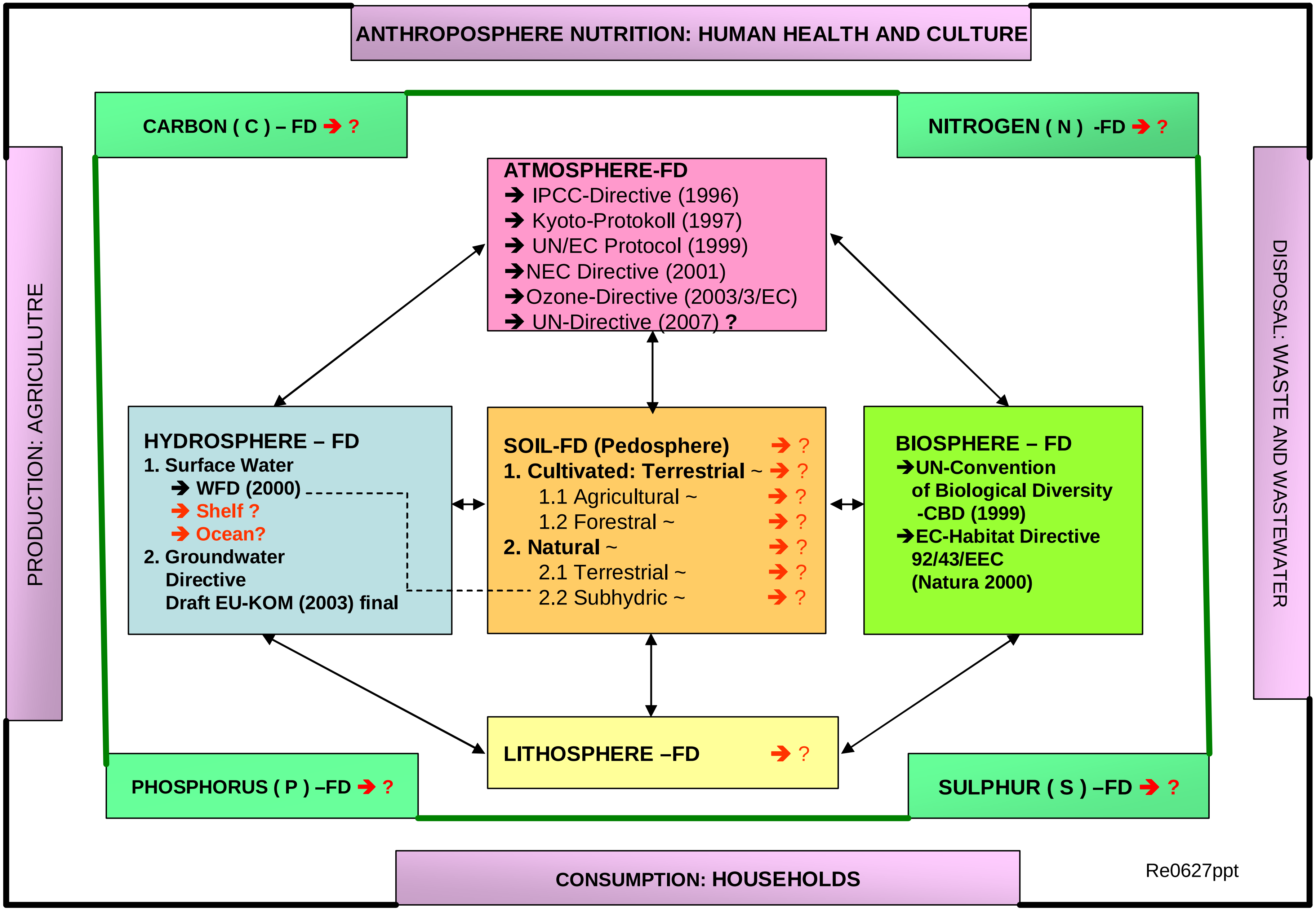
10. **No penalties if there are offences against Düngeverordnung**

9. (Non-)sustainable legislation

Tab. 41: Present international → and i.e. national legislation in the total nutrition system of agriculture with plant and animal nutrition, human nutrition, waste and waste water management referring
- to environmental spheres Pedosphere, Hydrosphere, Atmosphere and Biosphere (Lithosphere not considered)
- as well as to the nutrients involved Carbon (C), Nitrogen (N), Phosphorus (P) and Sulphur (S)

Environmental spheres		Pedosphere (Soil)	Hydrosphere (Water)	Atmosphere (Air)	Biosphere (Flora and fauna)
Nutrients involved		**C, N, P, S**	**C, N, P, S**	**C, N, S**	**C, N, P, S**
Nutrition System	**Agenda 21 of Rio (1992) vs Agenda 2000 EU (1999)**	**Agenda 21 of Rio (1992) vs Agenda 2000 EU (1999)**			
Agriculture with Plant nutrition and animal nutrition		▪ EU communication on soil protection (2002) : Thematic strategy for soil protection → DE:Soil regulation (1999) → OE : ÖPUL (2000) ▪ EC Cross compliance /modulation 1782/2003 (CAP) → DE : DirektZahl Verpfl. V (draft 2004) → OE: Invekos-Ums VO (draft 2004)	▪ Drinking water directive (98/83 EU) ▪ Nitrates directive (CD 91/676/EC) → DE: Düngeverordnung (1996) Draft (2005) → AT: ÖPUL (2000) Nitraktionsprogramm (2003) → NL: MINAS (1998/2006) • Draft Groundwater Directive (KOM /2003, 550 final) ▪ Water Framework Directive (2000/60EC) ▪ EU Marine Strategy (2004)	▪ Kyoto-Protocol (1997) ▪ IPCC Directive 96 / 61 / EC Integrated pollution prevention and control (1996) ▪ UN/EC Protocol (1999) ▪ NEC-Directive 2001/81/EC ▪ Ozon Directive (2003/3/EC) → DE: - Artikelgesetz (2001) - 4. BimSchV. (2001) - Baugesetzbuch § 201 (2004)	▪ UN-Convention of Biological Diversity (CBD/1999) ▪ E_Habitat Directive 82/43/EEC (Natura 2000) ▪ EU-ICZM ▪ Recommendation (30.05.2002)
Human nutrition		Recommendations daily intake: Reference values for: energy, protein, fat, (carbohydrates) and their shares of animal food as well as for meat 1. EURODIET (2000): EU population goals for nutrients and features and lifestyle consistent with the prevention of major public health problems in Europe 2. DACH (2001) National reference values in DE, AU, CH (approximately consistent with EURODIET 2000) 3. Präventionsgesetz (Germany 2005)			
Waste and waste water management		▪ Sewage sludge directive CD 86/278 / EEC ▪ Urban wastewater directive CD 75/442/EEC ▪ Landfill directive CD 1999/31/EC	▪ Bathing Water Directive 76/160/EEC ▪ Urban wastewater directive (UWWD-91/271/EEC, version RL 98/15) EC ▪ Water Framework Directive 2000/61 / EC	▪ Incineration Directive 2000/79 / EC	Re0626

Fig. 11: Existing (➔) and needed (➔) Framework Directives (FD) in the anthroposphere nutrition on the fundamentals of the Agenda 21 of Rio (1992) and related to the main nutrients C, N, P, S, (fossil) energy and contaminants (i.e. heavy metals,xenobiotics)



10. Activities: Integrated and adaptive management of water
10.1 not only of agriculture, but of nutrition and land use,
10.2 not only under climate change, but under environmental change and health
referring to the nutrients C, N, P, S

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Tab. 42:

Workshop: Agriculture, Water Management and Climate Change, 4-6th March 2008, McDonald Bath Spa Hotel, Bath, UK

Proposals of BSNLC as a basis for completing those activities (oral contribution):

Integrated and adaptive management of water

1. not only of agriculture, but of nutrition and land use,
2. not only under climate change, but under environmental change and health

referring to the nutrients C, N, P, S

C) ABSTRACT

Anthropogenic sources account for about 60 to 80% of the C- (only ca. 3% for CO_2-C), N-, P- and S-fluxes involved (in-)directly both in **global eutrophication, acidification as well as climate change**, each enhancing mostly the other, and damaging actually more than 60% of the **protection spheres** like **pedosphere, hydrosphere, atmosphere, lithosphere and biosphere and the anthroposphere within the nutrition system and human health especially in respect to food and water supply** (4th UNEP-Report: Global Environment Outlook (GEO) Environment for Development / 25th October 2007).

Resulting from life cycle analysis (LCA´s) about 50 (20-80) % of these anthropogenic C-, N-, P-, S-fluxes and emissions are caused by the **system nutrition of agriculture with plant and animal nutrition (production), human nutrition (consumption) and waste as well as waste water management (destruction, disposal**), similar shares by use of (fossil) energy and industrial / trade activities mainly in the so called developed countries. Therefore there is a need to optimise sustainable use and management of the nutrients C, N, P and S in respect to environment (➔ Consistency), corresponding consumption (➔ Sufficiency) and production (➔ Efficiency), especially within the above mentioned nutrition system.

With a holistic approach protection aims / nutrient standards are set here as critical C, N, P, S levels and loads as well as for healthy human nutrition for <u>all</u> the above mentioned environmental spheres and anthroposphere, respectively, because they are a necessary prerequisite for cause oriented and sufficiently mitigation and adaptation options and measures done <u>simultaneously</u> with special reference to the nutrition system and land use. Corresponding actually integrated but future needed integrated (inter-)national legislation especially in respect to sustainable nutrition is shown.

Sufficiency in (especially animal) food and feed as well as in bioenergy consumption and only corresponding production leads especially in the developed and industrialized countries with their tremendous over-nutrition to ca. 70 (60-80) % of the needed emission reductions of reactive C, N, P, S, flanked by “only” ca. 30 (20-40%) reductions with technical measures.

A proposal was made for common activities in mitigation and adaption as well as for research: “Land use, water management and environmental esp. climate change (in the EU-27): Assessment – Mitigation – Adaptation”.