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VU VRIJE UNIVERSITEIT AMSTERDAM

Sustainability of plant-based eating patterns

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Alpro Foundation Symposium - 30 November 2017 - Wageningen

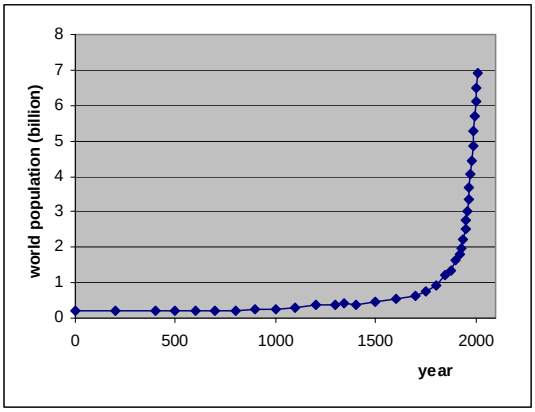
The big picture

- Food sustainability and food security
- Prioritizing environmental impacts — analysis
- Why nitrogen and protein are pivotal
- How to reduce impacts? — options
- Integrated consumer policy
- Health and sustainability frames — synthesis
- The road ahead

Food demand is skyrocketing ...

in parallel with population growth (mainly in Africa) ...

and rising incomes (mainly in Asia)



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The real challenge is still to come ...

By 2050 – 32 years! – we will need ~100% more crops

to satisfy 2 billion more people and more affluence

- for *food security* we need to *double yield / ha*
- for *sustainability* we need to *quarter impacts / ton*

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Yield increases are slowing down

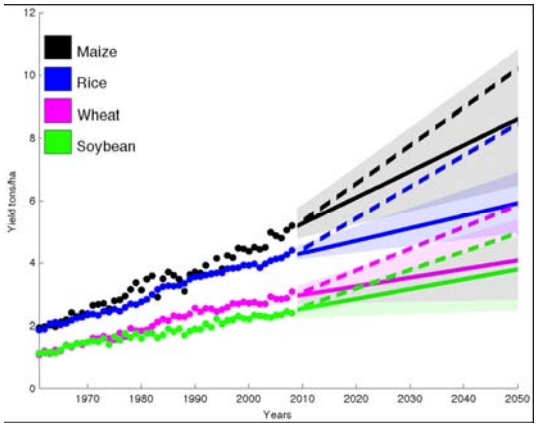
1.6% per year

1.0%

0.9%

1.3%

(2.4% needed)



Source:

Ray et al. (2013)

PLOSone e66428

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Global outlook

- "Global food prices are predicted to rise by 70-90% by 2030." (KPMG, 2012)
- "This year the middle classes in the Asia-Pacific region will outnumber those in the US and Europe combined." (PwC, 2015)

In addition, there will be impacts from:

- "peak oil" and "peak phosphate", projected by 2030
- 40% global water deficit, projected by 2030 (Rabobank, 2016)
- climate change, which will hit hard by 2050

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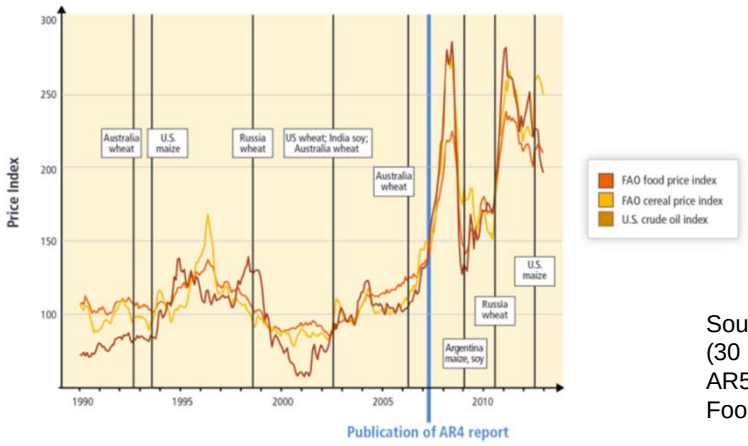
Food prices



Source: IPCC (30 March 2014) AR5 Chapter 7: Food security

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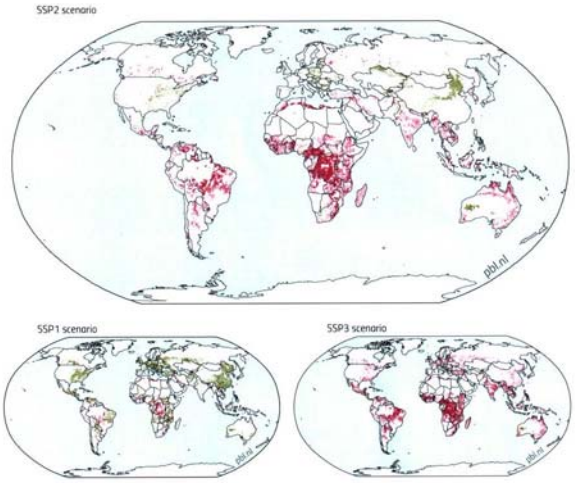
Land-use change 2010-2050



Shared Socio-economic Pathways:
- SSP1 - Sustainability
- SSP2 - Middle of the road
- SSP3 - Fragmentation (BAU)

SSP scenario:	1	2	3
Globalization of trade	hi	mi	lo
Meat consumption	lo	mi	hi
Land-use change regulation	hi	mi	lo
Crop yield improvement	hi	mi	lo
Livestock system efficiency	hi	mi	lo

Source:

Global Land Outlook 1st ed. (2017) UN Convention to Combat Desertification

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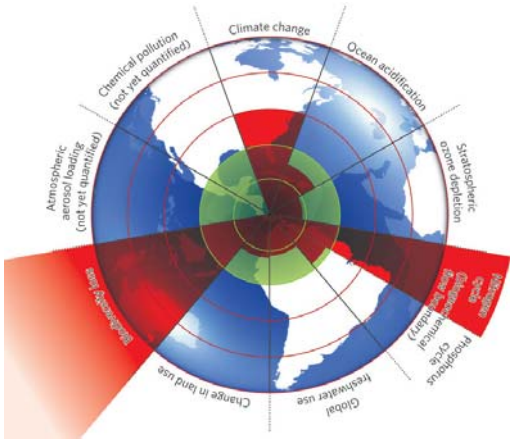
A safe operating space for humanity



Source: Rockström et al. (2009) Nature 461, 472-475

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Prioritizing impacts (safe boundary = 1)

1. Biodiversity loss >10
2. Nitrogen cycle 3.45
3. Climate change 1.1-1.5
4. Phosphate cycle 0.77-0.86
5. Ocean acidification 0.81
6. Land-use change 0.78
7. Freshwater use 0.65
8. Ozone depletion 0.50

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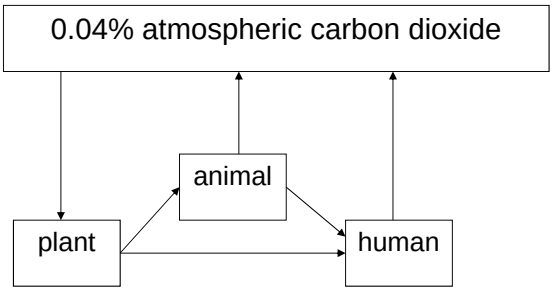
Natural carbon cycle



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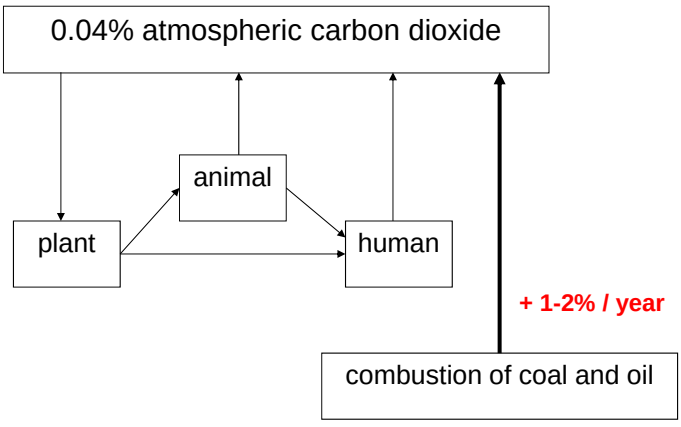
Current carbon cycle



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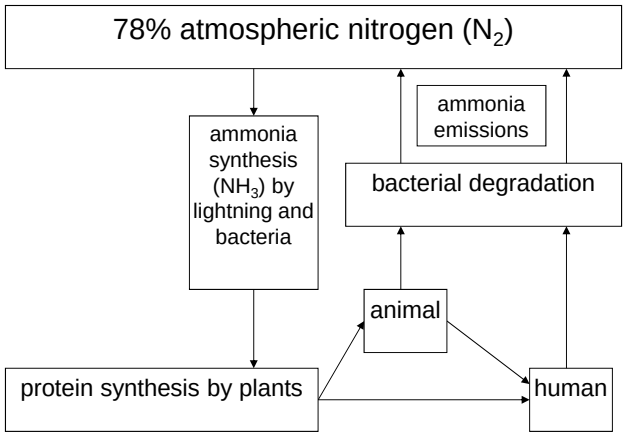
Natural nitrogen cycle



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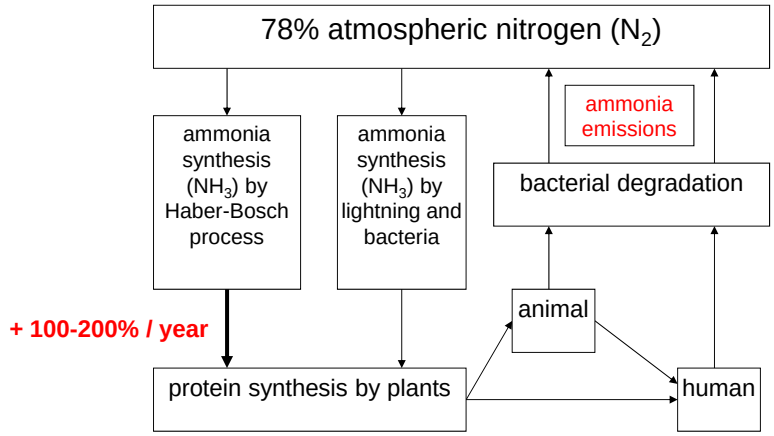
Current nitrogen cycle



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Algal bloom in the Gulf of Mexico

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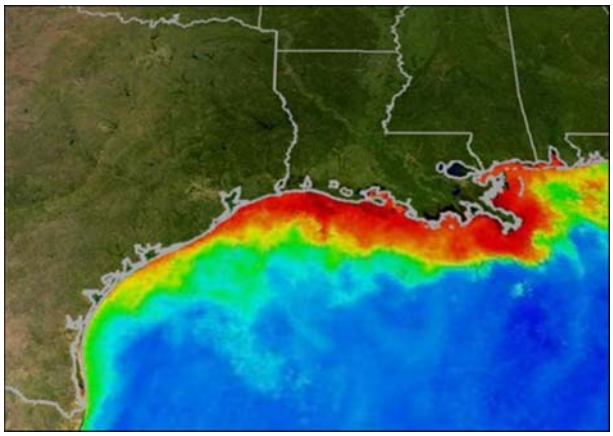
Dead zone in the Gulf of Mexico



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Impacts …

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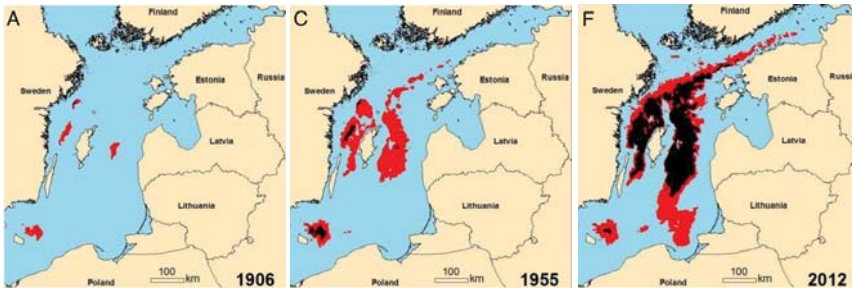
Dead zone in the Baltic Sea

Average annual oxygen levels (red <2 mg/L; black 0 mg/L)



Source: Carstensen et al. (2014) PNAS 111, 5628-5633

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Nitrogen and protein are pivotal

- Human contribution to C cycle 1-2%; N 100-200%
- Nitrogen fertilizer (100 Mtons/year) embodies:
  - 43% GHG emissions in a loaf of bread (Goucher, 2017)
  - 37% of ***all*** energy input in US agriculture (Lang, 2009)
- Emissions harm terrestrial ***plus*** aquatic biodiversity
- Terrestrial vertebrates by weight (Zalasiewicz, 2016): 5% wild; 30% humans; 65% livestock

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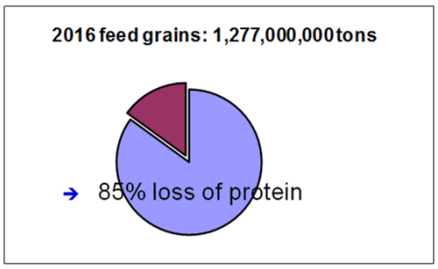
Protein inefficiency of factory farming

- 40% of global grain harvest and 70% of soy to livestock
- food and feed crops are competing for land + water
- alternative: *direct* human *plant protein consumption*



In intensive production systems (using feed crops):

- 1 kg animal protein requires 6 kg plant protein (resource loss)
- polluting ammonia emissions (leading to biodiversity loss)

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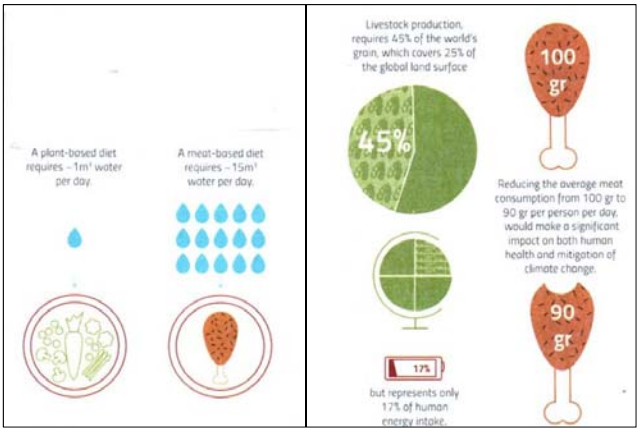
Diet change



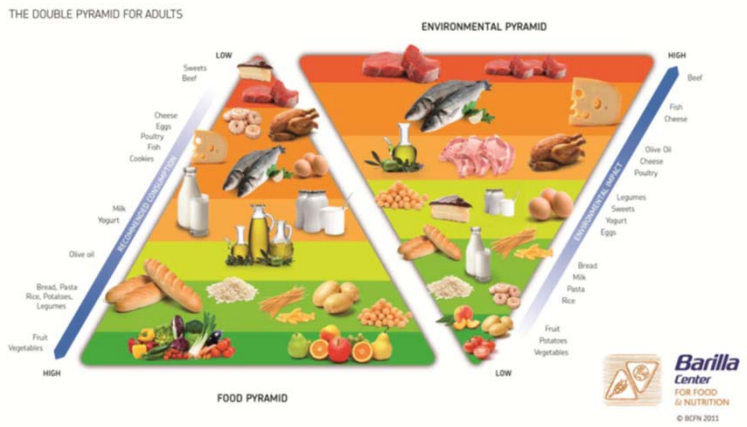
Source:

Global Land Outlook 1st ed. (2017) UN Convention to Combat Desertification

Nutrition guidelines are innovating

Barilla Center FOR FOOD & NUTRITION

Health and environment overlap: 80%



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Improving environment *plus* health

1. Reduce protein consumption (170% DRI)
2. Reduce caloric consumption (Alexander, 2017)
3. Reduce food waste (30% consumer)
4. Replace animal with plant protein (85% gain)
5. Upgrade residues (with pigs, fish, insects): moving towards a circular economy

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Integrated consumer policy

- New dietary guidelines (SE, DE, UK, NL, BE) address nutrition plus *sustainability*
- For consumers food *security* and food *safety* are stronger incentives than *sustainability*, but EU governments are developing food strategies addressing *all three* plus *obesity* (health)
- However, in order to "nudge" consumers towards more sustainable diets, a *health focus* is crucial !

Conclusions

- Double food production & quarter impacts by 2050? The *urgency* requires a sharp transition towards more sustainable, plant-based nutrition
- Sustainable *protein* supply is crucial to food security, human health and the planet's carrying capacity
- To consumers *health* is more important than *sustainability*
- Diet change is essential, but "nudging" is insufficient, so stern measures (taxation, choice editing) seem necessary
- Nevertheless, the argument to convince consumers is that *plant-based* diets are both *more sustainable* and *healthier*!

www.profetas.nl

Thank you for your attention!

Reading more:

Aiking (2014) American Journal of Clinical Nutrition 100, 483S-489S

De Boer & Aiking (2017) Ecological Economics 142, 238-248

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