

Sustainability of Plant-Based Eating Patterns

*Alpro Foundation Anniversary Symposium
Brussels – 24 March 2017*

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The big picture

- Food sustainability and food security
 - Prioritizing environmental impacts
 - Why nitrogen and protein are pivotal
 - Increasing urbanisation and affluence
 - Animal-based vs. plant-based diets
 - Optimising sustainable diets
 - Conclusions
- } global issue trends
- } national approach

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Food sustainability

- Sustainability: huge range of definitions!
- Ecology, Economy, Society (People Planet Profit)
- Sustainable food production (and consumption?)
- Human health, equity, animal welfare included?
- Context and time dependent

- Sustainability is a moving target!
- And the *rate of change* is staggering ...

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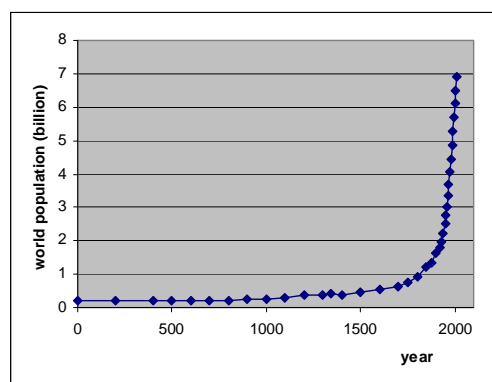
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Food demand is increasing ...

in parallel with
world population ...

... and affluence,
in China and India,
primarily



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The real challenge ...

By 2050 – 33 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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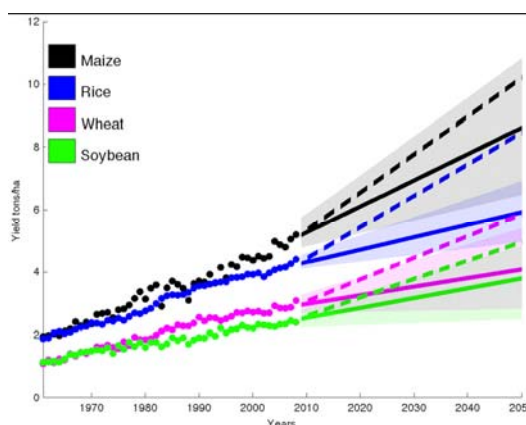
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Yield increases are slowing down

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% irrigation water deficit by 2030 (Rabobank, 2016)
- climate change, taking its toll from 2050

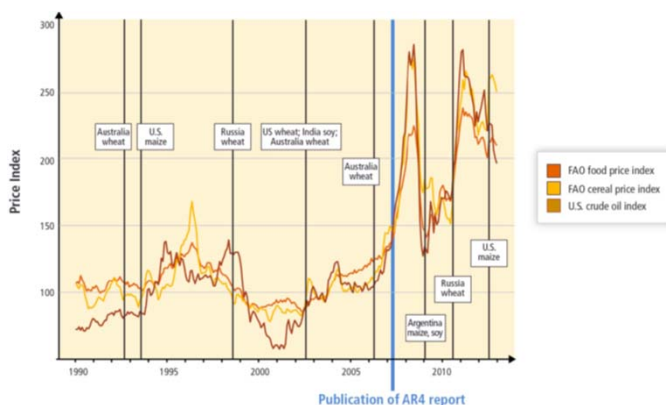
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Food prices



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

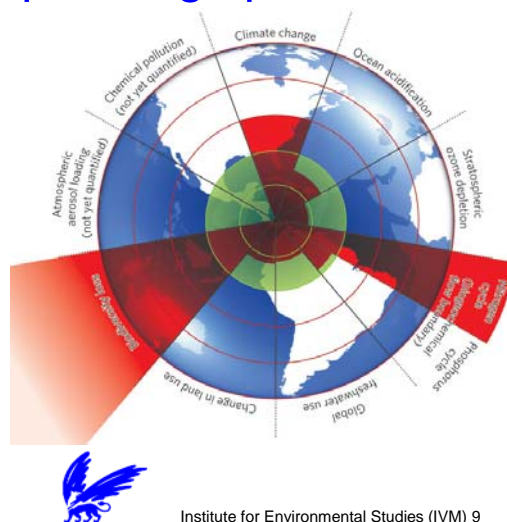
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A safe operating space for humanity



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

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Prioritizing impacts (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 |

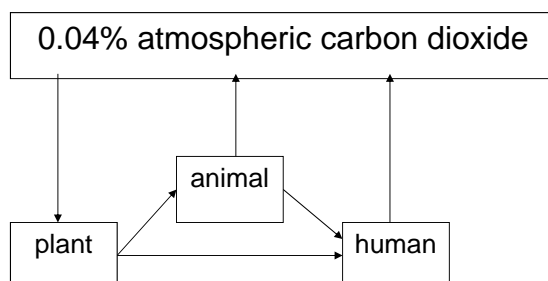
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Natural carbon cycle



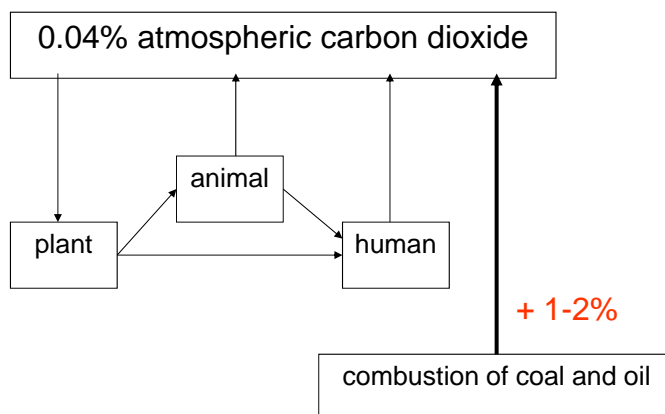
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Current carbon cycle



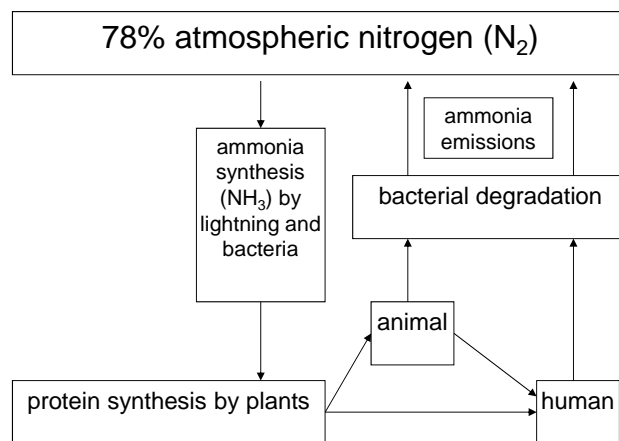
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Natural nitrogen cycle



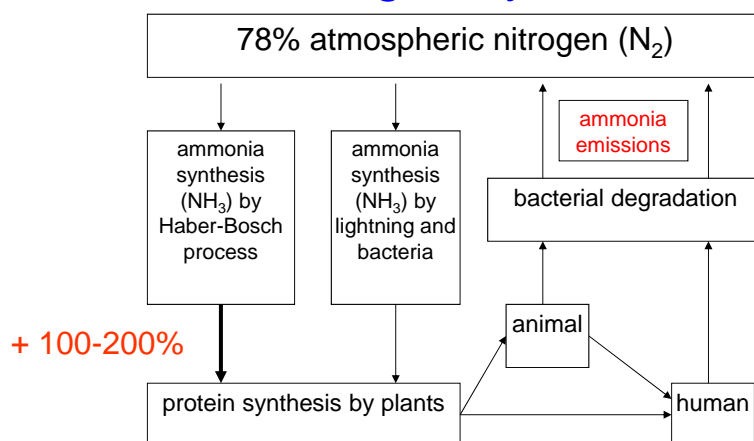
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Current nitrogen cycle



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Algal bloom in the Gulf of Mexico



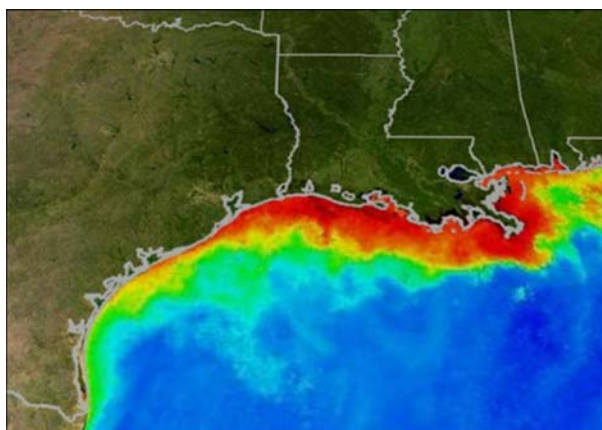
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Dead zone in the Gulf of Mexico



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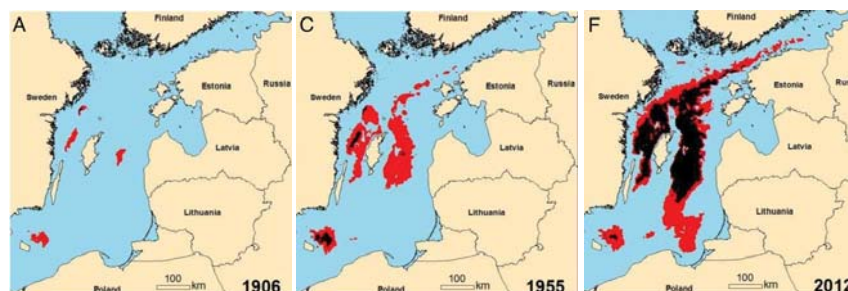


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Dead zone in the Baltic Sea

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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Impacts in the Baltic Sea



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Nitrogen and protein are pivotal

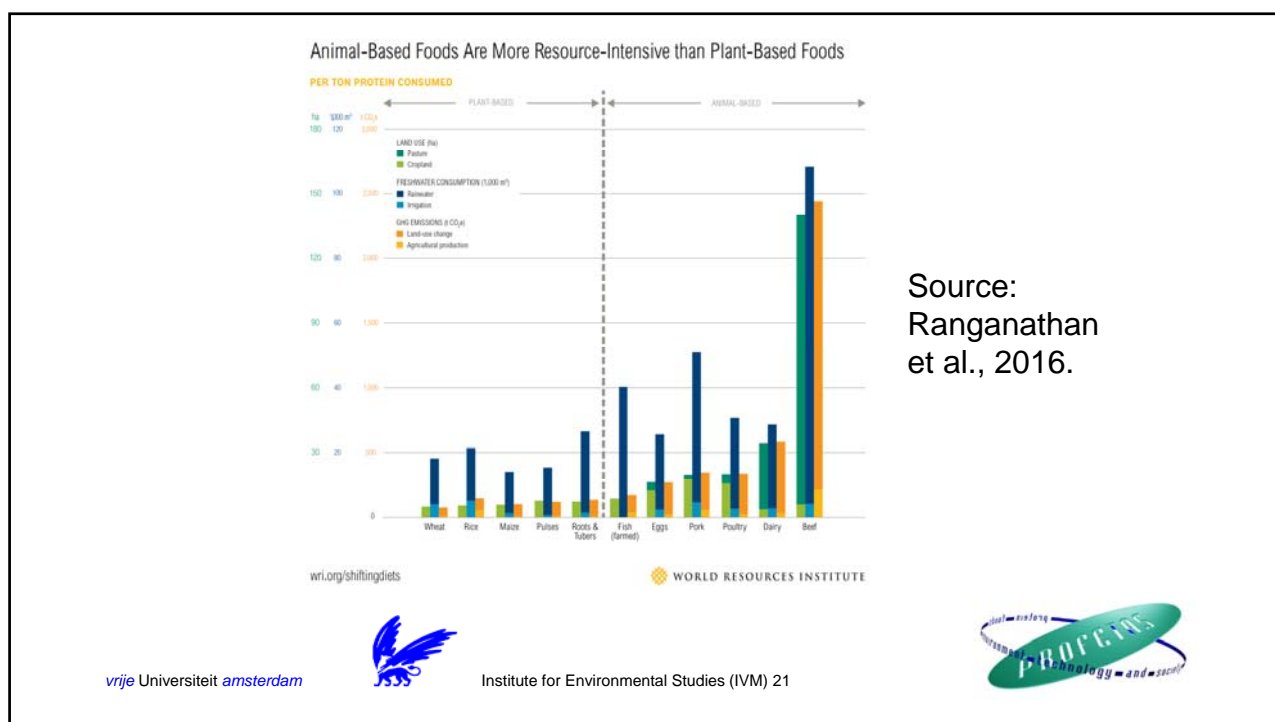
- Human contribution to C cycle 1-2%; N 100-200%
- C-cycle << N-cycle >> biodiversity
- Energy content of nitrogen fertilizer = 37% of **all** energy input in US agriculture (Lang et al., 2009)
- Even for a loaf of bread, 43% of GWP derives from nitrogen fertilizer (Goucher et al., 2017)
- Nitrogen fertilizer impacts both terrestrial and aquatic biodiversity (Westhoek et al., 2016)



Affluence leads to animal-based diets

- “This year the middle classes in the Asia-Pacific region will outnumber those in the US and Europe combined.” (PwC, 2015)
- Today’s total biomass of **all terrestrial vertebrates** is: wildlife 5%, human beings 30%, livestock 65% (Zalasiewicz, 2016)
- Consumers discard ca. 30% of food bought, but over-eating wastes even more, with negative impacts on both health and environment (Alexander et al., 2017)





How to achieve more sustainable diets?

- For a diet transition to succeed, changes to existing diets should be minimized (small cultural distance)
- So the Dutch Nutrition Centre developed a tool using data for the 206 most consumed food products in The Netherlands
- Two-person diets were found, consisting of 63 common products and costing € 37 per week, which are healthy *and* half the average climate impact (Van Dooren et al., 2015)
- The resulting diets, optimised for low price, low climate impact and high nutritional value, were predominantly *plant-based* !

Conclusions

- Double food production & quarter impacts by 2050?
The urgency is severely underestimated!
- Sustainable protein supply is crucial to food security, human health and the planet's carrying capacity
- Plant-based eating patterns were found
 - to be less resource-intensive than animal-based diets
 - to cause less biodiversity loss and climate change
 - to provide many health benefits
 - to be available at low cost
- Government, industry, consumer: take your responsibility!

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*Thank you for
your attention!*

Reading more:

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



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