Global Food Security

Sustainable, healthy food for all

What does sustainability really mean?

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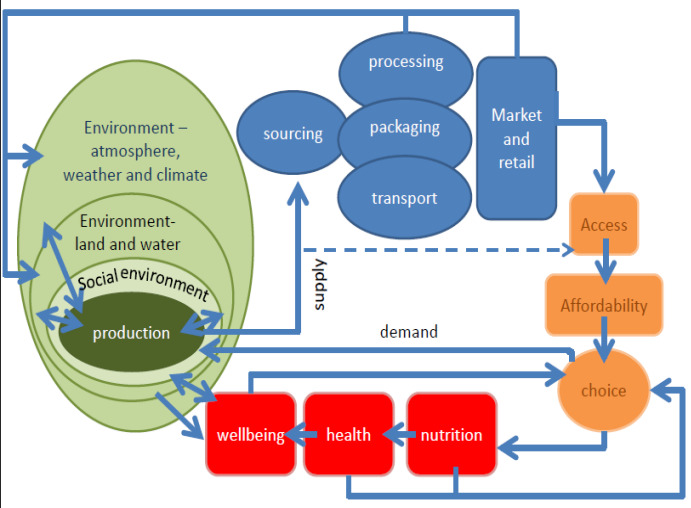
Global Food Security Programme



"Food security, nutrition and sustainable agriculture must remain a priority on the political agenda, to be addressed through a cross-cutting and inclusive approach, relevant to all stakeholders at global, regional and national level." [G8 statement July 2009]

Stakeholders in:
Academia
Industries
Civil Society
The Public

- We foster a systems' view across all major public funders of research

MRC Medical Research Council
E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL
BBSRC bioscience for the future
DH Department of Health
Technology Strategy Board Driving Innovation
DFID Department for International Development
EPSRC Engineering and Physical Sciences Research Council
NATURAL ENVIRONMENT RESEARCH COUNCIL
Food Standards Agency food.gov.uk
defra
Llywodraeth Cymru Welsh Assembly Government
The Scottish Government
BIS Department for Business Innovation & Skills

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2015 game changers

People

We are determined to end poverty and hunger, in all their forms and dimensions, and to ensure that all human beings can fulfil their potential in dignity and equality and in a healthy environment.

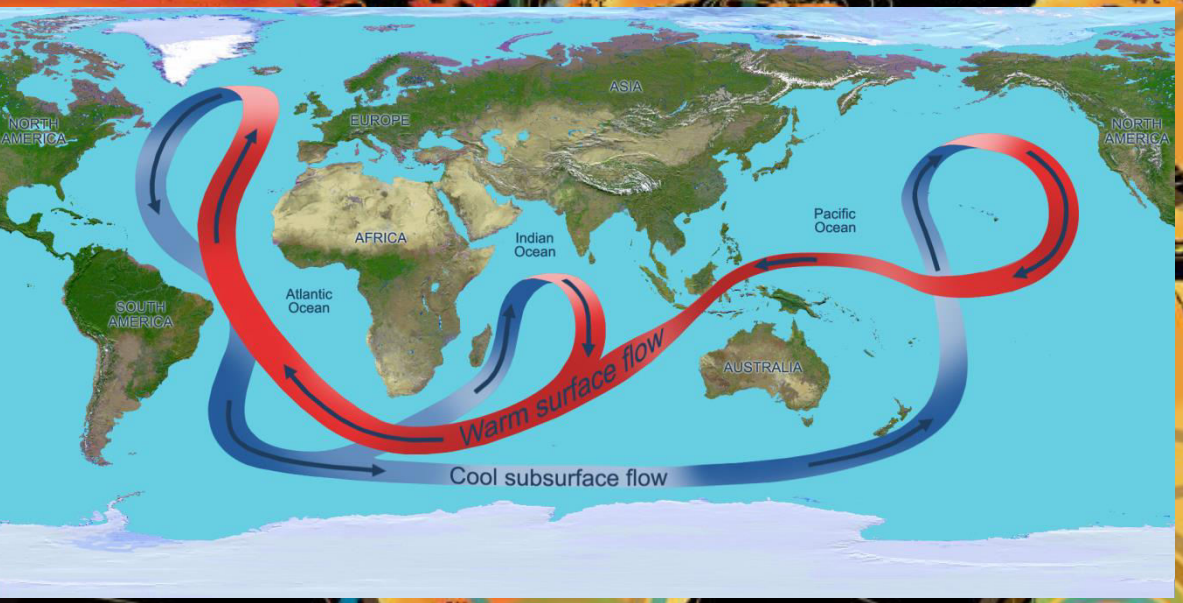
Planet

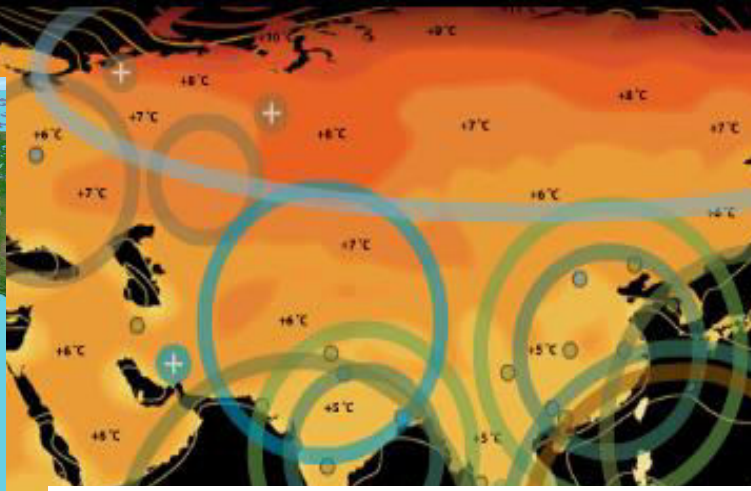
We are determined to protect the planet from degradation, including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations.

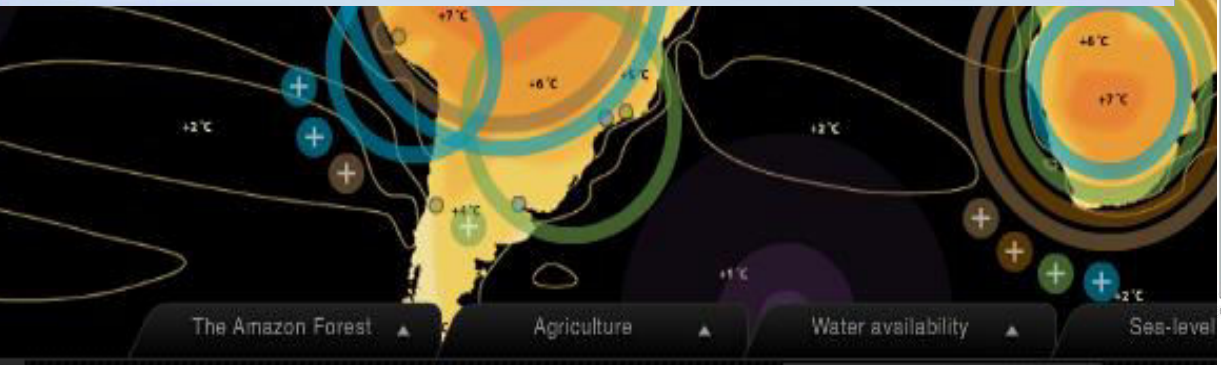
Met Office

The impact of a global temperature rise of 4°C (7 °F)

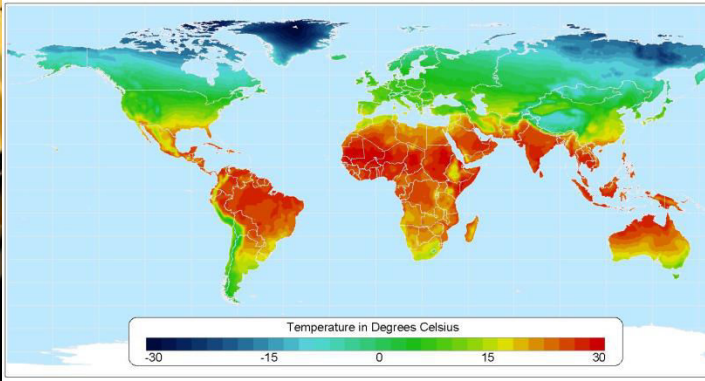
HM Government







Average Annual Temperature



Data taken from: CRU 0.5 Degree Dataset (New, et al.)

Atlas of the Biosph

Center for Sustainability and the Global Envir
University of Wisconsin -

The Amazon Forest ▲ | Agriculture ▲ | Water availability ▲ | Sea-level

Crops | Water Availability | Sea Level Rise | Marine | Drought | Permafrost | Tropical Cyclones | Extreme Temp | Health

+ °Celsius

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2	4	5	7	9	11	13	14	16	18	20	22	23	25	27	29

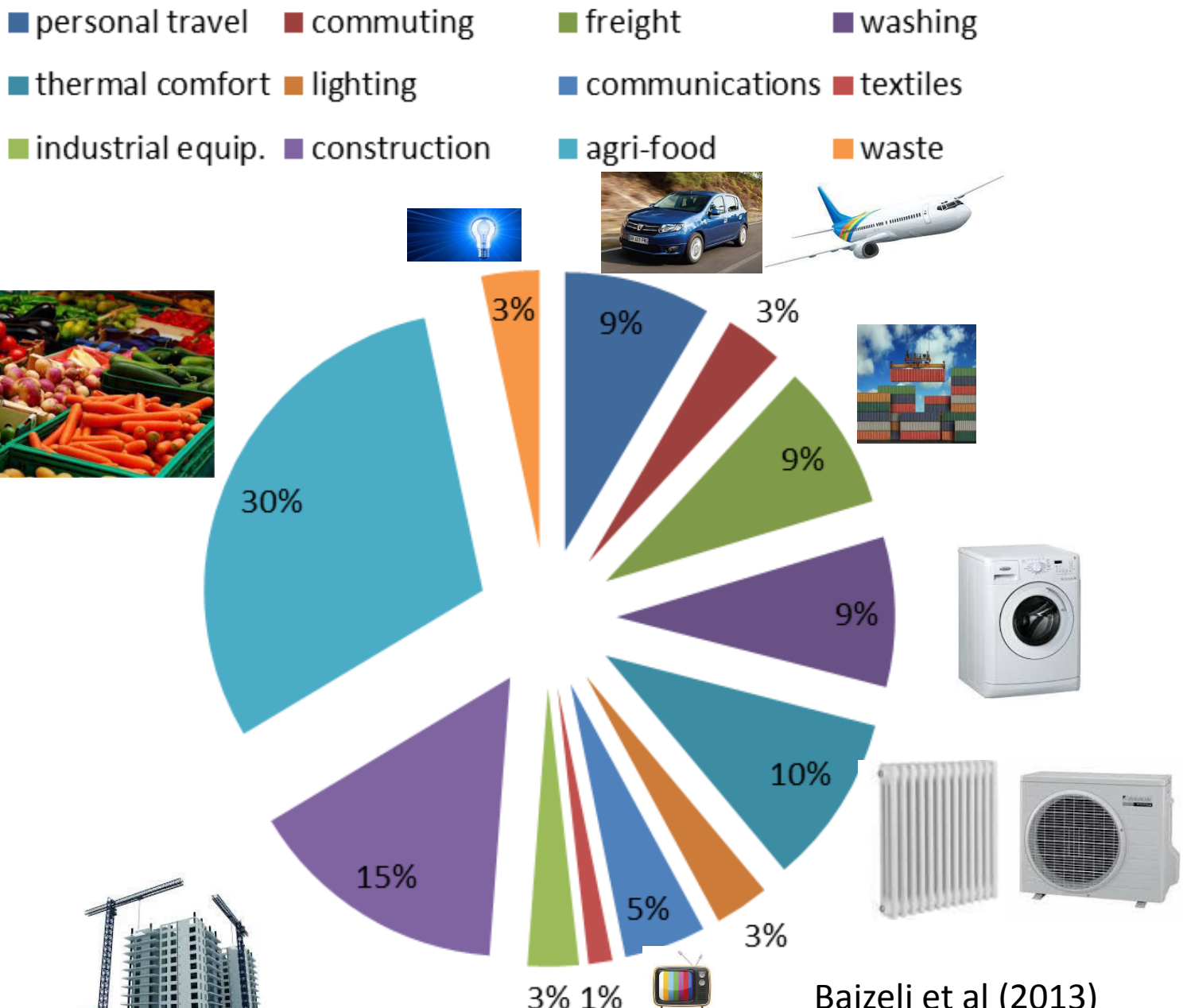
+ °Fahrenheit

City populations
5-10 Million
10-20 Million

Source: UN Statistics Division Demographic Yearbook 2007

Credits

GHG emissions by service (50.6 Gt CO2e total)



Baizeli et al (2013)

Food security occurs when all people at all times have access to sufficient, safe and nutritious food that meets their dietary needs and preferences for an ***active and healthy life***

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12th European Nutrition Conference

FENS 2015

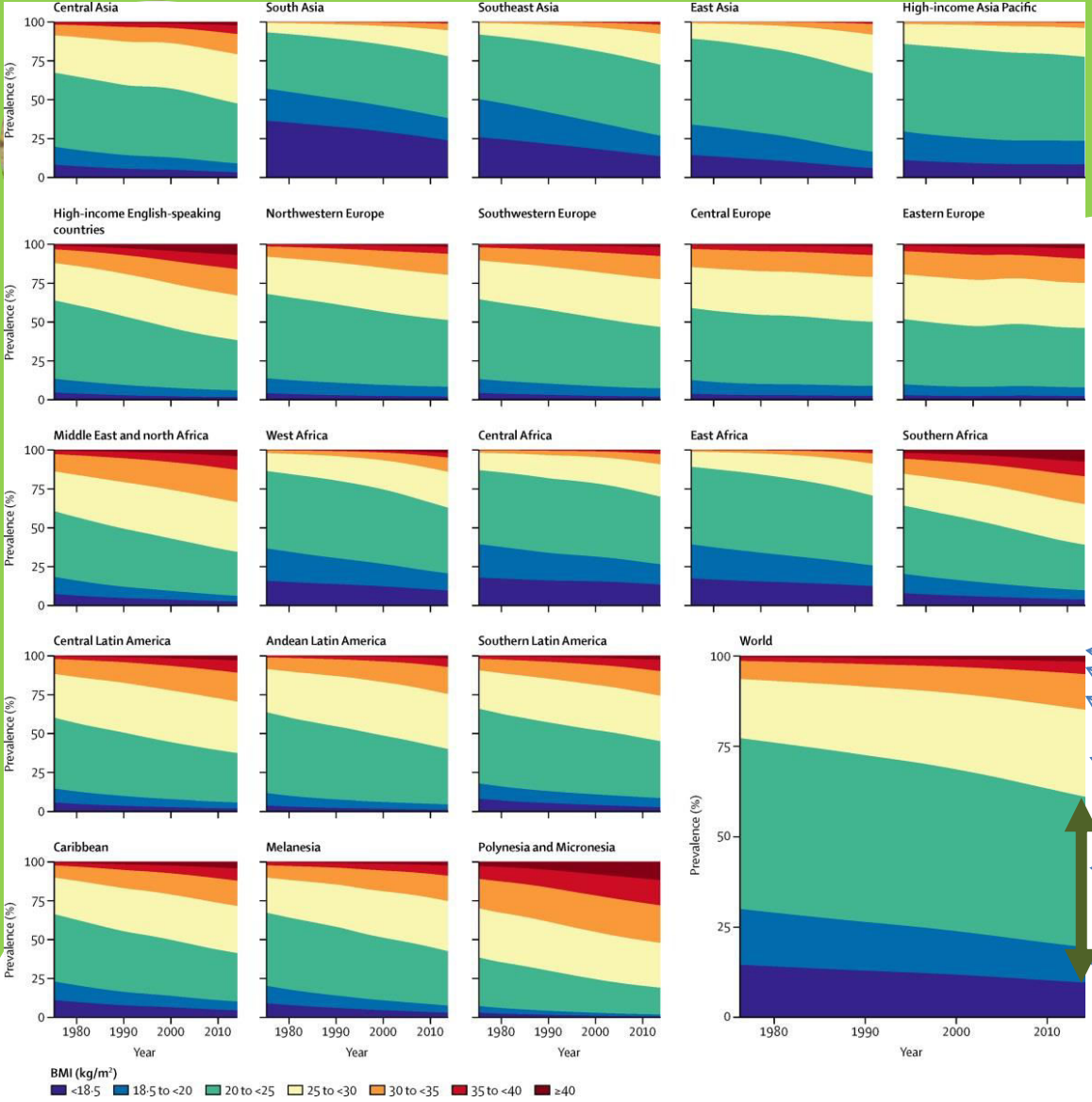
Nutrition and health throughout life-cycle

2016 → 2100

83.3

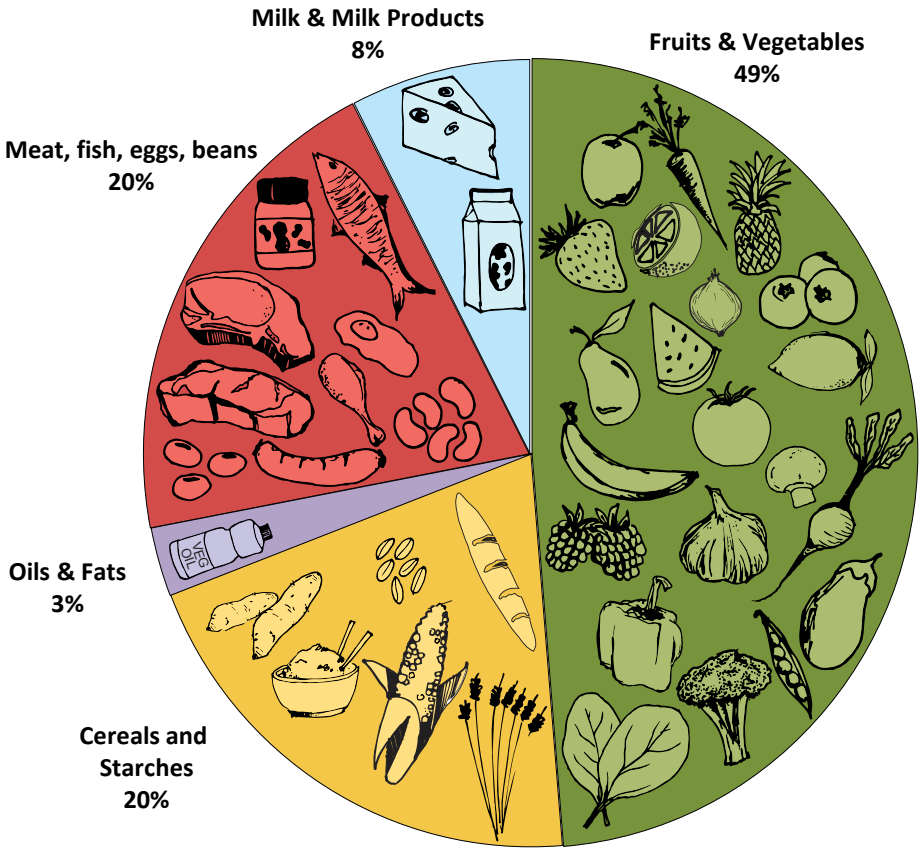
Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 19·2 million participants *The Lancet* Volume 387, Issue 10026, Pages 1377-1396 (April 2016) DOI: 10.1016/S0140-6736(16)30054-X

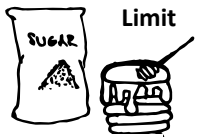
Trends in age-standardised prevalence of BMI categories in women by region



Very very obese
Very obese
Obese
Overweight
Normal
Low normal
Underweight

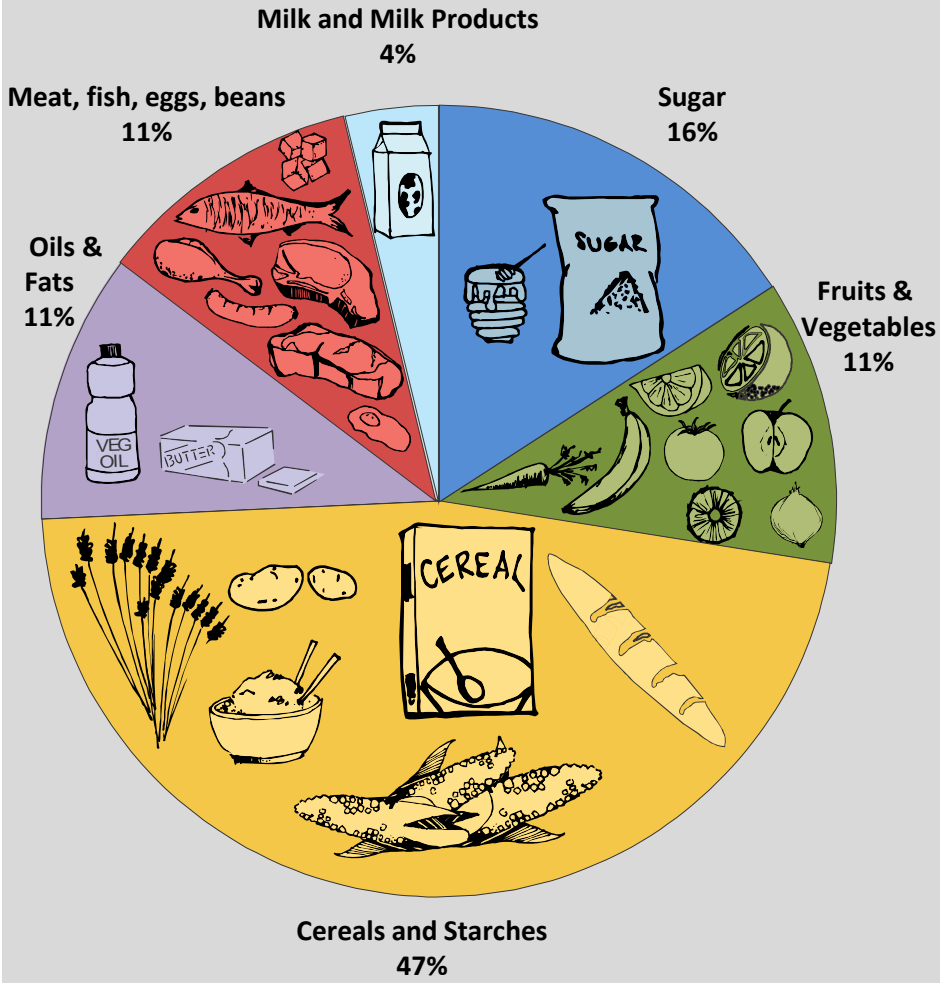
What we should be eating (Harvard's Healthy Eating Plate Model)



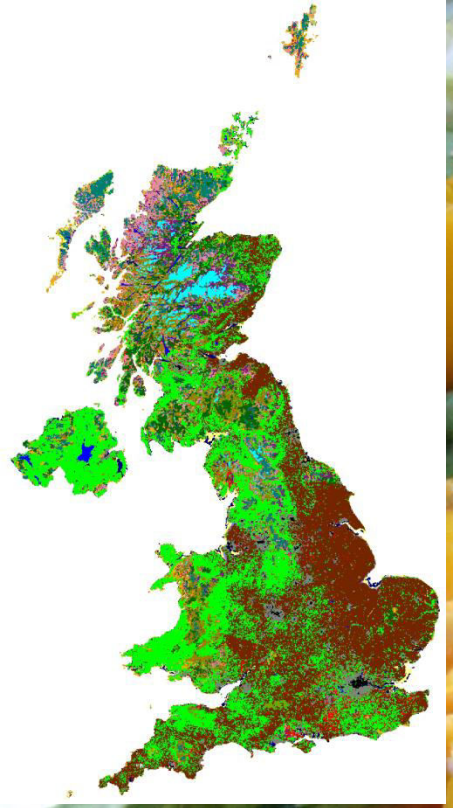


WHO<
5%

What we are actually producing (According to 2011 FAO)



Evan Fraser, Guelph, FBS analysis, 2015



Food loss and waste

Global food losses/waste is estimated to be 1.3 billion tonnes per annum (pa), equating to approximately one third of edible food intended for human consumption

The total food production of sub-Saharan Africa = EU+N Am food waste (230mt).

Total food waste has enough embedded calories to feed 2-3bn people

Many reasons for loss and waste: pack size, safety, food is cheap, culture

Need to recycle “from farm to flush”

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Our food system isn't sustainable

- Diet is related to ill health globally
- Production of few commodities at large scale is environmentally detrimental (soils, water, biodiversity etc)
- Cheap food produces waste
- Responsible for significant amount of global warming

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WHAT IS SUSTAINABILITY?

Sustainability is not “increasing efficiency”

Brundtland Report (1987): *"Sustainable development is development that meets the **needs** of the present without compromising the ability of future generations to meet their own needs."*

Terminological inexactitude

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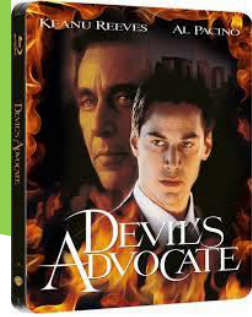
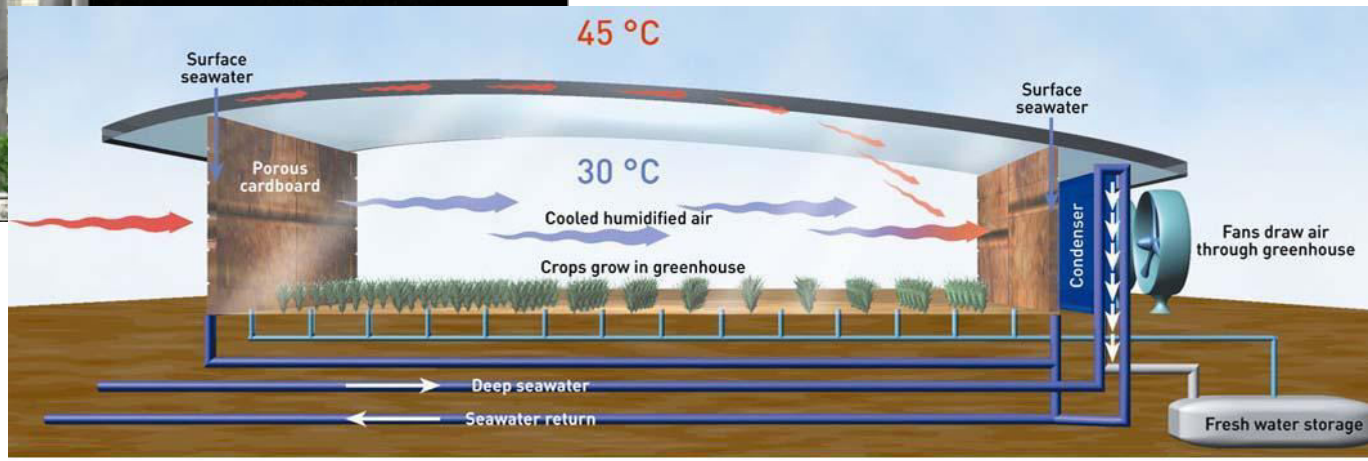
UN Agenda for development (1997) articulated that sustainability has three dimensions: envt, econ and social

- Definitions so broad as to be impossible to operationalise
- UN agenda implied equal weighting of three dimensions
- Often implicit assumption that economic and social are co-related
- From a "first principles" perspective can expect envt to ultimately underpin the other two

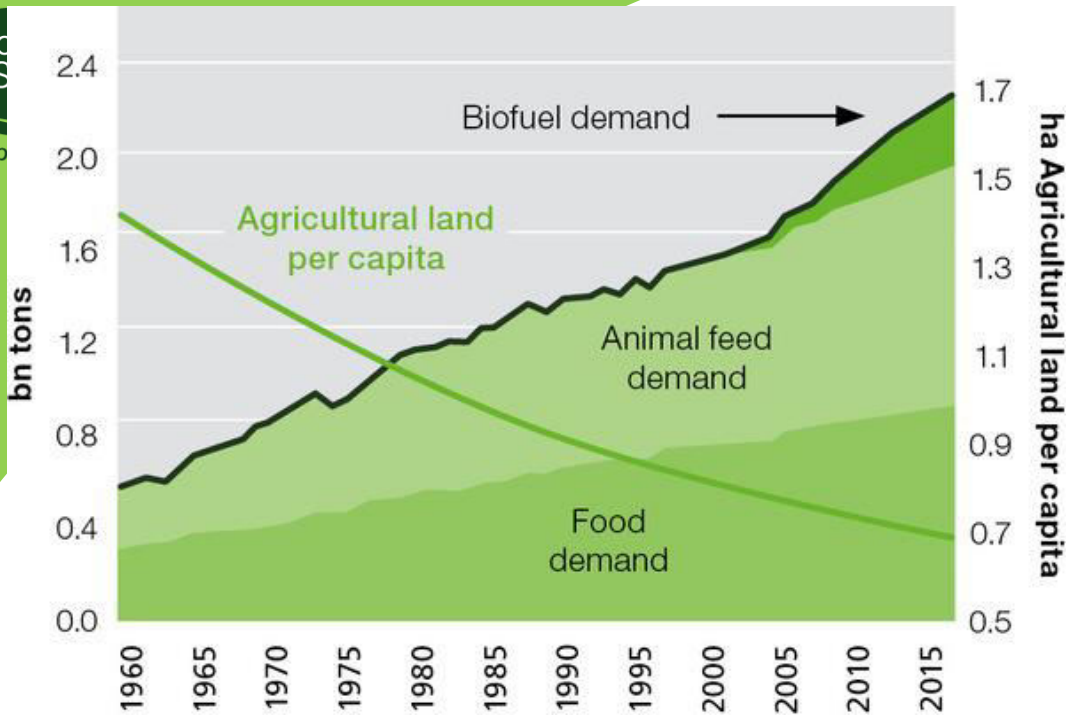
Sustaining economic growth

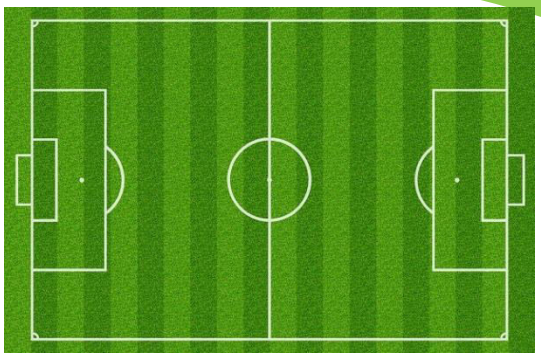


- Does it matter if the world is changing?



Are there limits to environmental exploitation?

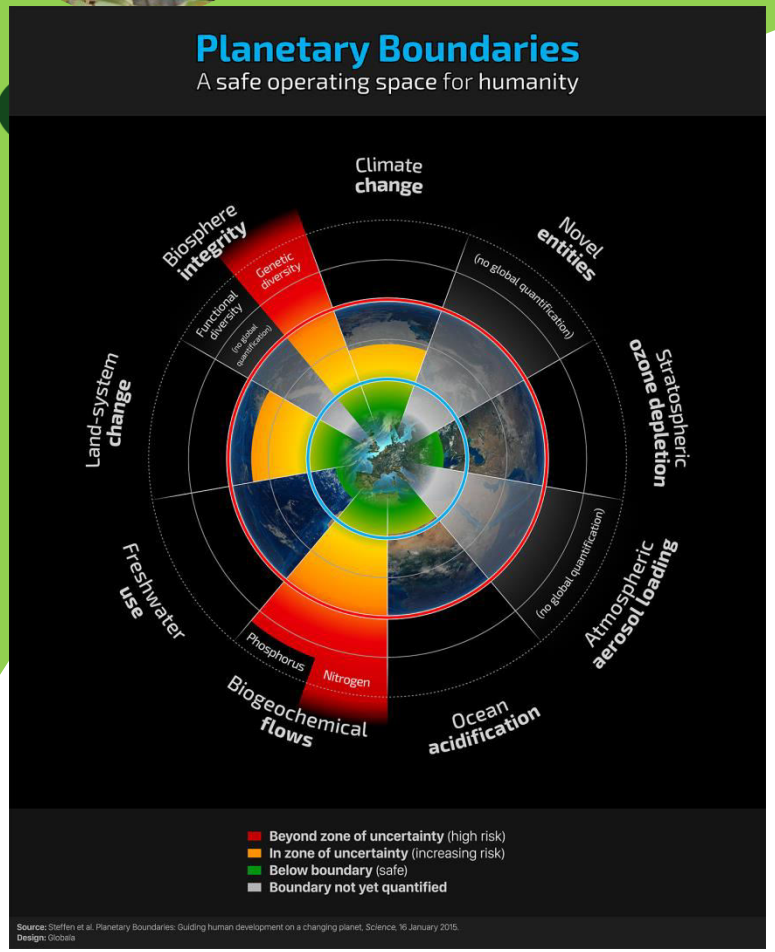




- Global output gone up nearly 4x
- Pop size 3bn to 7bn

15 gallons

Sustaining what?



- Growth?
- Whilst minimising impacts?
- Whilst maintaining natural capital?
- Whilst avoiding tipping points?
- Whilst keeping the world as it is?

What does land do?

Sustainability is about maintaining ecosystem services (including climate) at a landscape scale appropriate to place, societal needs and ethical values

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WHY IS SUSTAINABILITY NOT (JUST) ABOUT EFFICIENCY?

e.g. reducing waste, reducing packaging, reducing energy

Jevons' paradox: efficiency's *dark side*

- Genetic breeding and selection has more than doubled chicken yields at slaughter age (42 days) and halved the feed required
- Feed efficiency continually improving. For the same volume, UK impact in 15 years time as follows:
  - 86,000 tonnes less feed per year saving £10M pa
  - 288,000 tonnes less CO_2 equivalents per year valued at £8M pa

Roslin Institute

ACRBC 1957 Males – 2001 Feed

Ross 2001 Males – 2001 Feed

Day 43 **Day 57** **Day 71** **Day 85**

Year	1976	1999
Live weight at 42 days	1050g	2600g
Age at 2kg	63 days	36 days
Yield of breast meat	250g	340g
Feed/1kg breast meat	20kg	10kg

BBSRC bioscience for the future

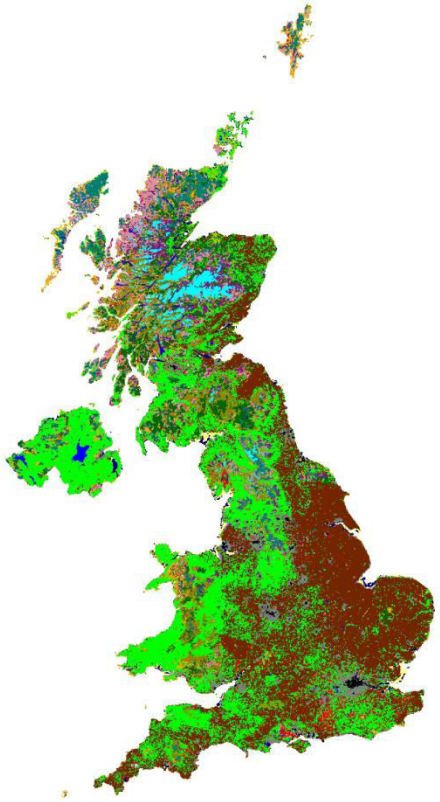
defra Department for Environment Food and Rural Affairs

ROSLIN

THE UNIVERSITY OF EDINBURGH

Aviagen™

Affymetrix



Better soil health
Less impact on water and atmosphere
Lower residues in food
More resilient to extremes (e.g. drought)
More biodiversity etc

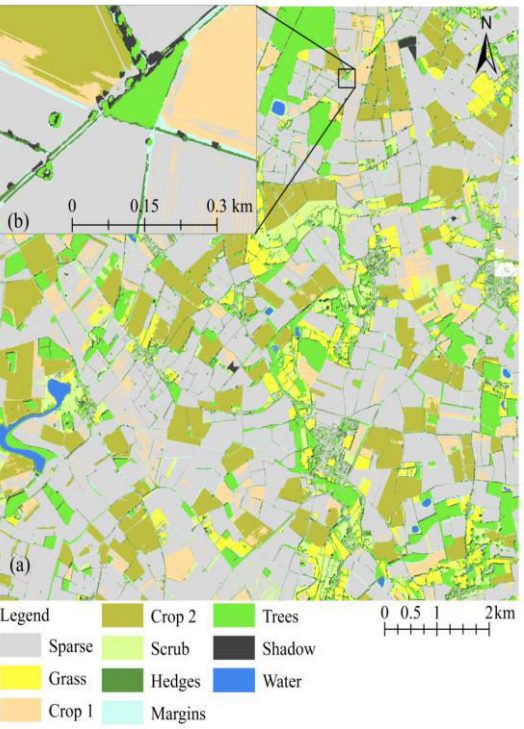
Changing demand is part of "sustainable"

Recipe-based approaches don't deliver sustainability *(sensu stricto)*

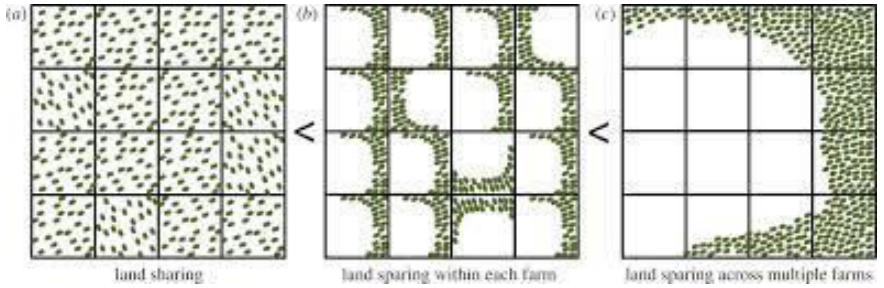
$$WUE = \frac{\text{Crop yield (kg)}}{\text{Water consumption } (m^3)}$$

- Huge number of variables across the three dimensions: "who choses which matters most"?
- "optimising" formally difficult because "who decides the weights?"
- Every place is different, and the "best thing" to do "depends…" (on place, on neighbours etc)
- Systems also very leaky: stakeholder mapping tricky

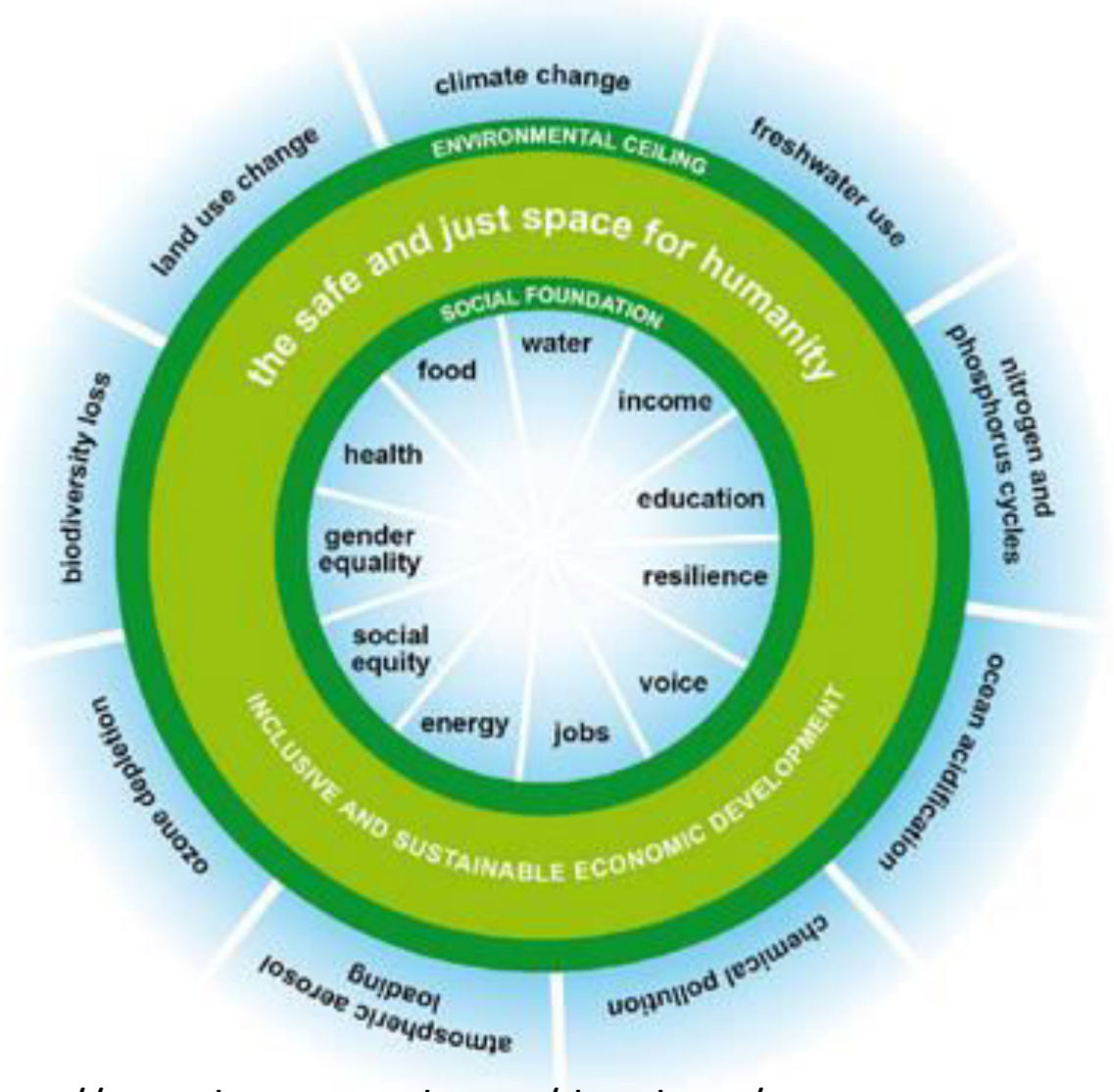
Place-based solutions are part of SI

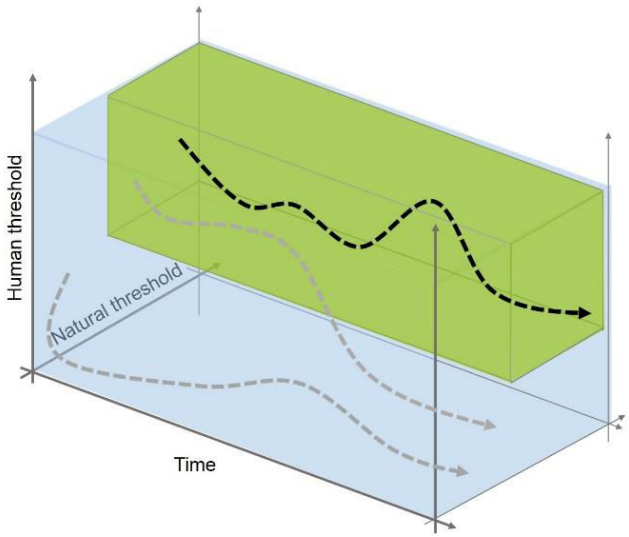


- It is possible to “design” landscapes better to deliver a range of goods
- Governance issues abound



Safe operating spaces





http://www.kateraworth.com/doughnut/

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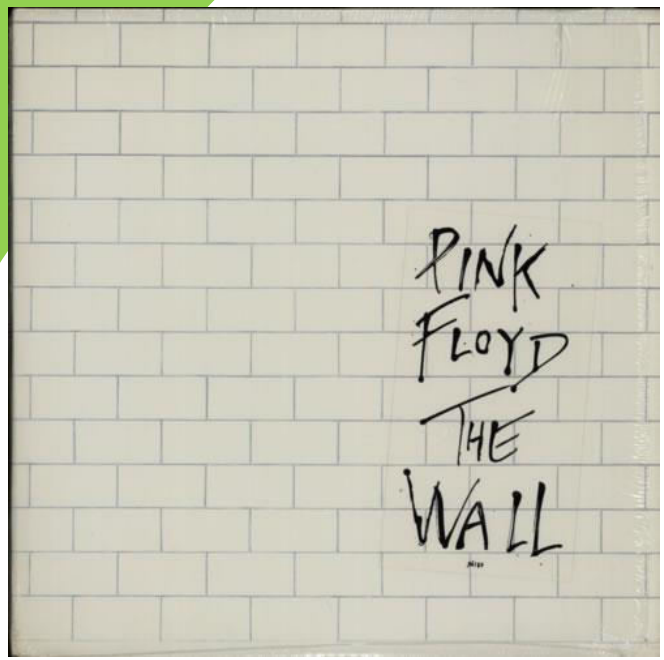
Sustainability in the food system

- No simple solutions (like increase efficiency; zero waste; develop GM; eat local; eat organic).
- Innovation needed in many areas
  - Make ag more sustainable through efficiency of process and in space
  - Maintain ecosystem services
  - Increase equity
  - Waste: Reduce first and reuse second
  - Make diets healthier and reduce demand



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NEED FOR CHANGE

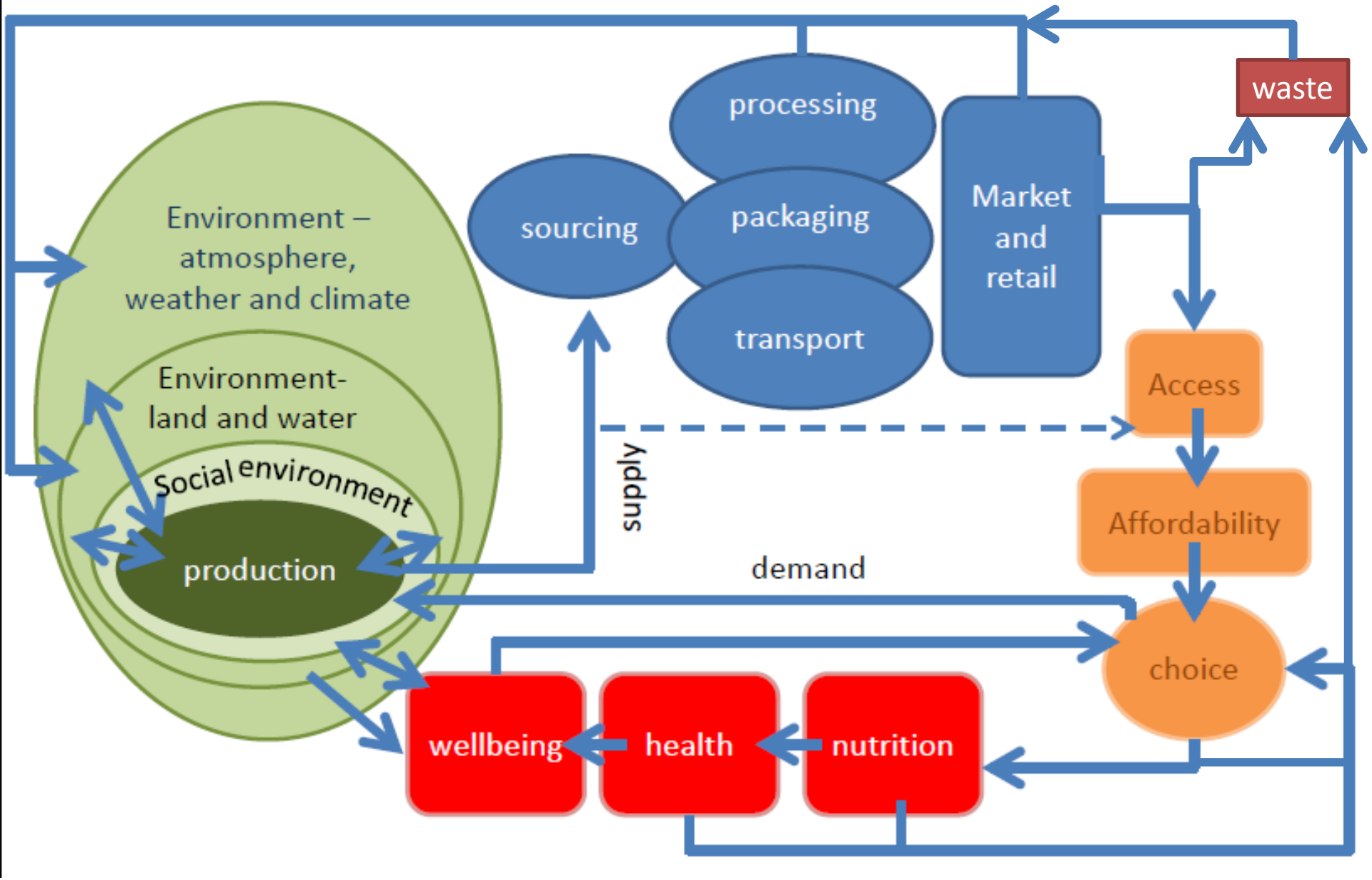
Globally, if we carry on as we are…

- We need to produce more food by 2050 than we have done in human history
- This will require 120% more water; 42% more cropland and loss of 14% more forest
- This will emit enough carbon dioxide to create 2 degrees of global warming
- We'll lose much of the world's biodiversity
- Food will increasingly be associated with early deaths

Importance of food-demand management for climate mitigation

Bojana Bajželj[1]*, Keith S. Richards[2], Julian M. Allwood[1], Pete Smith[3], John S. Dennis[4], Elizabeth Curmi[1] and Christopher A. Gilligan[5]

NCC 2014



How do we make the system “sustainable”?

Leverage point to make space for sustainable agric

vs

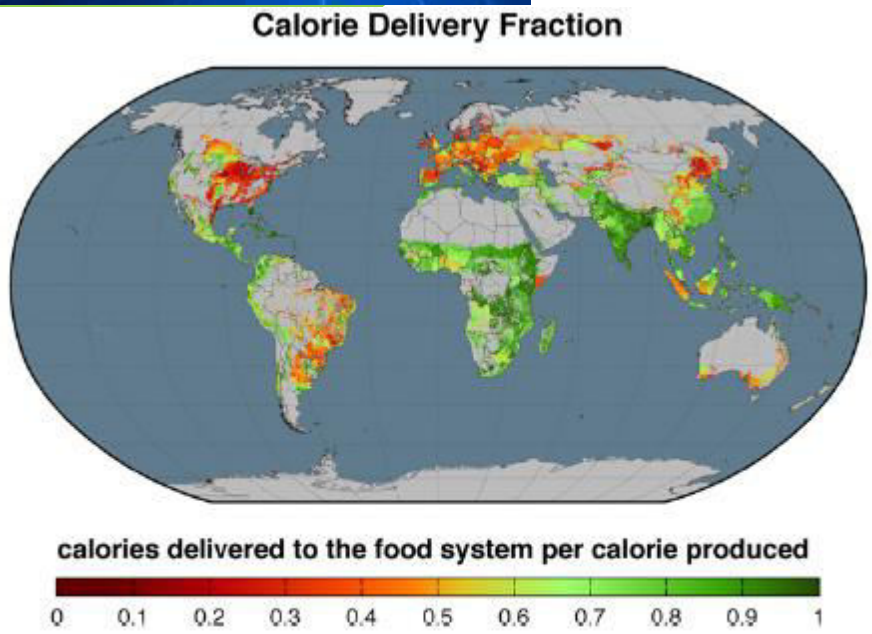


Figure 1. Calorie delivery fraction per hectare. The proportions of produced calories that are delivered as food are shown.

E S Cassidy *et al* Environ. Res. Lett. **8** (2013) 034015

The population of all Asia is 4.2bn

Business as usual is a Jevon's paradox: more is not enough

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Production (sustainable) → "full cost of food" → Less waste; Healthy consumption; Low environmental impact; Managed demand

Sustainable nutrition

Production (unsustainable) → Cheap food → Waste; Over consumption; Environmental impact; Increasing demand

The M25 model

2/3*2/3*(1-(1/3*1/5))=56/135=41% used

Food not lost/wasted/fed to animals or overeaten

Valuing more than price

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- Price is the lowest common denominator
  - All being equal price is a good descriminator
- Focus groups emphasise “I don’t understand why sustainability matters; I don’t trust green labels and I didn’t know what impacts my food choices have”
  - All is not equal: how can markets differentiate the “unequalness”?

Who has the power?

Who has the power to change it?

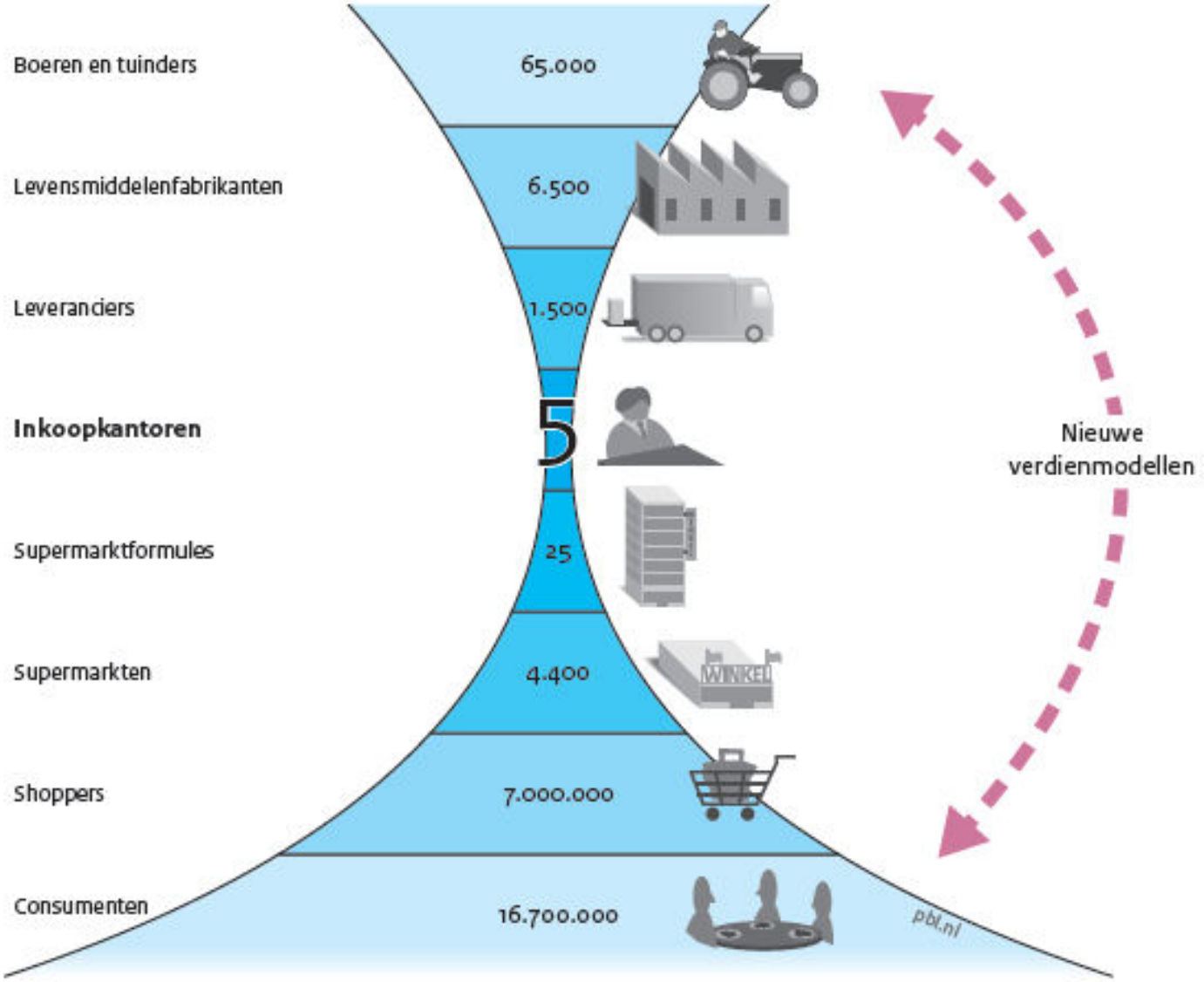

Fig p 13 from “Environmental Balance” report by the Dutch Environmental Agency http://themasites.pbl.nl/balansvandeleefomgeving/2012/).

Conclusions

- We *can* grow more food and reduce its environmental impact
- There is no "magic bullet" but scope for many innovations in many areas (including biotechnology)

  Unlikely we can grow enough food to meet demand sustainably as it is currently projected (without significant inequality)
- Changing demand (or population size) needed to make space for sustainability
- Social change therefore as important as scientific innovation
- Challenges require significant research investment, important to protect budgets

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Thank you!

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