Sustainable diets

Edward Joy
edward.joy@lshtm.ac.uk
Session outline

• What is a food system?
• What is sustainability?
• [Break]
• Quantifying environmental impacts of diets
• Sustainable food systems - what are the solutions?
• Discussion
Food system

All the actors and activities involved in the production, processing, transport and consumption of food.

Adapted from The Future of Food: http://www.futureoffood.ox.ac.uk/what-food-system.
Food system maps

• Groups of ~5

• Map out actors and activities for a food system of your choice
The importance of food and agriculture systems - activity

• Agriculture is responsible for ____ % of global greenhouse gas emissions and ____ % of global freshwater consumption

• Agriculture contributes ____ % of global GDP and ____ % of jobs

• Diets underlie ____ % of global disease burden
The importance of food and agriculture systems - activity

• Agriculture is responsible for 33% of global greenhouse gas emissions and 70% of global freshwater consumption

• Agriculture contributes 3.8% of global GDP and 30% of jobs

• Diets underlie 21% of global disease burden
Sustainable development (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.
Sustainable diets

Thus in bringing a larger share of our corn crop directly into human consumption and in giving to such perishable foods as milk, vegetables, and fruit a more prominent place in the diet, the food conservation movement has been working toward permanent improvements in our national food economy at the same time that it saved the wheat, meat, fat, and sugar needed for export to our armies and to hungry Europe.

Sherman (1919)
Sustainable diets (FAO, 2010, adapted):
Sustainable diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations.

*Sustainable diets are:*

1) protective and respectful of biodiversity and ecosystems;
2) culturally acceptable;
3) accessible, economically fair and affordable;
4) nutritionally adequate, safe and healthy;
5) optimize natural and human resources;
6) Resilient to shocks and change.
1) Protective and respectful of biodiversity and ecosystems

The relatively stable, 11,700-year-long Holocene epoch is the only state of the ES that we know for certain can support contemporary human societies.
2) Culturally acceptable

Environment ministry spokesperson Michael Schroeren

We decided to take the symbolic step to ban meat and fish at external events because we want to practise what we preach.

No one would have problems with stricter regulations around mass livestock farming, but we shouldn’t make the mistake to prescribe a lifestyle to people.

Anton Hofreiter, former co-chair of the German Greens
3) Accessible, economically fair and affordable

3 portions veg
2 portions fruit

Miller et al. 2016
4) Nutritionally adequate, safe and healthy

Muthayya et al., 2013
5) optimize natural and human resources
6) Resilient

What a pickle: UK gripped by courgette shortage

Cold and wet weather hits crops in Spain, sending prices soaring and customers bemoaning empty supermarket shelves

SOURCE: U.N. Food and Agriculture Organization
Where are we heading?

Tilman & Clark, 2014
Changing diets

- Milk
- Sugar

FAOSTAT, 2016

Changing disease burden

- Nutritional deficiencies
- Diabetes

GBD, 2015
Global prevalence of undernutrition (FAOSTAT)

Global calcium supplies and prevalence of deficiency (Kumssa et al. 2015)
Global GHG emissions from agriculture (FAOSTAT)

Global agricultural land area (FAOSTAT)
Wider food system changes
Food system maps

• Groups of ~6

• Map out actors and activities for a food system of your choice

• Identify sustainability concerns

Environment  Economy  Society and health
Bio-physical

Socioeconomic

Political/institutional/regulatory

Cultural

ENVIRONMENT

Low incomes among farming households

Methane from rice production

Vulnerable to drought

Low yields

Processors exclude smallholders (quality, reliability, scale...)

Unhealthy foods marketed to children

Non-biodegradable packaging

Freshwater use in irrigation

Low-tech value chain, storage → food waste

Unhealthy foods marketed to children

Increasing sugar consumption – health, water

Dual burden of malnutrition

Rapidly rising diabetes

Increasing reliance on imports

Increasing sugar consumption – health, water

Low yields
Quantifying environmental impacts of diets
What are people eating?

- Food consumption diaries
- Food consumption recall
- Food frequency questionnaires
- Household surveys
- Food Balance Sheets
## Module G: Food Consumption Over Past One Week

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Millet
Teff
kg per household per week
Where does the food come from?

What was the environmental footprint of the crop/livestock product?

http://www.exiobase.eu/
Securing fresh water for everyone

Imagine life without clean, fresh water. That is the future for many unless we rethink how we use each drop. Yet with every mouth comes a mind and smart ideas to resolve the world’s water crises.

http://waterfootprint.org/en/
Fig. 4. The relationship between average cereal yield and water footprint per ton of cereal. Period: 1996–2005. The dots represent average country data.
Potential pitfalls

• Dietary data not representative of population
• Lack of data on intra-national trade
• Poor spatial resolution of production/environmental footprint data
• Moisture contents in harvested products *versus* food items
• Use ≠ impact
A plate of food contains 200 g cooked rice and 100 g cooked beans. What is the blue water footprint?

- 70% of rice is domestically produced, 30% is imported
- Domestic and imported rice have a blue WFs of 250 and 100 litres per kg, respectively.
- 100% of beans are domestically produced with a blue WF of 80 litres per kg
- Harvested and cooked rice have moisture contents of 10% and 40%, respectively.
- Harvested and cooked beans have moisture contents of 10% and 30%, respectively.
<table>
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<tr>
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<td>harvested weight (g)</td>
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<td>blue WF (L/g)</td>
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<td>blue WF (L)</td>
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<td>Total blue WF (L)</td>
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Solutions
Tilman & Clark, 2014
Barilla Center for Food & Nutrition
• Healthy diet = 17% lower GHG and +7m life years over next 30 years
• Co-benefits between diet, health and GHGs,
• Trade-offs when high emissions savings are required.
• Used to support PHE “sustainable food plate”

Green et al. 2015
Milner et al. 2015
Relative differences in GHG emissions (kg CO\textsubscript{2}eq/capita/year) between current diets and sustainable diets

- Vegan (n=14, mdn=-45)
- Ruminants replaced by monogastric + no dairy (n=1, mdn=-33)
- Vegetarian (n=20, mdn=-31)
- Meat + dairy partially replaced by plant-based food (n=5, mdn=-31)
- Pescatarian (n=6, mdn=-27)
- Healthy guidelines + further optimisation (n=16, mdn=-27)
- Ruminants replaced by monogastric (n=6, mdn=-21)
- Meat partially replaced by mixed food (n=7, mdn=-12)
- Healthy guidelines (n=21, mdn=-12)
- Mediterranean (n=8, mdn=-10)
- New Nordic Diet (n=3, mdn=-7)
- Meat partially replaced by plant-based food (n=8, mdn=-7)
- Balanced energy intake (n=6, mdn=-6)
- Meat partially replaced by dairy products (n=3, mdn=-2)

Aleksandrowicz et al., 2016
Relative differences in land use (m²/capita/year) between current diets and sustainable diets

- Vegan (n=6, mdn=-55)
- Vegetarian (n=7, mdn=-51)
- Pescatarian (n=4, mdn=-39)
- Ruminants replaced by monogastric (n=3, mdn=-37)
- Healthy guidelines + further optimisation (n=5, mdn=-34)
- Mediterranean (n=5, mdn=-27)
- Healthy guidelines (n=10, mdn=-20)
- New Nordic Diet (n=1, mdn=-18)
- Meat + dairy partially replaced by plant-based food (n=3, mdn=-16)
- Meat partially replaced by plant-based food (n=4, mdn=-10)
- Meat partially replaced by dairy products (n=1, mdn=-4)
- Meat partially replaced by mixed food (n=1, mdn=-3)
- Balanced energy intake (n=2, mdn=-3)

Aleksandrowicz et al., 2016
Relative differences in water use (L/capita/year) between current diets and sustainable diets

- Vegetarian (n=9, mdn=-37)
- Pescatarian (n=2, mdn=-28)
- Healthy guidelines + further optimisation (n=4, mdn=-22)
- Meat + dairy partially replaced by plant-based food (n=3, mdn=-15)
- Ruminants replaced by monogastric (n=1, mdn=-11)
- Mediterranean (n=4, mdn=-10)
- Balanced energy intake (n=1, mdn=-8)
- Healthy guidelines (n=9, mdn=-6)
- Vegan (n=1, mdn=107)

Aleksandrowicz et al., 2016
Find your way
to eat greener, not too much and be active
Dietary choices drive production?
Subsistence settings?

Developed consumer economies? Subsistence settings?
Solutions
Sustainable intensification?
Vegetables

What a produce shortage

Cold and wet weather has been moaning empty supermarket shelves.

Fruit

Strawberry deals forever? British fruit in shops two months early

Mild days and new glasshouse tech mean the summer fruit – a Wimbledon and Henley staple – is starting its season in March.
Conservation agriculture

- C storage
- Resilience to drought/heavy rain
Future cellular agriculture production site (Shojinmeat)

Feedlot, Texas (Mishka Henner)

Vertical farming (industrytap.com)
Boserup

“Malthusian Catastrophe”

Population

https://davidruyet.wordpess.com
The power of population is indefinitely greater than the power in the earth to produce subsistence for man.

The power of ingenuity would always outmatch that of demand.
Will Steffen

Ultimately, there will need to be an institution...operating, with authority, above the level of individual countries to ensure that the planetary boundaries are respected.

Some argue that humanity can now survive, and even thrive, in a rapidly destabilizing planetary environment, but that is a belief system based on supreme technological optimism...
It is likely that a large fraction of people on Earth would not be alive today without the artificial production of fertilizer. How can such ethical and economic issues be matched with a simple call to set limits? [...] food is not optional.

the human-altered ecosystems of the Anthropocene represent the only state of the planet that we know for certain can support contemporary civilization.
Critical (but not cynical)

“Something’s just not right—our air is clean, our water is pure, we all get plenty of exercise, everything we eat is organic and free-range, and yet nobody lives past thirty.”
References

- Sherman, H. Permanent gains from the food conservation movement. Columbia University Quarterly 21:19, 1919