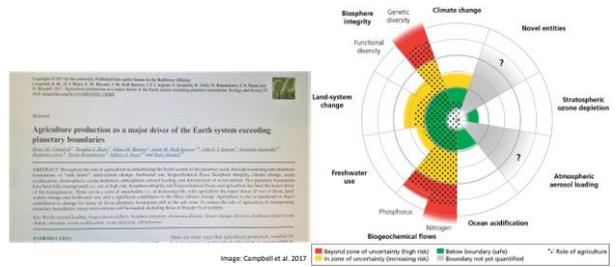


Achieving food security under climate change: regulatory challenges ahead!



Impact of agriculture on planetary boundaries



Relationship climate change, agriculture, food security

1. Agriculture contributes to climate change

- Contribution agriculture, forestry and other land use (AFOLU): about 25% of all anthropogenic emissions
 - Non-CO₂ emissions:
 - methane: livestock, rice cultivation (25x impact CO₂)
 - nitrous oxide from soils; synthetic fertilizers, manure on soils and pasture (300x impact CO₂)
 - CO₂ emissions: deforestation, peatland drainage, tillage (soils)
 - But: also important source of sequestration (soils, vegetation)
- Global emissions from agriculture have been rising since 1990 (down in Europe, up in Asia)
 - But contribution of AFOLU went down because of increase other sectors
- EU (and most member states): 10% emissions from agriculture
- EU's agricultural emissions should reduce by 36% by 2030 (in order to meet long term mitigation targets in cost-effective way)



Carbon footprint of your food



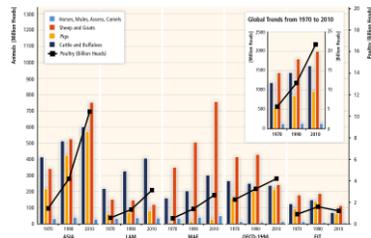
One glass of dairy milk per day (over a year) = passenger car emissions of a 941 km trip
 (compared to oat milk = 270 km trip)



One hamburger (75 gr of beef) per week (over a year) = 2,482 km trip (or 1 return trip by plane London-Malaga).
 Space needed: 1,735m² land, equal to the space of 6 tennis courts
 (compared to tofu = 51 km trip).
 Note, however, that water needed for tofu production is high: 587 litres of water, equal to 9 showers lasting eight minutes)



Sharp increase livestock (esp. poultry in Asia)



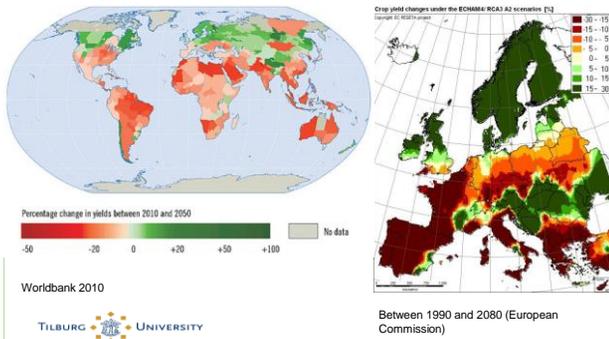
Source: P. Smith et al., Agriculture, Forestry and Other Land Use (AFOLU), in: Climate Change 2014: Mitigation of Climate Change, WGII, IPCC AR5 (Cambridge University Press)

Background: climate change & food security

2. Agriculture will suffer heavily from climate change

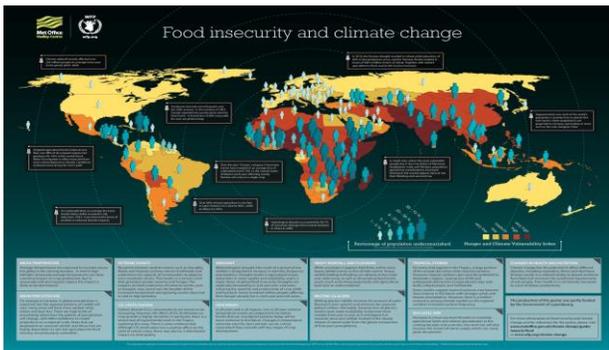
- Negative yield impacts for all major crops in tropical and temperate regions (at 2° C, even at 1.5° C although less dramatic)
 - Reduced water availability, temperature shifts, extreme weather events (floods), increasing occurrence of pests
- Example: 56% of crops in Sub-Saharan Africa negatively affected by 2050
- Extensive yield losses expected from 2050 in EU (south)
 - droughts, extreme weather events, floods, pests
- Increase of irrigation demand by more than 40% in Europe
- IPCC: Strong top-down policies linked with, and fed by, bottom-up initiatives needed to achieve required level of adaptation





Background: climate change & food security

3. >40% increase global food production needed by 2050
- Population growth: 7.5 → 10 billion (especially Africa, India)
 - Rise in calorie intake by 60% due to greater affluence (esp. China, India)
 - Additional farm land needed of about twice size of India
 - Mostly for livestock keeping (only 55% of world's crop calories feed people directly)
 - (plus space for biomass supply, carbon sequestration, afforestation)
 - Leads to further increase greenhouse gas emissions
 - In the Netherlands no further decline of emissions from agriculture expected until 2050 (even with further technological advances)
 - Leads to further biodiversity loss, increasing nitrogen/phosphates load, water shortages, zoonotic diseases



What solutions do we have?

- Technological fixes (examples)
 - Methane capture and conversion into biogas in livestock keeping
 - Precision agriculture using big data (optimizing production by combining data on soils, weather conditions, pests, growth rate generated through robotics/big data/remote sensing)
 - Genetic modification of livestock's digestion system, livestock feed change
 - Cultured meat
- Behavioural changes (examples)
 - **Farmer:** agroforestry, organic farming, rotational grazing, crop rotation, soil carbon
 - **Consumer:** plant based diet, food waste reduction
- Changes with other relevant stakeholders: supermarkets, agri investment banks etc.
- 'Climate smart agriculture': mitigation & adaptation & increase food production

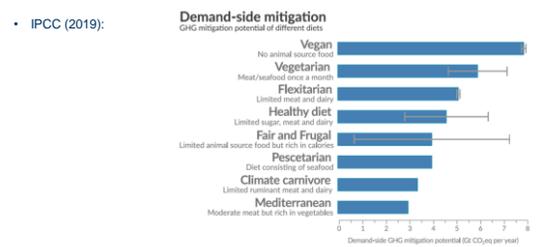


Food system response options



Source: IPCC, Climate change and land (2019)

Also needed: climate smart consumption



Legal challenges ahead of us

- Entire food production-consumption chain needs to be reformed: food transition
- At a global level
 - Food markets are global markets
 - All countries have to contribute
- Focus: European Union
 - Paris Agreement
 - EU climate law
 - EU agriculture law



Adapted by Christl Ma, Center for Environmental Farming Systems.
Photo: Wikipedia (2) and Creative Commons (3). Drawing: the Food System: An agricultural learning program for groups and learning walks.
Cornell University, Department of Sustainable Design and Education. <https://www.cornell.edu/foodsystem/>

Paris Agreement (2015)

- General aims: well below 2° C or at 1.5° C (Art. 2) = 90% emission reduction, transition to net zero carbon emissions worldwide in second half of this century
- On agriculture: nothing
- On food security: mentioned as limiting factor for mitigation measures (Art. 2)
- However:
 - Balance between emissions and removals by sinks implies drastic emission cuts from AFOLU & much attention for sinks in AFOLU
 - Most NDCs refer to agriculture (74% of the 138 NDCs submitted by May 2016)
 - Most National Adaptation Plans include agriculture
 - Many provisions on financial & technical support for adaptation in developing countries *de facto* focus on agriculture

EU law on climate change & agriculture: climate change law

- Agricultural emissions are covered by the Effort Sharing Regulation 2018/842/EU
 - End goal 2030 plus annual emission allocations (AEAs) 2021-2030
 - 30% on average below 2005 emissions for all ESR sectors combined in 2030
 - No described measures: discretion for MS, including on which sectors they wish to focus
 - Monitoring and reporting required
 - LULUCF emissions are not covered
- LULUCF Regulation 2018/841/EU, for 2021-2030:
 - Emissions equal sequestration (net zero emissions)
 - Only emissions from cropland, grassland, forestry (not animal husbandry, also not animal excretions from grazing livestock = ESR)
- Changes imminent due to European Climate Law: -55% overall reduction by 2030

EU law on climate change & agriculture: agriculture law

- Common Agriculture Policy (CAP) already focuses on climate change (somewhat):
 - *Cross compliance* rules partly focus on climate change (minimum soil cover, minimum land management to limit erosion, maintenance of soil organic matter)
 - *Green direct payments* already partly aimed at sequestration and mitigation (crop diversification, permanent grasslands, ecological focus areas obligations)
 - Payment directly to individual farmer, 30% of direct payments for Green direct p.
 - *Rural development payments* already partly aimed at sequestration and adaptation (restoring ecosystems, promoting shift to climate resilient agriculture, agri-environment-climate measures)
 - Payment to MS government. MS Rural Development Programmes - set focus areas, quantified targets & describe measures & allocate funding, co-funding MS/EU
 - Focus areas may include GHG emissions reductions and increased sequestration
 - Examples: grassland management, biogas conversion, convert plant waste into compost and apply to soils

EU law on climate change & agriculture: agriculture law

- Many shortcomings current CAP when focusing on mitigation, adaptation and food security:
 - 'high path-dependency and inertia' of the sector, allocated budget for climate measures not used
 - insufficient funds for deep and full transition of Europe's agriculture sector
 - commitment period too short: 1-5 years. Should be: 100 years
 - accounting not based on quantification of carbon sequestration/emission reduction
 - payments based on amounts of hectare under a certain management scheme or on income forgone/additional costs, not on amount of carbon sequestered
 - generic character, general rules, not sufficiently tailored to individual farms
 - a lot of 'flexibility' for member states: not always sufficiently climate smart, implementation & enforcement issues
- Confirmed by European Court of Auditors (21 June 2021): €100 billion of CAP funds attributed to climate action (2014-2020) → 0% GHG emission reductions...

Towards EU legislation to reduce agricultural emissions

- European Green Deal (2019) (carbon neutral in 2050) also focuses on agriculture
- *Farm to Fork Strategy* for a fair, healthy and environmentally-friendly food system (2020) also focuses on agriculture
- No legal instruments have been designed yet. Options to consider:
 - Further reform of CAP (current plans: 40% of budget to climate change measures, but also more room for member states, 'eco-schemes' on carbon farming)
 - Revision of LULUCF Regulation (European Commission's 2030 Climate Target Plan: "consider inclusion of non-CO₂ emissions from agriculture")
 - Integrate agricultural emissions in the ETS, or develop a separate 'carbon farming' instrument which pays farmers for the carbon sequestered (the latter is suggested by the European Commission's Farm to Fork Strategy)
 - Legislative proposals expected by the end of 2021

Example: should we integrate agriculture into the EU ETS?

- Directly: farmers have to surrender allowances for their emissions
 - Difficult due to small size individual farms, heterogeneity among farms, such as: local environmental circumstances, individual practices (e.g., deep versus shallow tillage)
 - Monitoring, Reporting and Verification (MRV) problematic
 - Perhaps only with some large, relatively homogenic farms (e.g., large pig farms)
- Indirectly: farmers can sell credits from on-farm GHG emission reduction projects to regulated sectors (energy, aviation, shipping, industry) ("offsets")
 - Examples: Australia, California, Ontario, Quebec
 - Current research project: Experiences? Lessons for EU? (2022)
 - Earlier research into Australia's carbon farming programme showed relatively good results:
 - » stimulated farmers to move to climate smart agriculture
 - » advanced knowledge (e.g., soil carbon)
 - » many co-benefits: economic, resilience, biodiversity
 - » regulatory framework is robust, high level of compliance (auditing system works well)
 - » real reductions (monitoring)
 - » additional reductions (beyond business as usual, mostly...)



Other elements of the instrument mix

- Many more legal and non-legal instruments are needed to achieve food transition:
 - Towards a smart instrument mix (Gunningham and Grabosky 1998)
 - EU: use all existing instruments (CAP, LULUCF, ETS)
- Consumer has to be targeted too (and retail, supermarkets, etc.)
 - Bottom up (individual dietary choices) and top down ('landscape changes' – markets)
 - Meat tax (through VAT or otherwise)
 - Subsidies for cultured meat and vegetarian/vegan alternatives (VAT or otherwise)
 - Education, social media, role models, 'nudging'
- Will cultured meat be a game changer?
 - Imagine a world without commercial livestock keeping! Rewilding farmland?



Thank you!



Agroforestry. Photo credits: Louis Bolk Institute (left); New Food Magazine (right)



This research has received funding of the Dutch Research Council NWO under grant agreement 406.18.RB.004