AR5: Agriculture and FOLU

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Agriculture, Forestry and Other Land Use (AFOLU)

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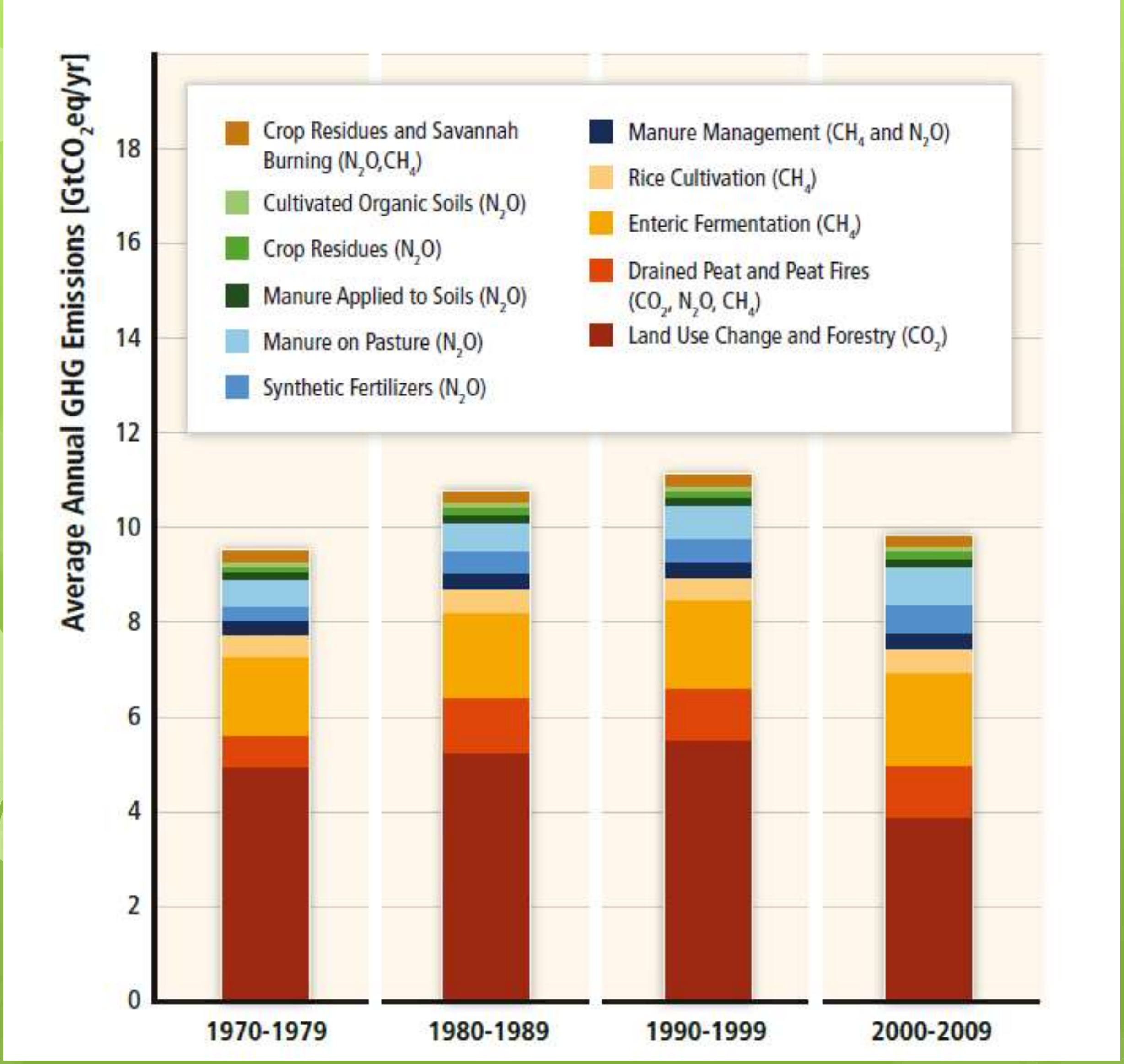
Outline of Chapter 11

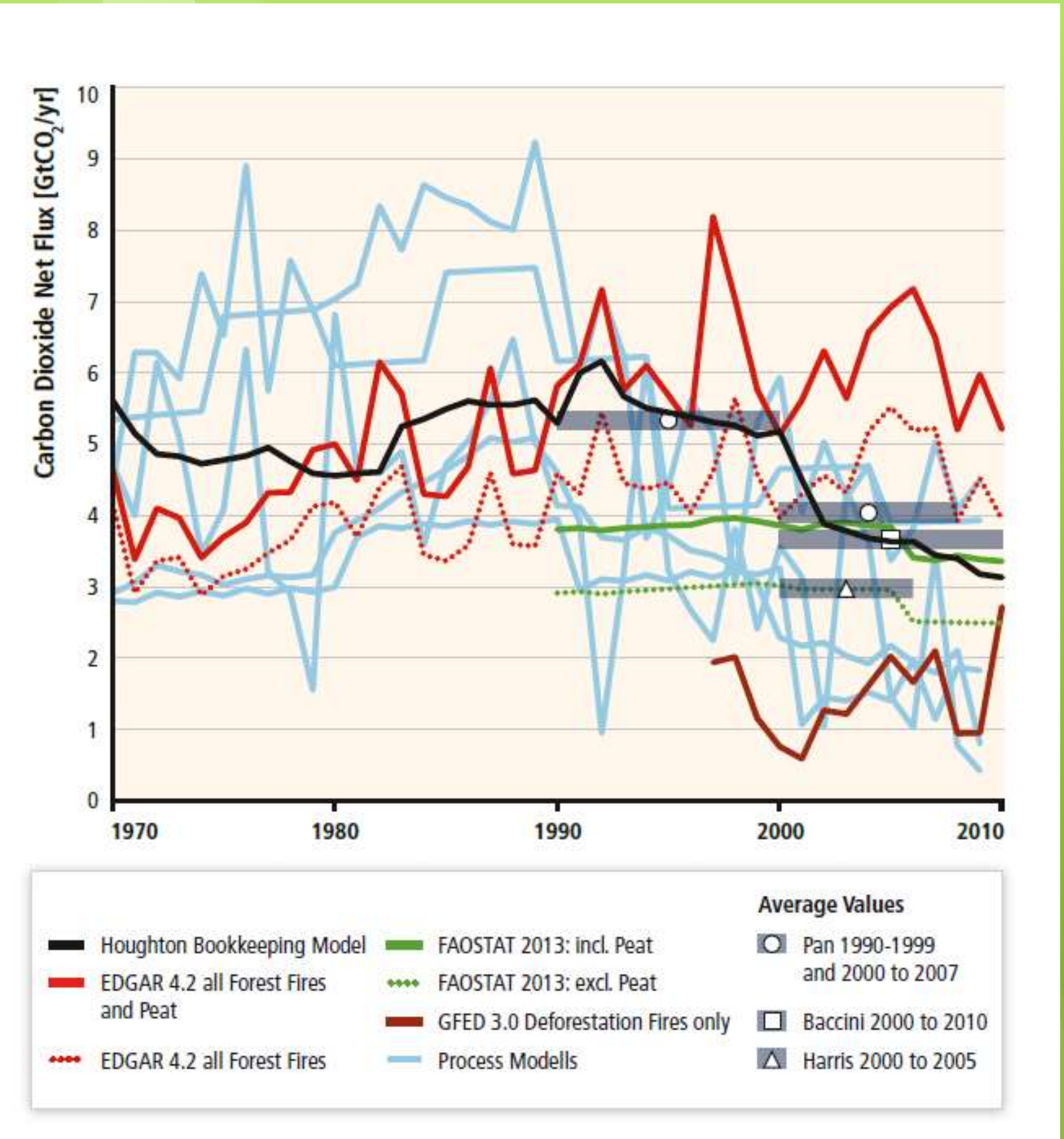
- Emission trends and drivers
- Mitigation technology options (supply-side)
- Infrastructure and systemic perspectives (demand-side options for mitigation)
- Climate change effects and interaction with adaptation (including vulnerability)
- Costs and potentials
- C-benefits, risks, and spillovers
- Barriers and opportunities
- Sectoral implications of transformation pathways and sustainable development
- Sectoral policies
- Bioenergy

Emission trends and drivers (agriculture)



- Global GHG emissions from agriculture comprise about 10-12% of total anthropogenic emissions (5.2-5.8Gt CO_2 eq/yr)
- Enteric fermentation and ag. soils – 70% of total GHG emissions from agriculture, followed by rice (9-11%), biomass burning (6-12%) and manure management (7-8%)
- Main drivers: increase in land area (+7% since 1970) and in number of animals (1.4 fold since 1970)
- Food availability per capita has risen by 18.4% since 1970

Emission trends and drivers (forestry and other land use, including land use change)



- Fluxes are dominated by CO_2, primarily emissions due to deforestation, but also uptake due to reforestation/regrowth.
- FOLU accounted for 1/3 of global anthropogenic CO_2 emissions for 1750-2011, and 12% for 2000-2009.
- Large range of global FOLU estimates due to large uncertainties
- All approaches agree on decline in FOLU CO_2 emissions in 2000s due to decreasing rates of deforestation

Supply-side mitigation options

Supply-side options: reduction of GHG emissions per unit of land/animal or per unit of product

- Forestry: decreasing deforestation, sustainable management of forests (extending rotation cycles), restoration of degraded forests, afforestation, wildfire protection – *with differences in their relative importance across regions* risk of non-permanence
- Croplands and grasslands: improved N efficiency, high C input (residues), optimal (reduced) N fertilizers rates and application management, inhibitors, reduced tillage, water management of rice fields and ag. peatlands, fire protection, no overgrazing, restoration of organic soils, biochar application risk of non-permanence
- Livestock: improved feed or dietary additives, improved breeds with higher productivity, optimal manure storage conditions and rotation time, anaerobic digests, low N-containing feed, inhibitors

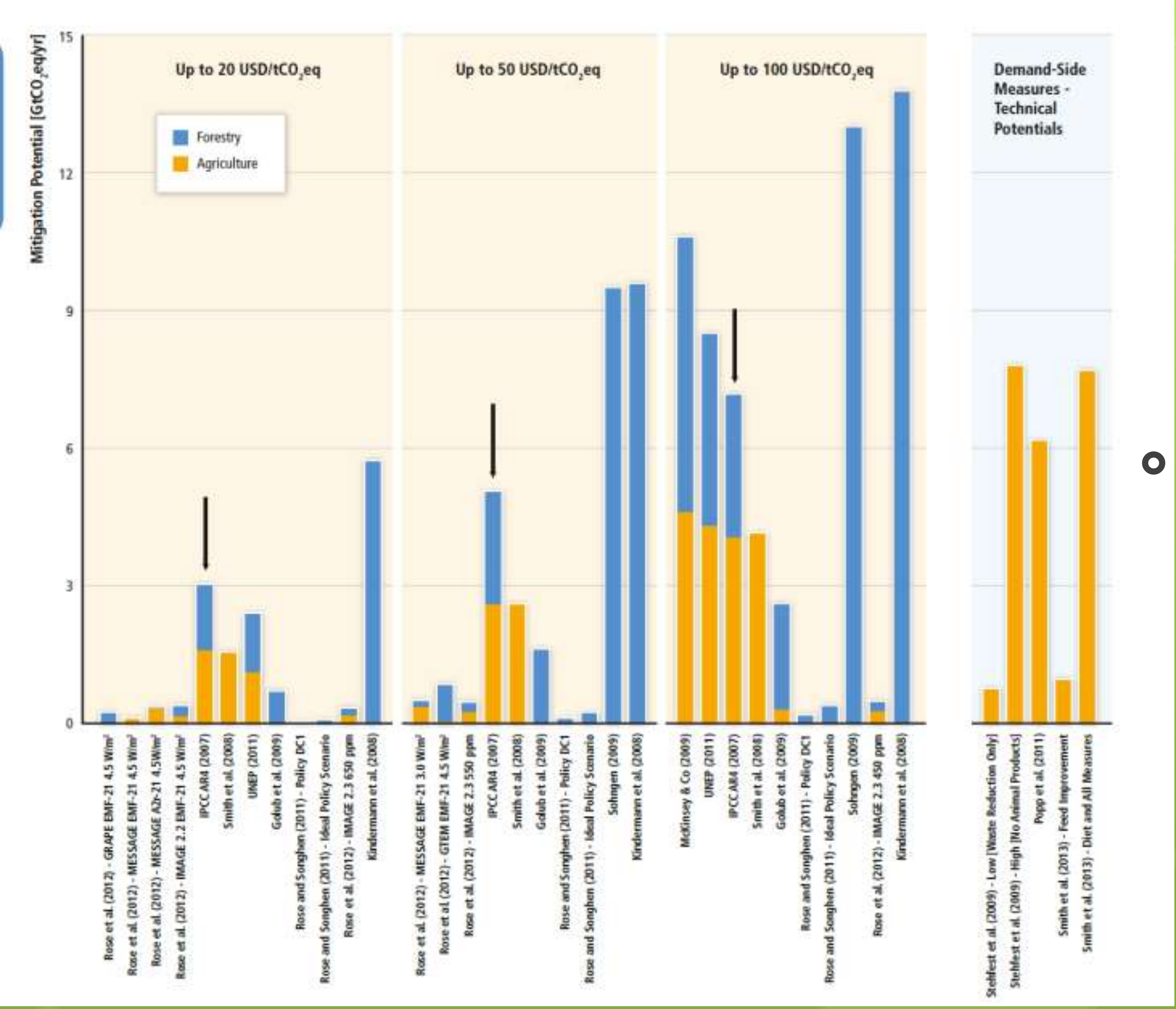
Demand-side mitigation options

- Competition for land-use may be affected by mitigation in AFOLU
  - In general reduced demand for AFOLU products decreases inputs (fertilizers, energy) and land demand
  - But: using land for C sequestration or bioenergy may result in the increase of land competition
- Reduced losses in food supply chain (globally 30-40% of produced food is lost)
- Changes in human diet towards to less emission-intensive products (more plant-based food instead of animal-based)
- Demand-side options related to wood and forestry (recycling of wood products, protection from illegal logging (certified forestry), use of by-products and wastes for energy)

Climate change effects and interaction with adaptation (including vulnerability)

- AFOLU activities can either reduce or accelerate climate change by affecting biophysical processes (e.g. evapotranspiration, albedo) and change in GHG fluxes to and from the atmosphere
- Some ecosystems may become a source instead of sink depending on its vulnerability and other disturbances (droughts, fires, etc.)
- Wetlands, peatlands and permafrost soils comprise extremely large C stocks – risk of C losses (increased peat decomposition and peatfires due to climate change, melting of permafrost)
- Adaptation options: mixed-species forests, species adapted to different temperature regimes, assisted natural regeneration, fire and insects protection, protecting areas, enriched biodiversity of agricultural ecosystems, soil moisture protection, etc.)
- Adaptation and mitigation synergies (e.g. reduced deforestation also result in maintaining of biodiversity, fire protection) and trade-offs (land competition)

Costs and potentials



- The economic mitigation potential of supply-side measures is estimated to be 7.2 to 11 $GtCO_2eq/yr$ in 2030 (consistent with carbon prices up to 100 \$/tCO_2 eq), about a third of which can be achieved at a <20 \$/tCO_2 eq (medium evidence, medium agreement).
- Demand-side measures, such as changes in diet and reductions of losses in the food supply chain, have a significant, but uncertain potential to reduce GHG emissions from food production (medium evidence, medium agreement). Estimates vary from roughly 0.76–8.6 $GtCO_2eq/yr$ by 2050

C-benefits, risks, and spillovers

- Implementation of AFOLU mitigation measures may result in a range of outcomes beyond changes in GHG balances: positive (co-benefits) and adverse (implying risk)
- The same measure in different areas (countries) may result in different outcomes and may affect:
  - Food security (intensification of production but decrease of ag. area)
  - Water resources
  - Biodiversity
  - Land availability
  - N pollution
  - Desertification
  - Land tenure and land-use rights

Barriers and opportunities

- Recognize different circumstances among countries
- Socio-economic barriers and opportunities
  - Financing
  - Poverty
  - Social acceptance
- Institutional barriers and opportunities
  - Clear land tenure and land-use rights
  - Institutional capacity
- Ecological barriers and opportunities (availability of land and water, vulnerability)
- Technological barriers and opportunities (limitations in generating and applying science and technology knowledge)

Sectoral implications of transformation pathways and sustainable development

- Some mitigation measures may require large-scale transformations in human societies, in particular in the energy sector and the use of land resources.
- Coordination between mitigation activities is needed (bioenergy incentives and forest protection policy)
- Coordination of mitigation activities over time (fragmented of delayed forest protection policy could accelerate deforestation)
- The type of incentive structure has implications
  - International land-related mitigation projects currently considered as high risk investments (depends on price of CO_2)
  - Voluntary markets – may provide base for mitigation activities in agriculture and forestry

Sectoral policies

- Policies governing agricultural practices and forest conservation and management are more effective when involving both mitigation and adaptation.
- Some mitigation options in the AFOLU sector (such as soil and forest carbon stocks) may be vulnerable to climate change (medium evidence, high agreement).
- When implemented sustainably, activities to reduce emissions from deforestation and forest degradation (REDD+ is an example designed to be sustainable) are cost-effective policy options for mitigating climate change, with potential economic, social and other environmental and adaptation co-benefits (e.g., conservation of biodiversity and water resources, and reducing soil erosion) (limited evidence, medium agreement).

Bioenergy

- Bioenergy can play a critical role for mitigation, but there are issues to consider, such as the efficiency of bioenergy systems (robust evidence, medium agreement)
- Barriers to large-scale deployment of bioenergy include concerns about GHG emissions from land, food security, water resources, biodiversity conservation and livelihoods.
- Land-use competition effects of specific bioenergy pathways remain unresolved.
- There are options with low lifecycle GHG emissions within bioenergy technologies (e.g., sugar cane, Miscanthus, fast growing tree species, and sustainable use of biomass residues); outcomes are site-specific and rely on efficient integrated 'biomass-to-bioenergy systems', and sustainable land-use management and governance.

Thank you!