Tensions between climate change adaptation and mitigation and production of agricultural biomass and food

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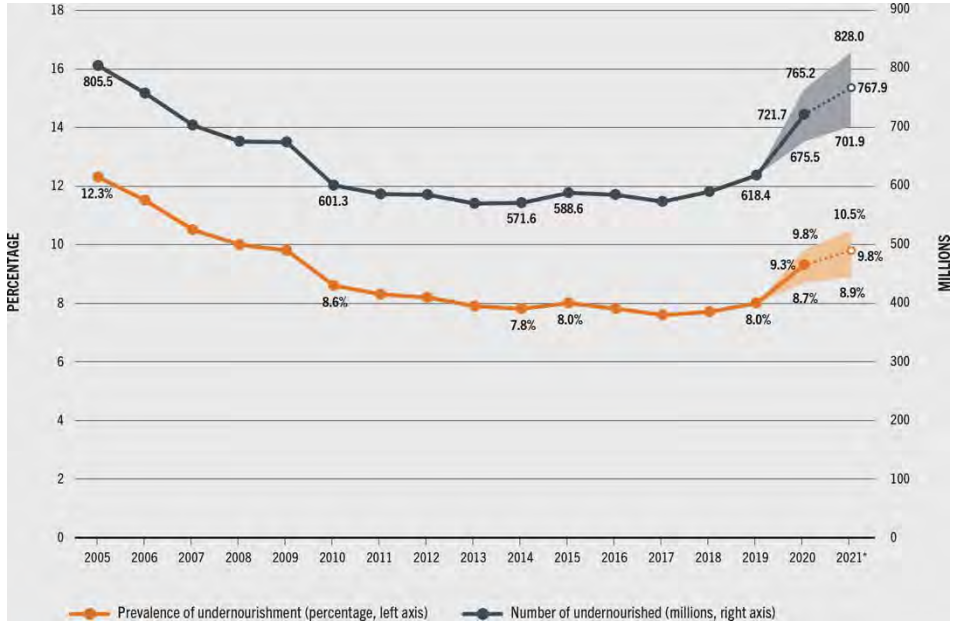
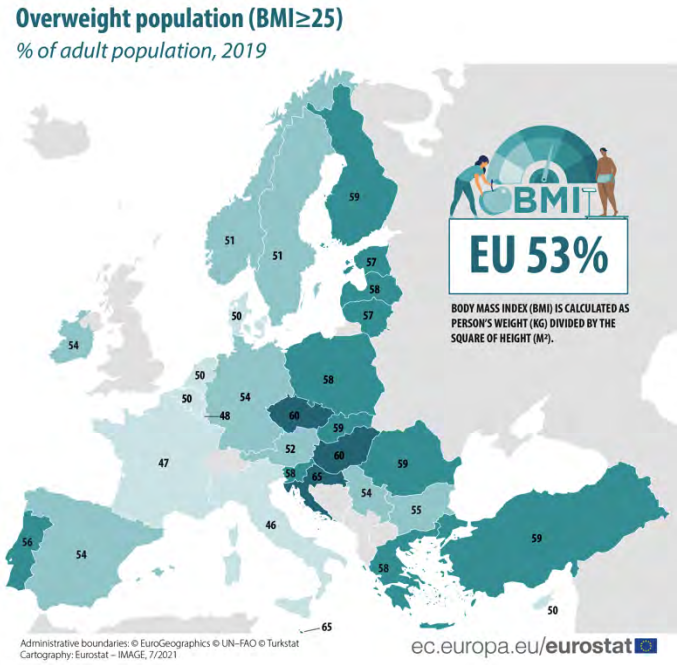
EURAGRI webinar - 06 March 2023
Reflections on COP27: outcomes, challenges, and new issues for european agri-food research and policy

Food security and nutrition

- Between 700 and 830 million people in the world are facing hunger.
- Increase trend since 2014.
- ≈ 2 billion people with a deficiency => vit. A, vit. B9, Fe, I, Zn…
- Growing impacts of obesity and unhealthy diet-associated non-communicable diseases.



(https://www.fao.org/3/cc0639en/online/sofi-2022/)

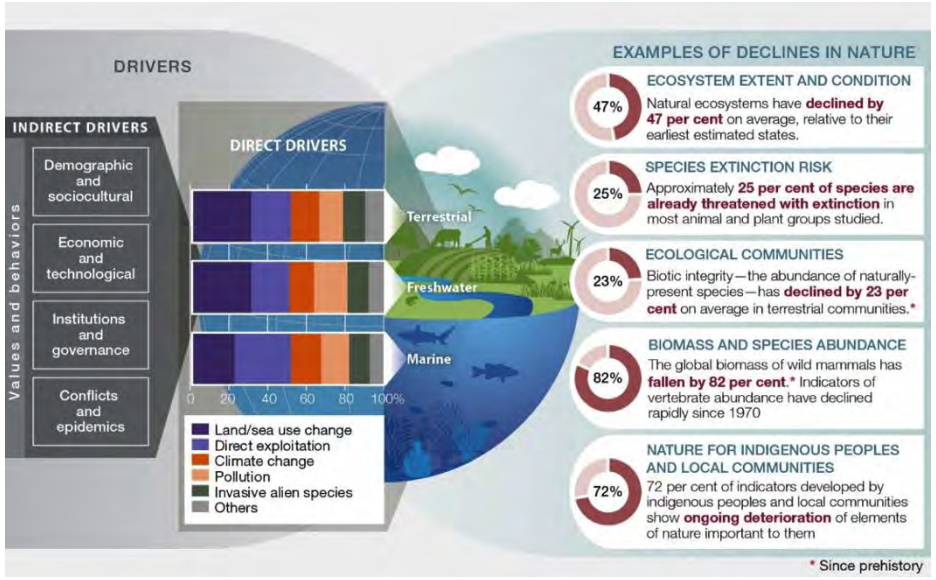


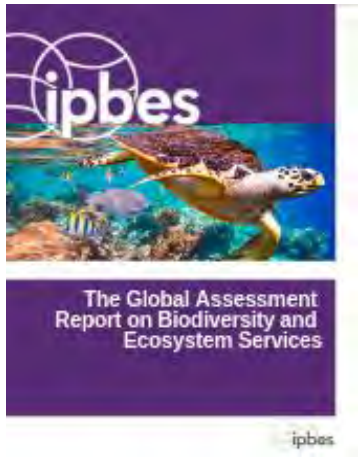
(https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210721-2)

=> How to sustainably feed >10 billion people in 2050?

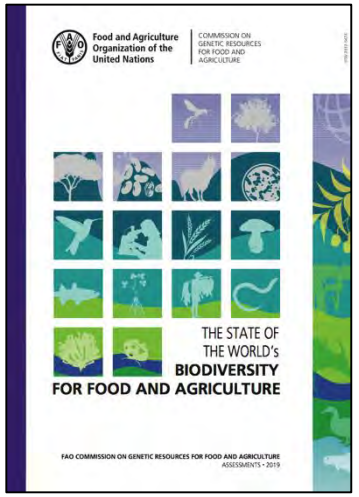
Biodiversity

- Land use and agriculture are among the main drivers of biodiversity erosion (IPBES, 2019).
- Many key components of planned diversity are in decline; the proportion of animal breeds at risk of extinction is increasing and crop diversity is decreasing (FAO, 2019).
- Many hotspots of agrobiodiversity and crop wild relatives are also under threat or not formally protected; the conservation status of wild relatives of domesticated livestock has also deteriorated (FAO, 2019; IPBES, 2019).

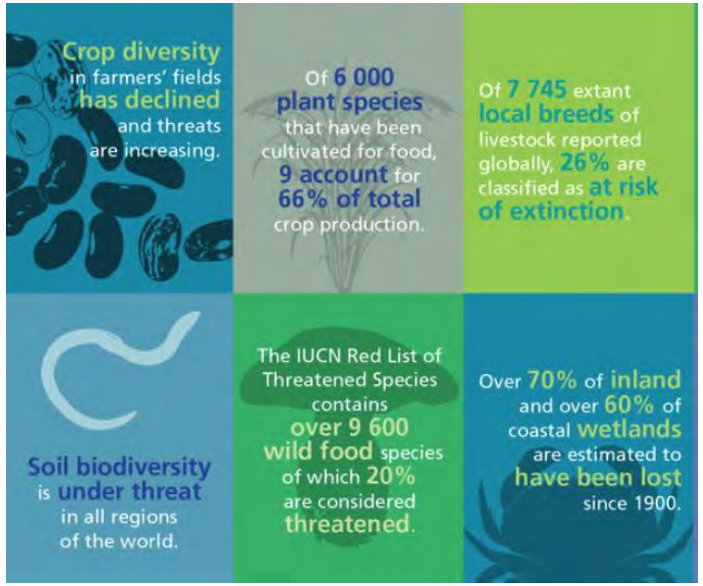




(IPBES, 2019)



(FAO, 2019)

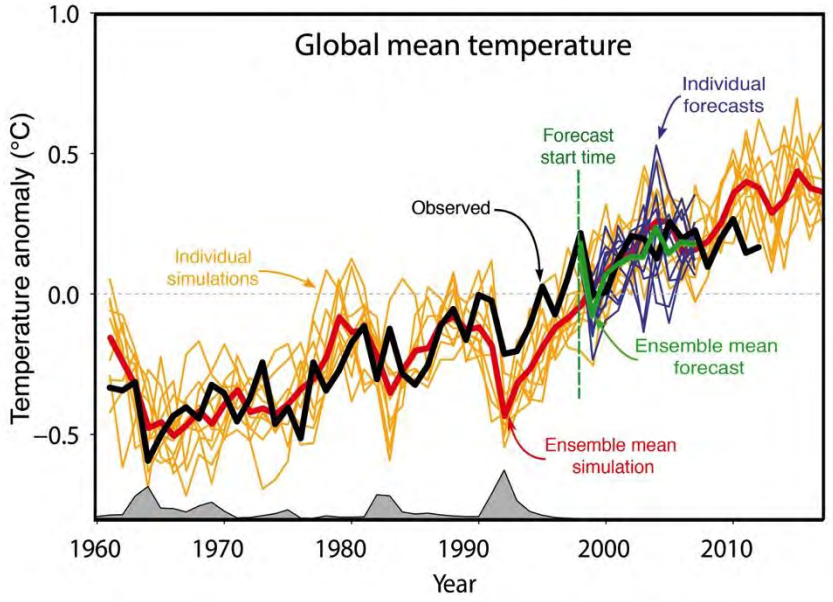


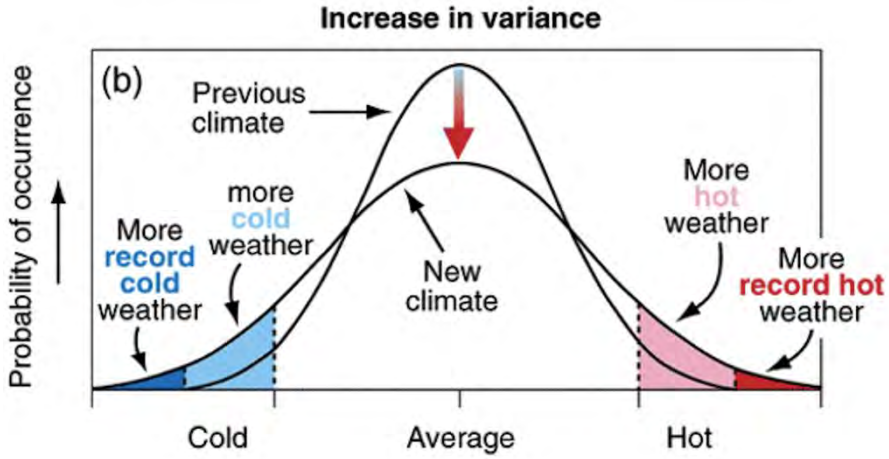
Climate change

1 Trends

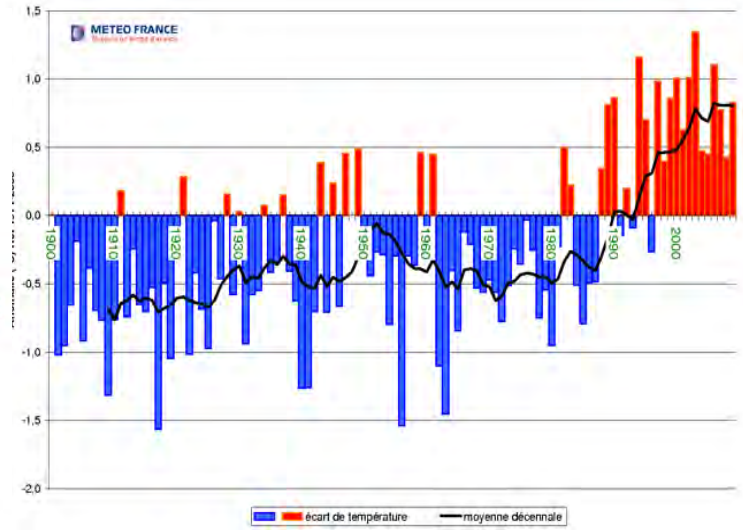
2 Extreme events

3 Seasonal and inter-annual variability

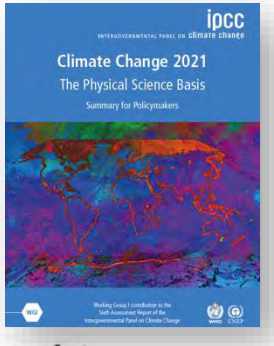




(IPCC, 2001)



Examples of current consequences of climate change



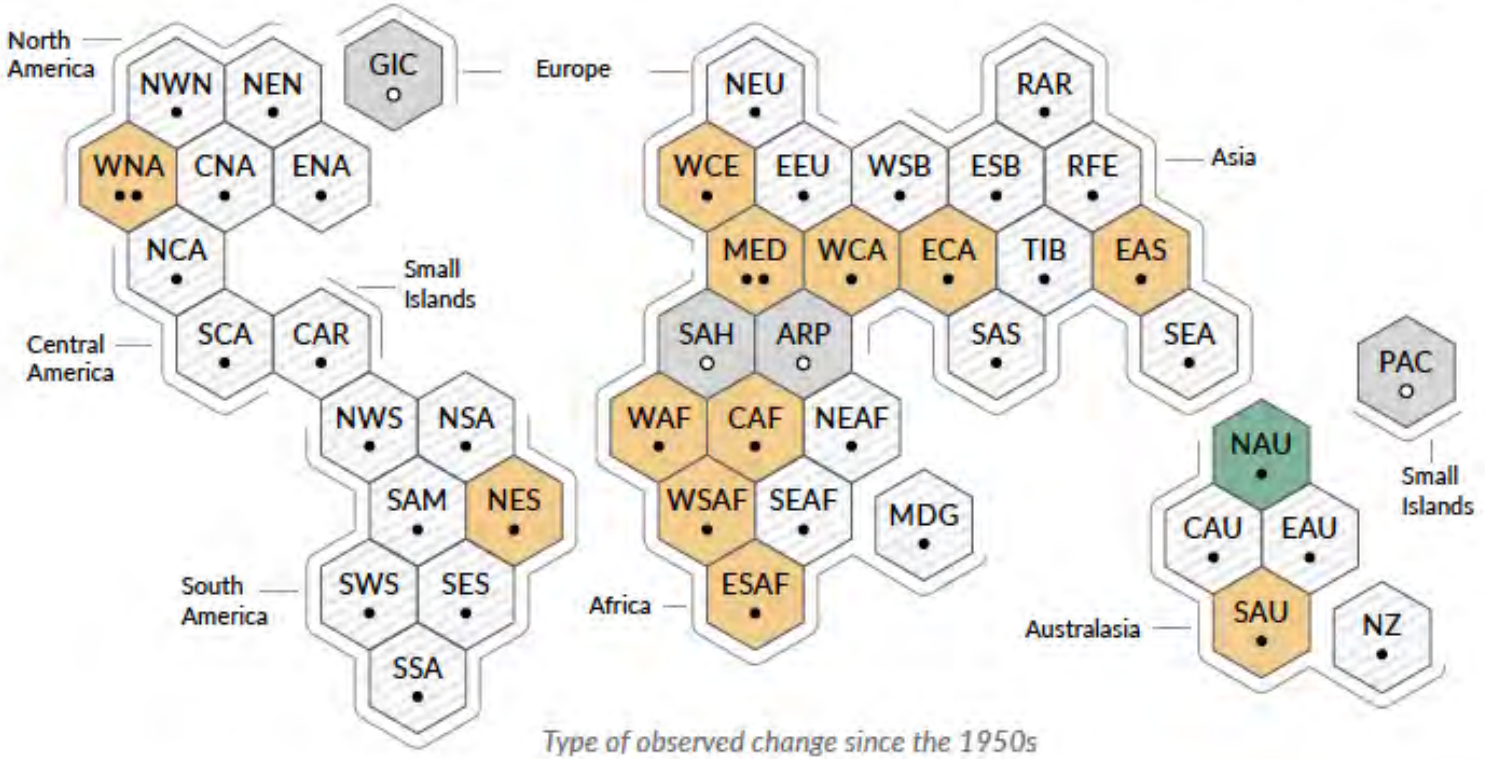
c) Synthesis of assessment of observed change in **agricultural and ecological drought** and confidence in human contribution to the observed changes in the world's regions

Type of observed change in agricultural and ecological drought

- Increase (12)
- Decrease (1)
- Low agreement in the type of change (28)
- Limited data and/or literature (4)

Confidence in human contribution to the observed change

- ●●● High
- ●● Medium
- ● Low due to limited agreement
- ○ Low due to limited evidence

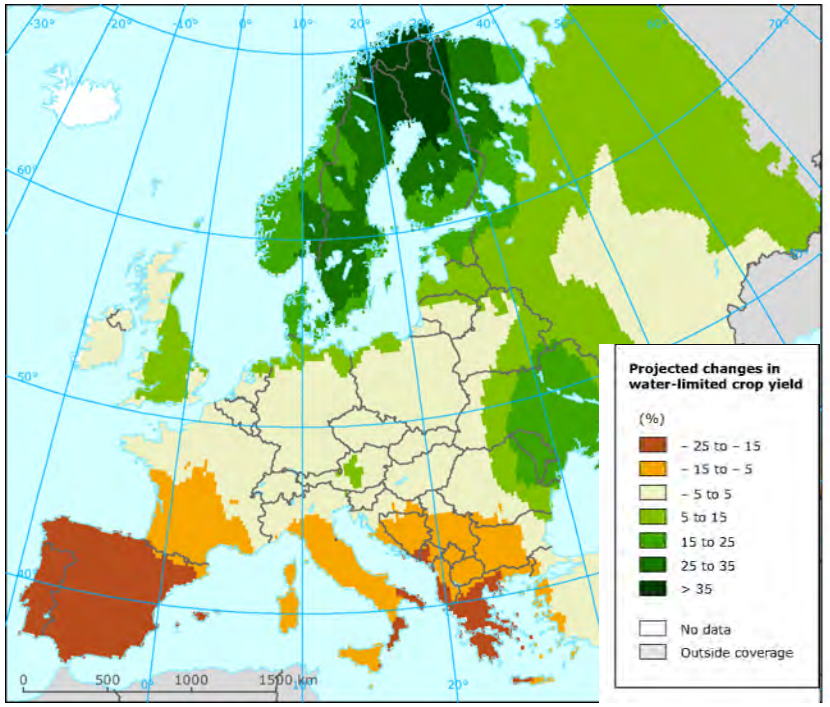


Type of observed change since the 1950s

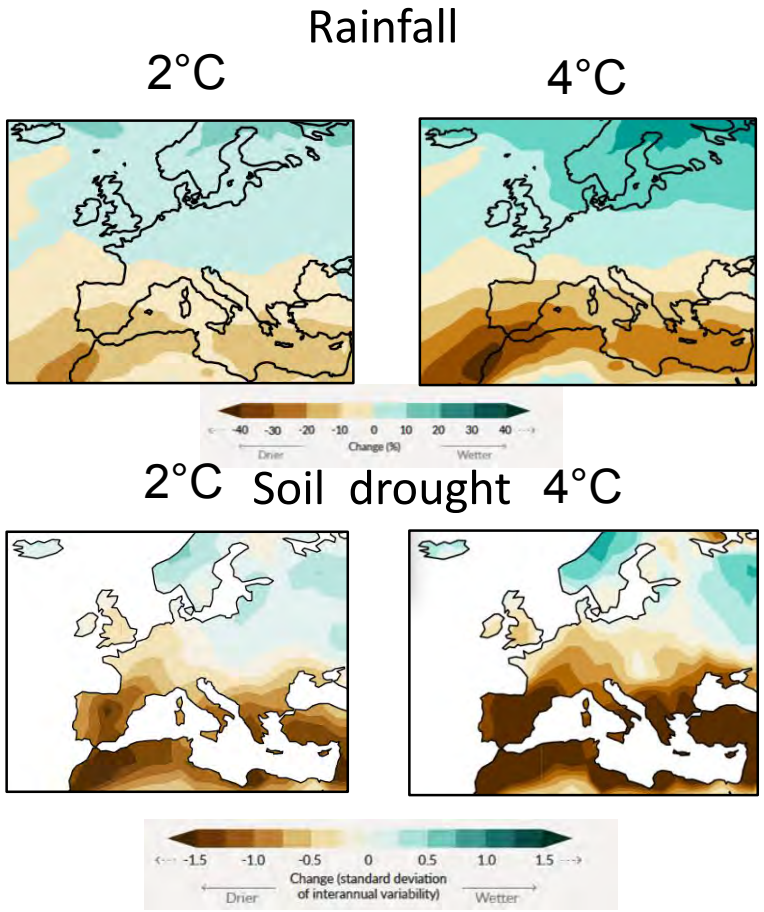
(IPCC AR6 WG1, SPM, 2021)

An expected reinforcement of impacts

- Few opportunities
- Weather extremes (T°, drought, flooding)
- Changes in phenology
- Crop yield stagnation/decrease
- Increased pest pressure
- Changes in product quality
- Loss of land value



(EEA, 2017)



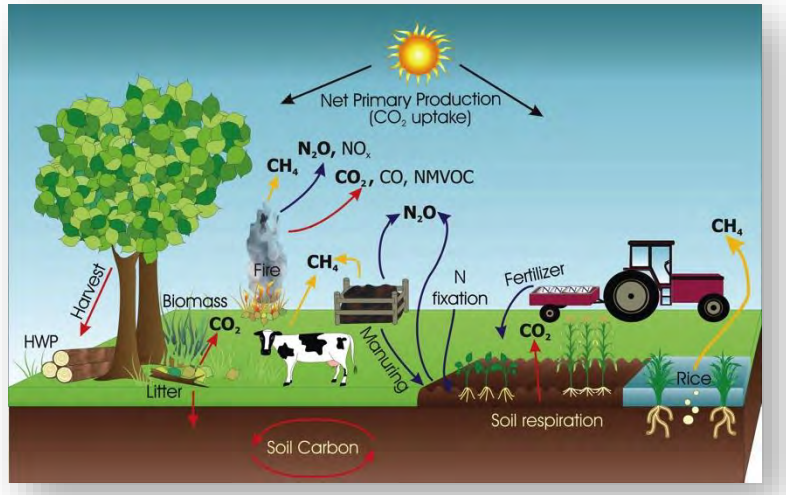
(IPCC AR6 WG1, SPM, 2021)

=> Climate change poses a growing threat to food production

=> Strong actions needed for mitigation <u>and</u> adaptation

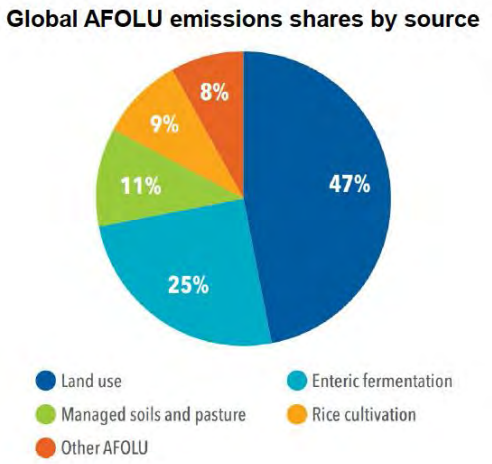
Food systems contribution to climate change

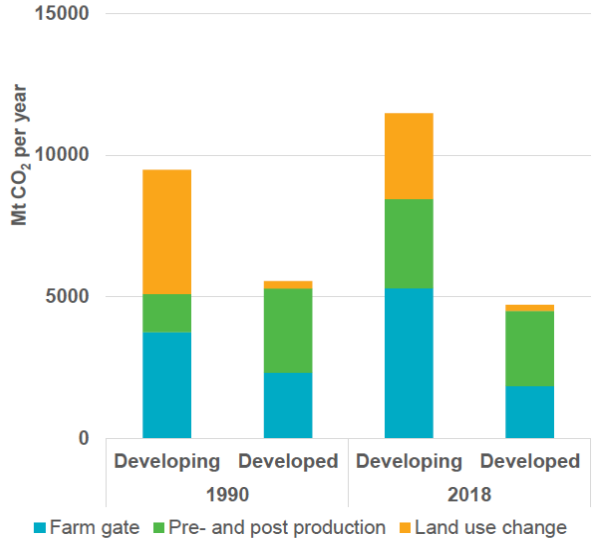
- More than 33% of total GHG emissions
- ≈ 21% from agriculture, forestry and other land use (AFOLU)
- Rising contribution from developing countries
- Potential of AFOLU to become a net emission sink



(IPCC, 2006)

=> Strong actions needed for mitigation



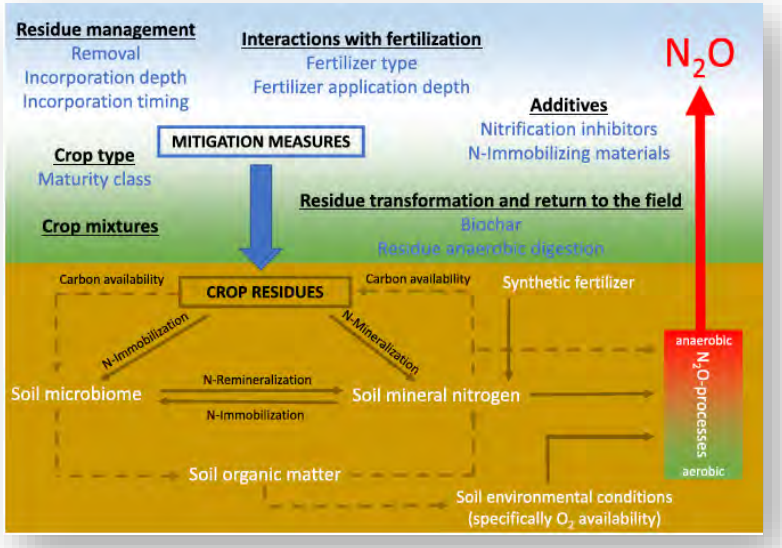


(IFPRI, 2022; https://doi.org/10.2499/9780896294257)

Mitigation(1/2): reducing agriculture GHG emissions

- **CO_2** : development of renewable energies, until complete decarbonization of the energy consumed by the sector in 2050…
- **CH_4** : improved manure management; limitation of enteric fermentation via animal feed additives (e.g., 3-NOP, extruded linseed, algae, etc.) and genetic selection...
- **N_2O** : decrease in nitrogen input to crops; use of organic fertilizers instead of mineral fertilizers; improved crop residue management; use of nitrification inhibitors; reduction of protein contents in livestock rations; legumes development…

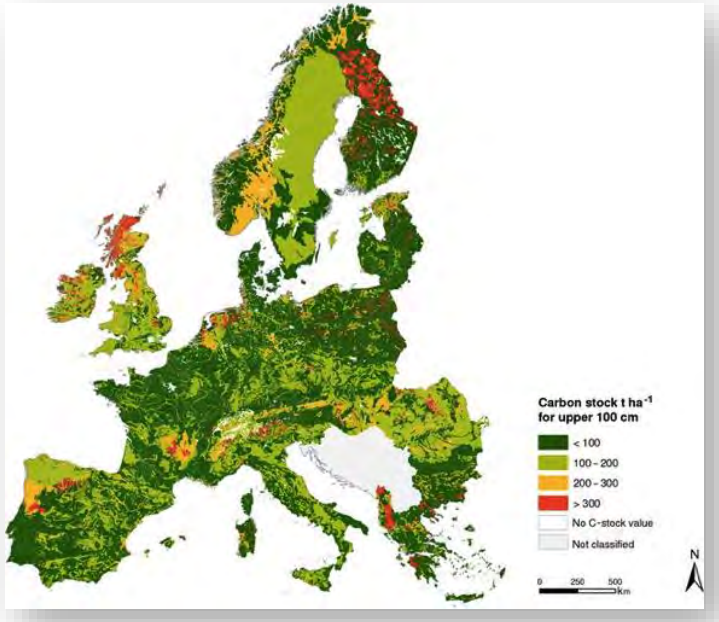
=> food/non food competition



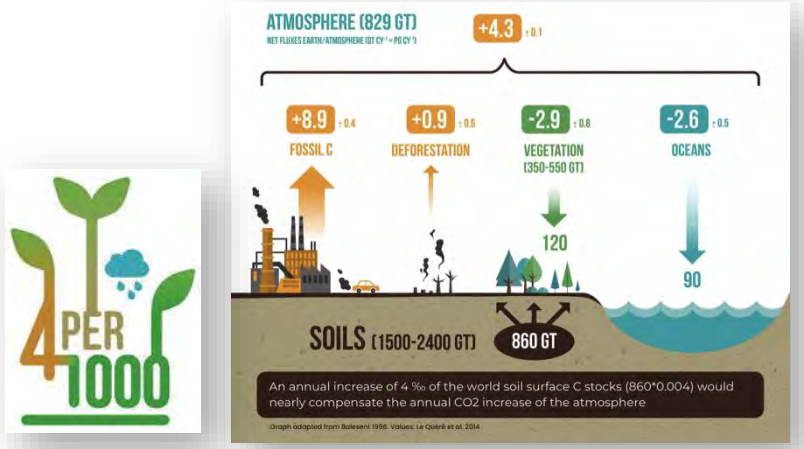
(Abalos *et al.*, 2022)

Mitigation(2/2): increasing carbon sequestration is soils

- AFOLU is the only economic sector with serious potential to become a net emissions sink, i.e., pulling more GHGs out of the atmosphere than it emits though carbon storage in biomass and **soils**
- Examples of soil organic carbon sequestration practices :
  - Cover/intermediary/associated crops
  - Nourishing soils with manure and compost
  - Reduced tillage
  - Agroforestry/hedges
  - Biochar
  - …
- EU and international initiatives: 4 per 1000, CIRCASA and ORCASA, IRC on soil carbon…

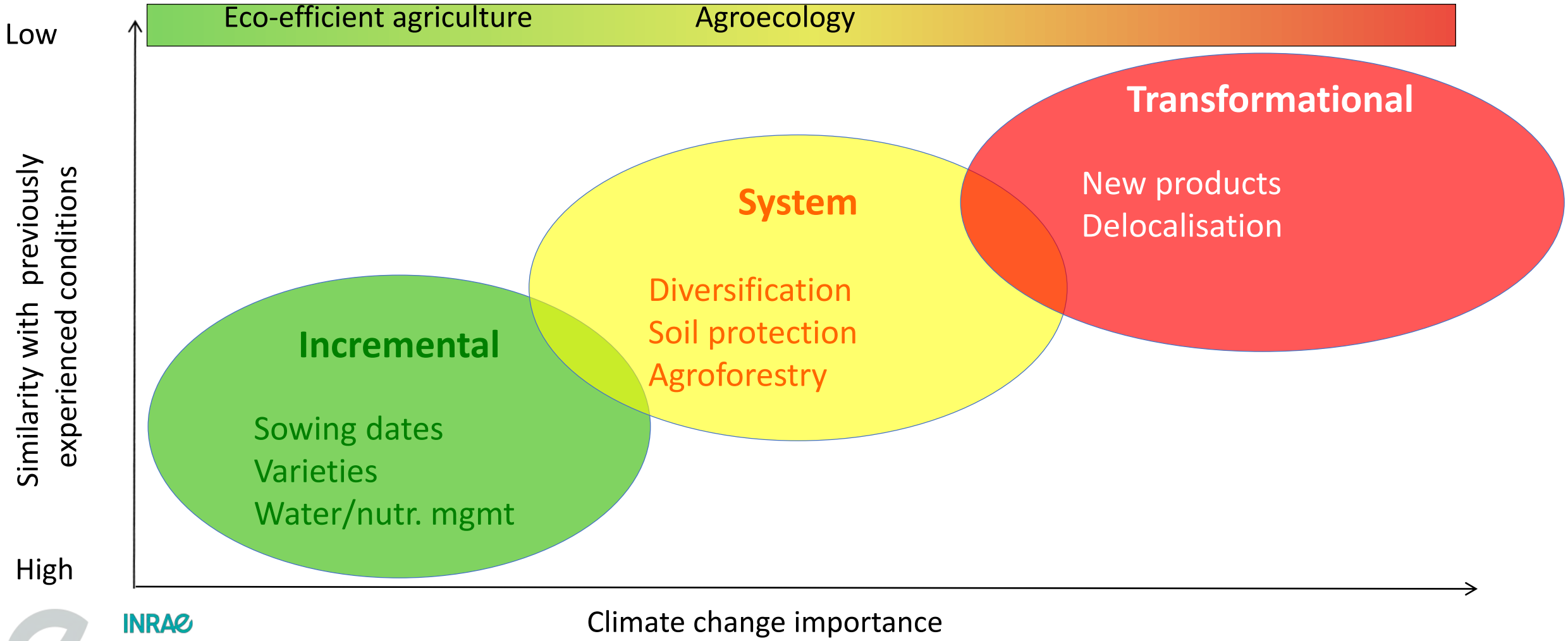


(Kristensen *et al.*, 2019)



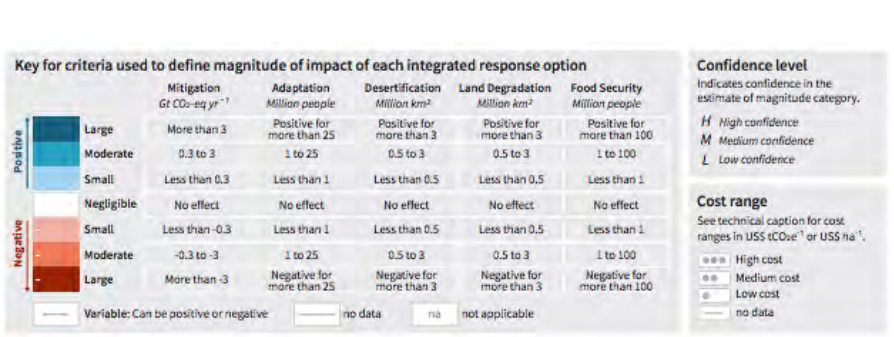
(https://4p1000.org/)

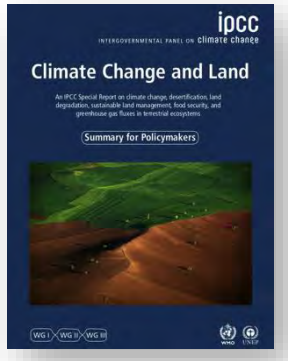
Nature and forms of CC adaptation in agriculture



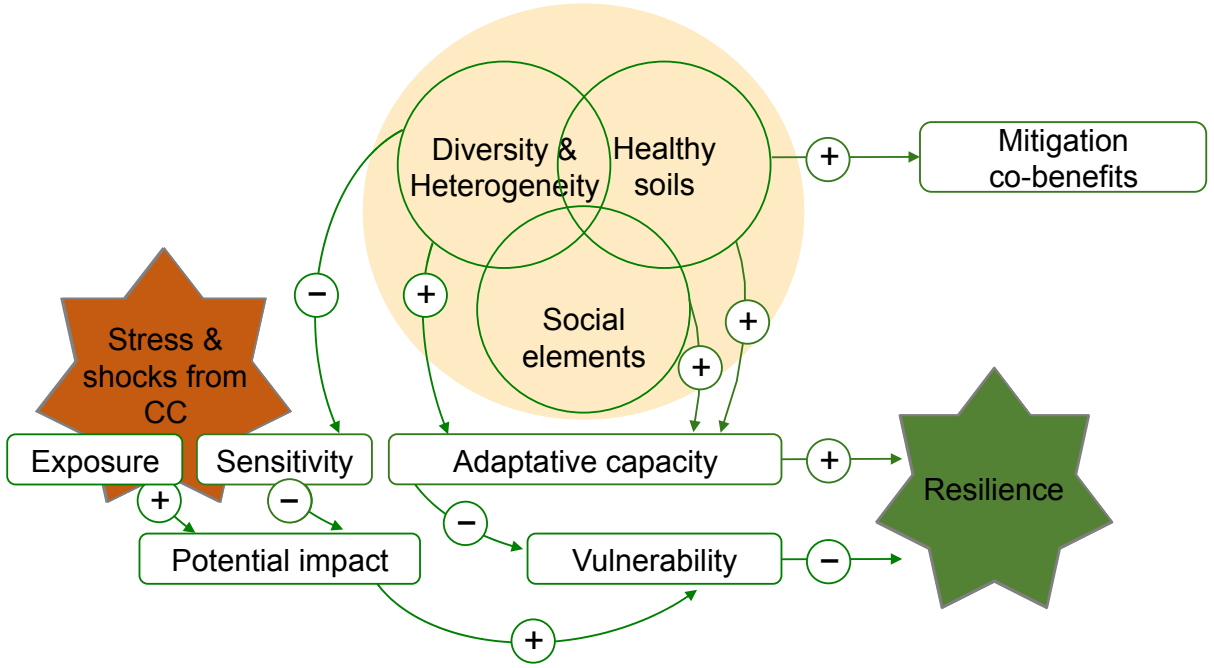
Fostering synergies and increasing resilience

Response options based on land management		Mitigation	Adaptation	Food Security	Cost
Agriculture	Increased food productivity	L	M	H	—
	Agro-forestry	M	M	L	●
	Improved cropland management	H	L	L	●●
	Improved livestock management	M	L	L	●●●
	Agricultural diversification	L	L	L	●
	Improved grazing land management	H	L	L	—
	Integrated water management	L	L	L	●●
	Reduced grassland conversion to cropland	L	—	L	●
Forests	Forest management	H	L	L	●●
	Reduced deforestation and forest degradation	H	L	L	●●
Soils	Increased soil organic carbon content	H	L	L	●●
	Reduced soil erosion	L	L	L	●●
	Reduced soil salinization	—	L	L	●●
	Reduced soil compaction	—	L	L	●
Other ecosystems	Fire management	M	M	L	●
	Reduced landslides and natural hazards	L	L	L	—
	Reduced pollution including acidification	L	M	L	—
	Restoration & reduced conversion of coastal wetlands	M	L	L	—
	Restoration & reduced conversion of peatlands	H	—	L	●
Response options based on value chain management					
Demand	Reduced post-harvest losses	H	M	H	—
	Dietary change	H	—	H	—
	Reduced food waste (consumer or retailer)	H	—	M	—
Supply	Sustainable sourcing	—	L	L	—
	Improved food processing and retailing	L	L	L	—
	Improved energy use in food systems	L	L	L	—
Response options based on risk management					
Risk	Livelihood diversification	—	L	L	—
	Management of urban sprawl	—	L	L	—
	Risk sharing instruments	L	L	L	●●





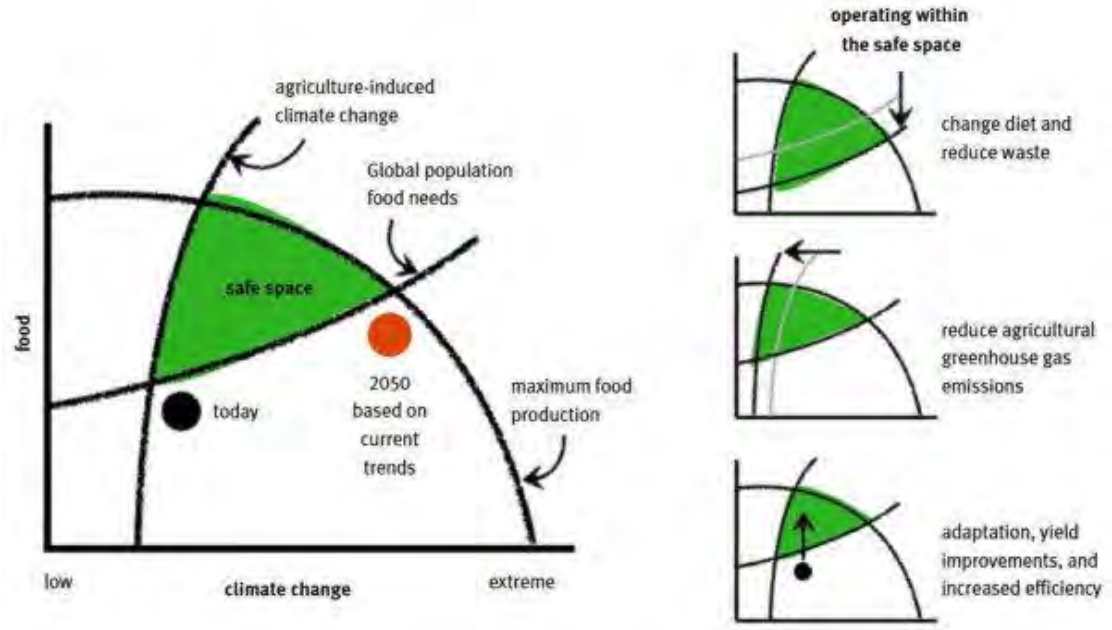
(https://www.ipcc.ch/site/assets/uploads/sites/4/2022/11/SRCCL_SPM.pdf)



(after FAO, 2020)
http://www.fao.org/3/cb0438en/CB0438EN.pdf

A safe operating space for food and climate system?

- A safe operating space is needed, that provides adequate food and nutrition for everyone without crossing critical environmental thresholds.
- Feeding 10 billion people sustainably by 2050 requires closing three gaps (WRI, 2019):
  - A 56 percent food gap between crop calories produced in 2010 and those needed in 2050 under “business as usual” growth;
  - A 593 million-hectare land gap between global agricultural land area in 2010 and expected agricultural expansion by 2050;
  - An 11-gigaton yearly GHG emission gap between expected agricultural emissions in 2050 and the target level needed to hold global warming below 2°C.

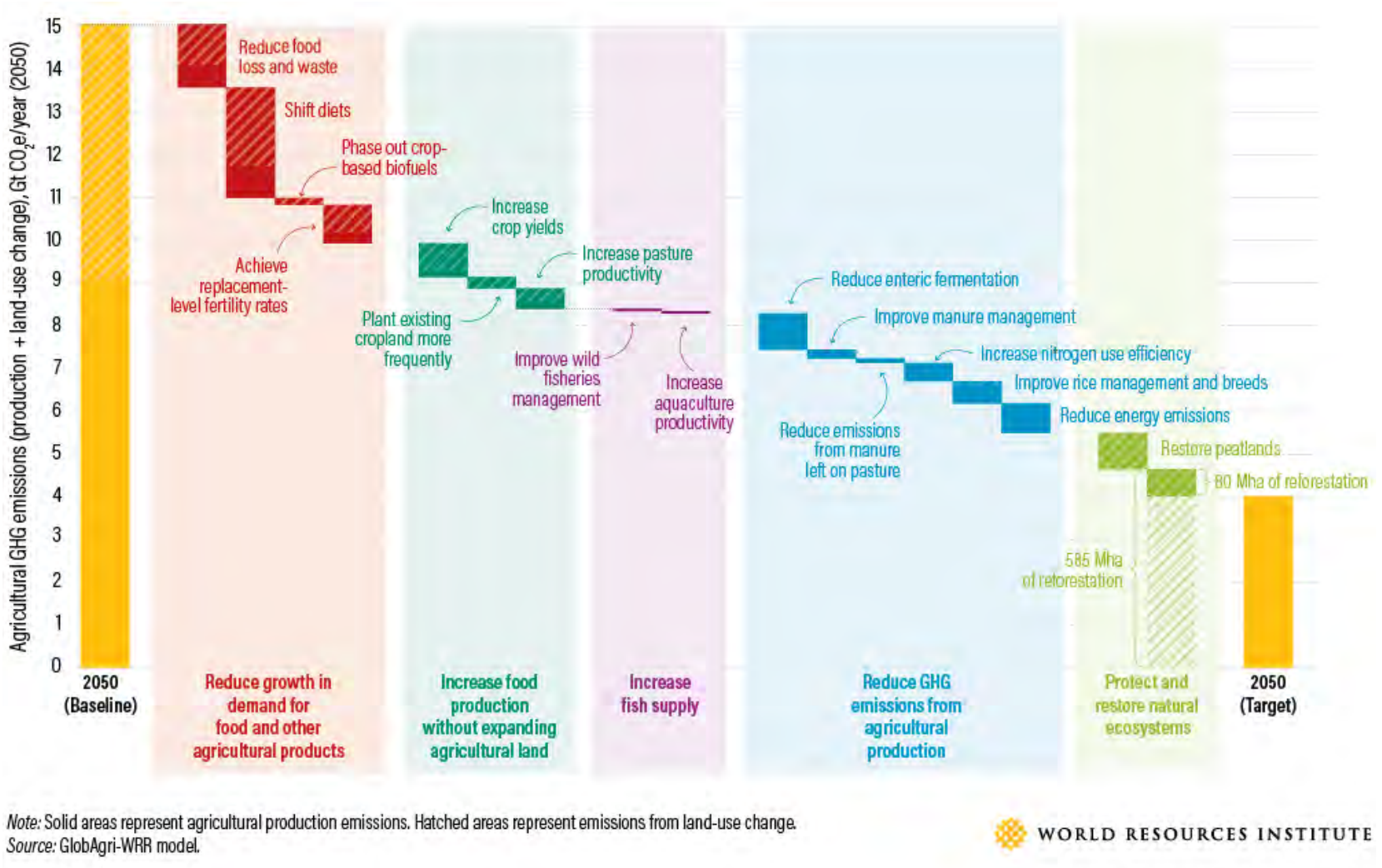


(Beddington *et al.*, 2012; http://www.agricultureandfoodsecurity.com/content/1/1/10)

(WRI, 2019 ; https://research.wri.org/wrr-food)

Solutions for a sustainable food future (after WRI, 2019)

1. Reduce growth in demand for food and other agricultural products.
2. Increase food production without expanding agricultural land.
3. Increase fish supply.
4. Reduce GHG emissions from agricultural production.
5. Protect and restore natural ecosystems.



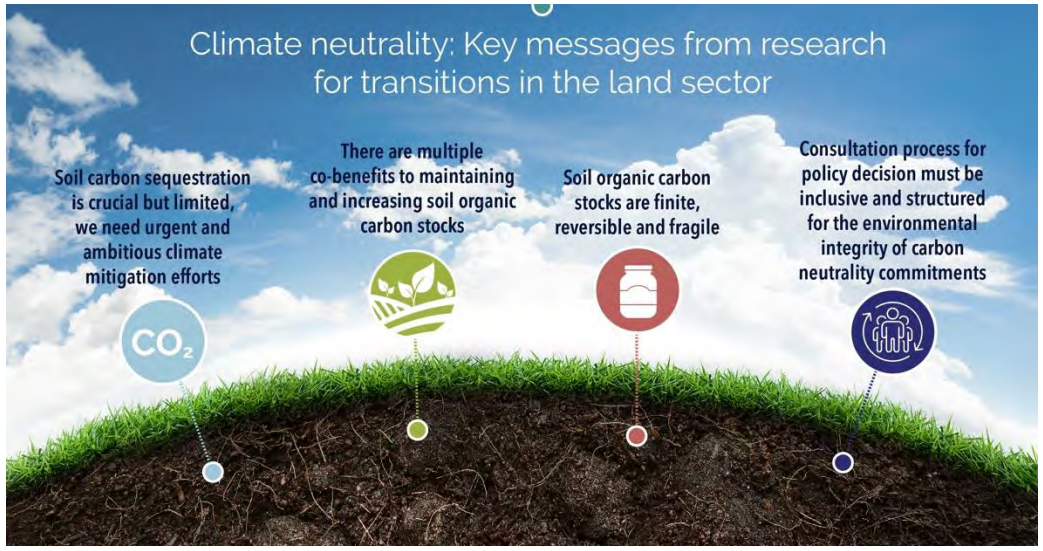
Note: Solid areas represent agricultural production emissions. Hatched areas represent emissions from land-use change.
Source: GlobAgri-WRR model.

WORLD RESOURCES INSTITUTE

(https://www.wri.org/insights/how-sustainably-feed-10-billion-people-2050-21-charts)

Messages from INRAE, IRD and CIRAD delivered at COP27

- Messages to reach carbon neutrality



- Messages for sustainable land-use transitions => getting out of the land sharing/land sparing debate

(https://www.inrae.fr/en/news/after-cop27-where-are-we-climate-change-and-land)

Conclusion and perspectives

- Mutually compatible strategies for food system are urgently required that address:
  - Sustainable food production
  - Renewable energy production
  - Climate change mitigation
  - Climate change adaptation
  - Biodiversity conservation
  - Sustainable use of natural resources

- In depth transformation is needed to foster resilience to shocks of different nature.
- Multiple options should be combined.
- Maintaining capacity for adaptation, learning and transformation at the heart of resilience.

Thank you for your attention