Bioeconomy Workshop, Toulouse, November 19, 2019

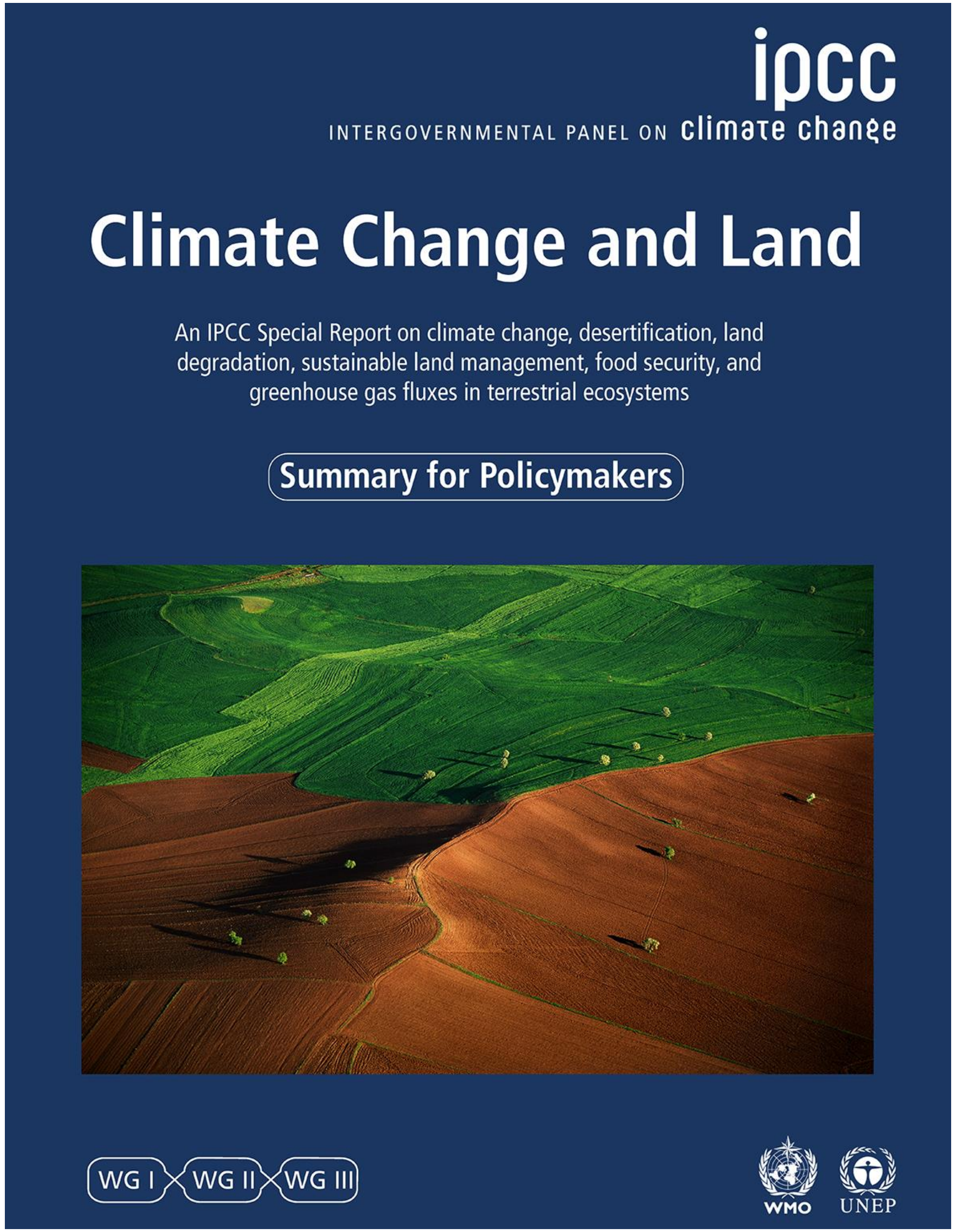
Climate change, land degradation and the sustainable production of bioresources

Jean-François Soussana

INRA, Paris, France

CLIMATE CHANGE AND LAND

An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems.



REPORT COVER IMAGE:
Agricultural landscape between Ankara and Hattusha, Anatolia, Turkey (40°00' N – 33°35' E)
©Yann Arthus-Bertrand | **www.yannarthusbertrand.org** | **www.goodplanet.org**

The report outline proposed by the scoping meeting was agreed, after some refinement, by the Panel

1: Framing and context

2: Land-climate interactions

3: Desertification

4: Land degradation

5: Food security

6: Interlinkages between desertification, land degradation, food security and GHG fluxes: Synergies, trade-offs and integrated response options

7: Risk management and decision making in relation to sustainable development

Report Structure

Land provides the basis for human livelihoods and well-being.

- Warming over land has occurred at a faster rate than the global mean.
  - *1.53°C Higher over 2006–2015.*
- Current use of land and loss of biodiversity are unprecedented in human history.
  - *Climate change will add to these challenges.*
- Urgent action would buffer the negative impacts from over-exploitation of resources.
- Restricting warming to "well below 2°C" would greatly reduce the negative impacts of climate change on land.

INTERGOVERNMENTAL PANEL ON climate change

Emissions and Land

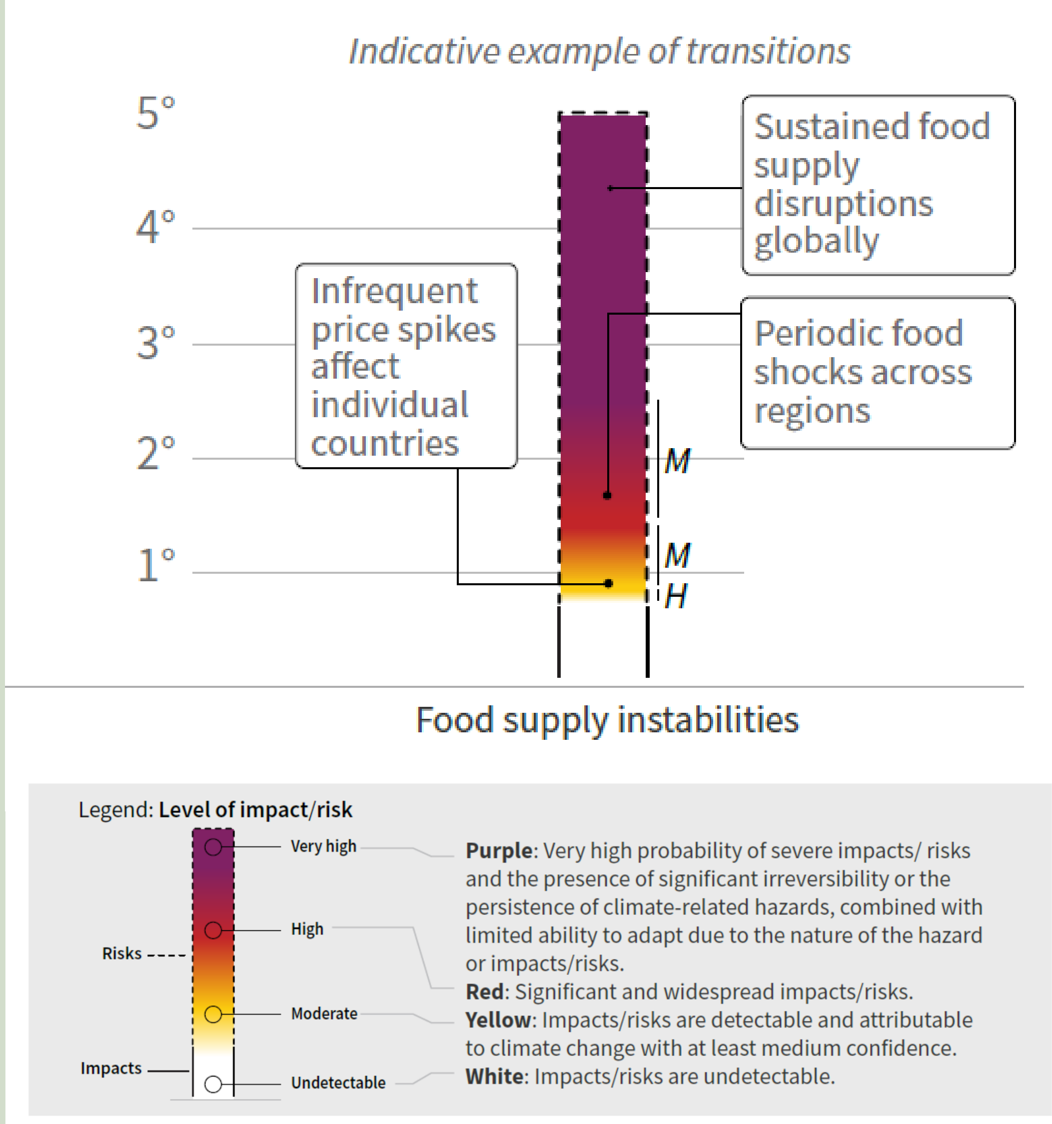
- Gross emissions from AFOLU make up **23% of total global emissions**.
- Land accounts for **44% of net anthropogenic methane** emissions.
- **50% of the nitrogen applied** to agricultural land is **not taken up** by the crop, resulting in nitrous oxide emissions.
- Grazing lands are responsible for more than one-third of total anthropogenic nitrous oxide emissions and one-half of agricultural emissions.

Climate change has already affected food security

- **In many lower latitude regions, yields of some crops (e.g. maize and wheat) have declined, while in many higher-latitude regions yields of some crops (e.g. sugar beet) have increased over recent decades**
- **Climate change has reduced animal growth rates and productivity in pastoral systems in Africa**
- **There is robust evidence that agricultural pests and diseases have already responded to climate changes, resulting in both increases and decreases of infestations**

IPCC, SR CCL, SPM, 2019

Risks to food supply stability as a result of climate change



The stability of food supply is projected to decrease as the magnitude and frequency of extreme weather events that disrupt food chains increases

Increased atmospheric CO_2 levels can also lower the nutritional quality of crops

Median economic models project a 7 % increase in food prices due to climate change by 2050 leading to increased risks of food insecurity

The most vulnerable people will be more severely affected

Increased warming may amplify migration both within countries and across borders

INTERGOVERNMENTAL PANEL ON climate change

IPCC, SR CCL, SPM, 2019

Significant mitigation potential for response options in the global food system

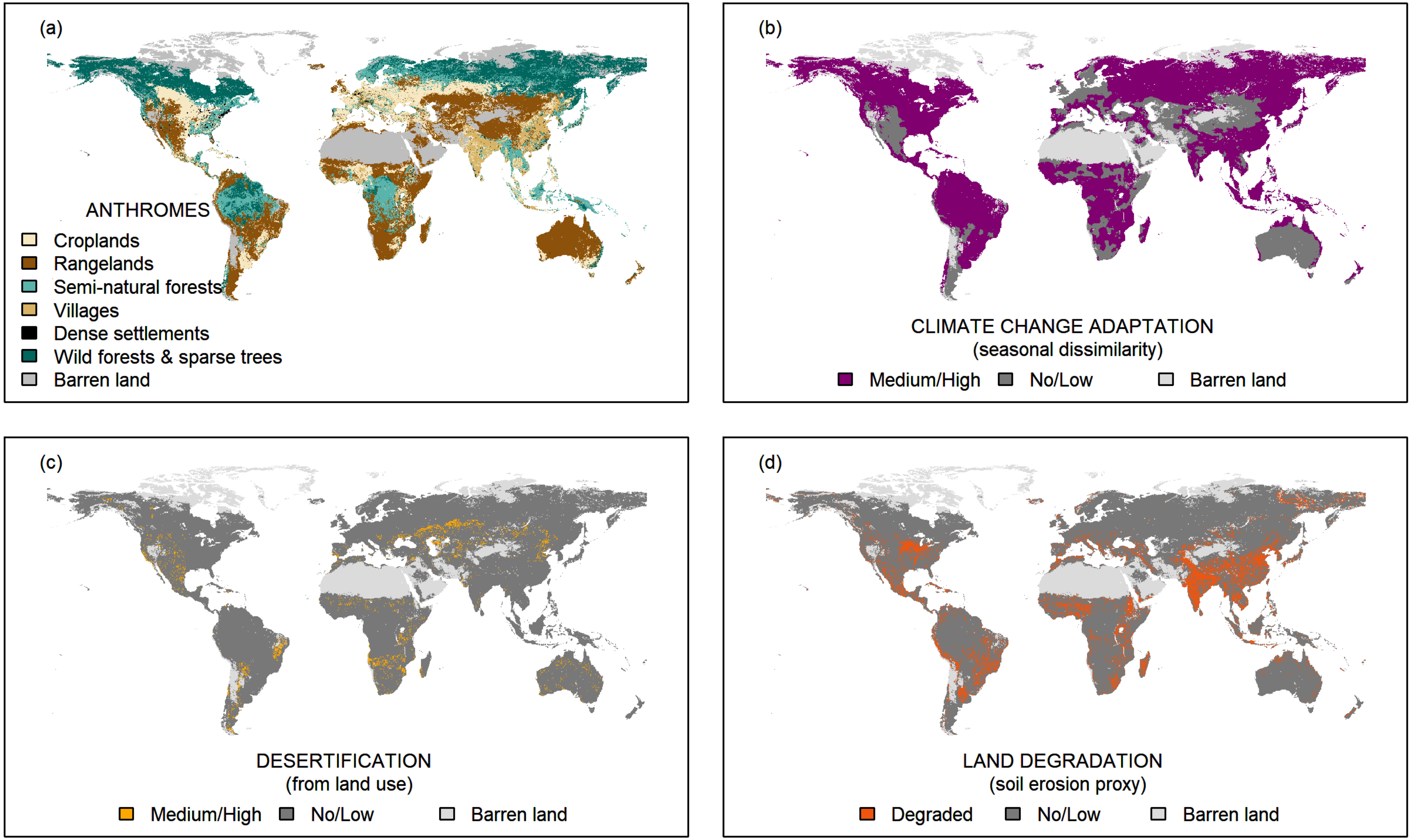
Emissions from the global food system are estimated to be 21-37% of total net anthropogenic GHG emissions

Response options across the entire food system, from production to consumption, including food losses and wastes, can be deployed and scaled up to support adaptation and mitigation

A number of agricultural response options (e.g. soil carbon sequestration and agroforestry) deliver co-benefits across land-based challenges

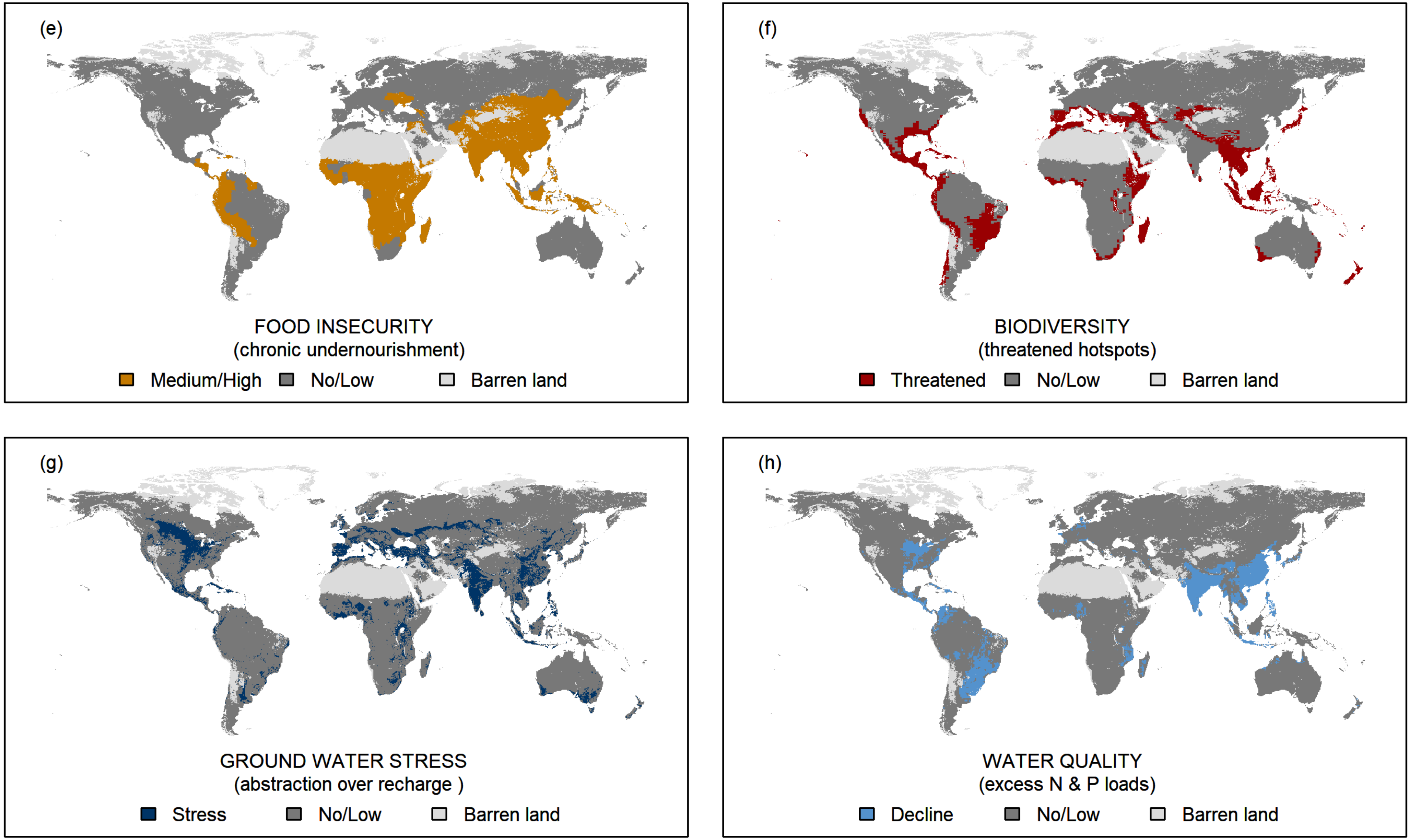
The total technical mitigation potential from crop and livestock activities and agroforestry is estimated to be between 2.3 and 9.6 Gt CO_{2e} per year by 2050

Land is subjected to interlinked challenges (1/2)



IPCC, SR CCL, Chap. 6, 2019

Land is subjected to interlinked challenges (2/2)



IPCC, SR CCL, Chap. 6, 2019

Potential global contribution of response options to mitigation, adaptation, combating desertification and land degradation, and enhancing food security

Example from Response options based on land management
INCREASED SOIL ORGANIC CARBON CONTENT

	Mitigation	Adaptation	Desertification	Land degradation	Food security	Cost

Increased soil organic carbon content

Key for criteria used to define magnitude of impact of each integrated response option

		Mitigation *Gt CO_2-eq yr^{-1}*	Adaptation *Million people*	Desertification *Million km^2*	Land Degradation *Million km^2*	Food Security *Million people*
Positive	**Large**	More than 3	Positive for more than 25	Positive for more than 3	Positive for more than 3	Positive for more than 100
Positive	**Moderate**	0.3 to 3	1 to 25	0.5 to 3	0.5 to 3	1 to 100
Positive	**Small**	Less than 0.3	Less than 1	Less than 0.5	Less than 0.5	Less than 1
	Negligible	No effect	No effect	No effect	No effect	No effect
Negative	**Small**	Less than -0.3	Less than 1	Less than 0.5	Less than 0.5	Less than 1
Negative	**Moderate**	-0.3 to -3	1 to 25	0.5 to 3	0.5 to 3	1 to 100
Negative	**Large**	More than -3	Negative for more than 25	Negative for more than 3	Negative for more than 3	Negative for more than 100

Variable: Can be positive or negative —— no data na not applicable

Confidence level

Indicates confidence in the estimate of magnitude category.

H *High confidence*
M *Medium confidence*
L *Low confidence*

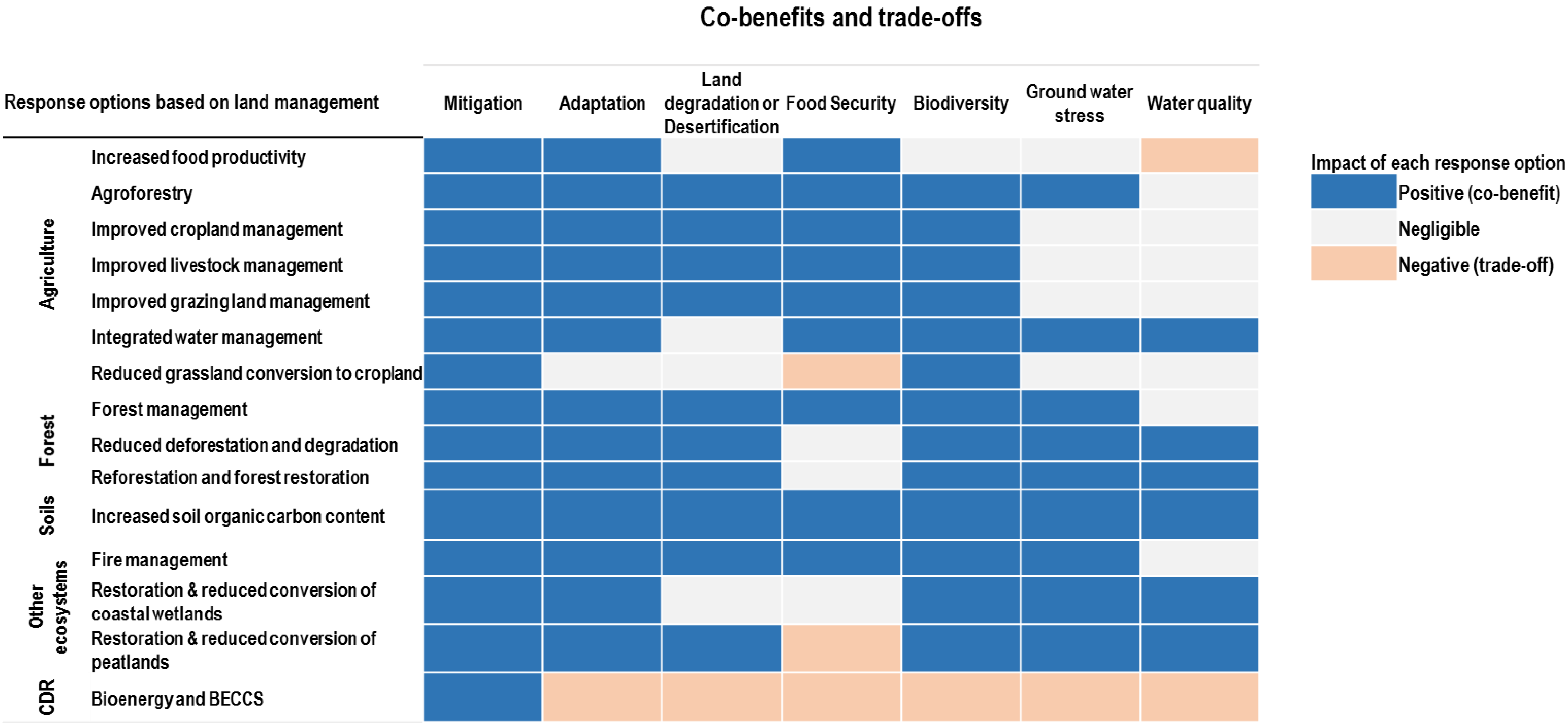
Cost range

See technical caption for cost ranges in US$ tCO_2e^{-1} or US$ ha^{-1}.

●●● High cost
●● Medium cost
● Low cost
—— no data

After IPCC, SR CCL, SPM, 2019

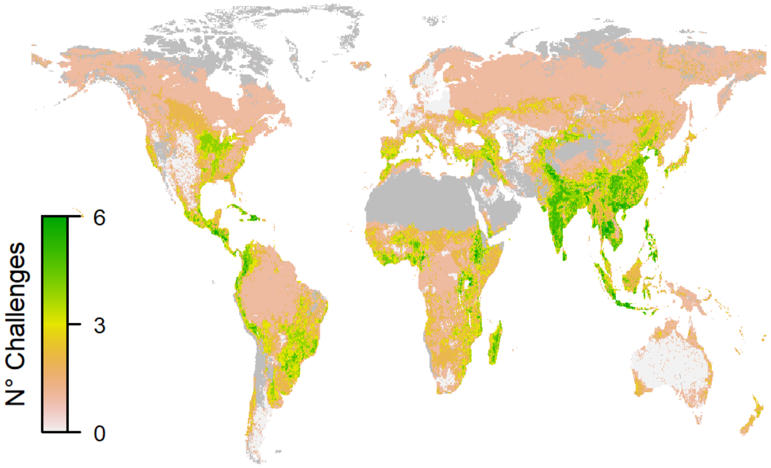
Land management responses and their global impacts on land based challenges



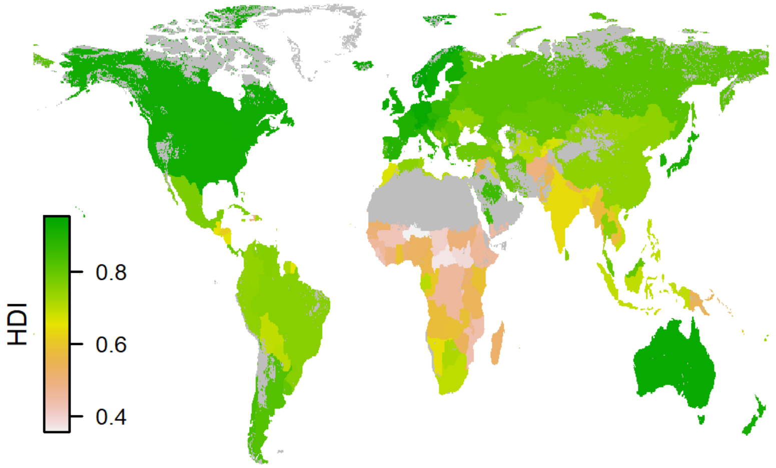
After IPCC, SR CCL, SPM and Chap. 6, 2019

Across countries, the greater the number of land challenges, the fewer the responses with only co-benefits and the lower the human development index (HDI)

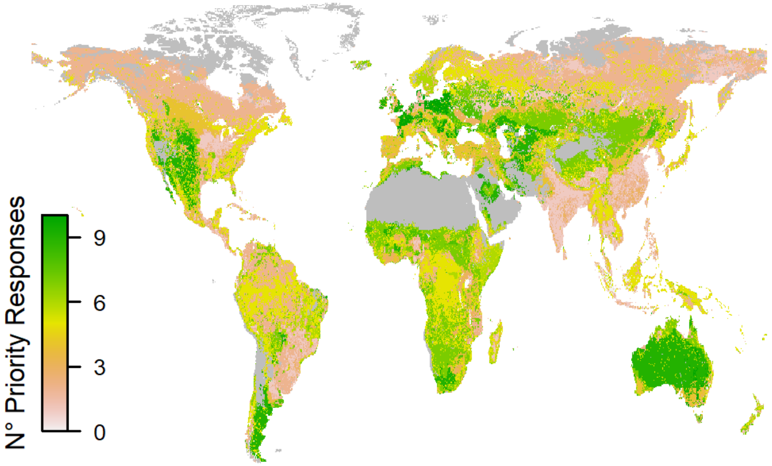
a Number of challenges



b Human Development Index



c Number of responses delivering co-benefits to all challenges

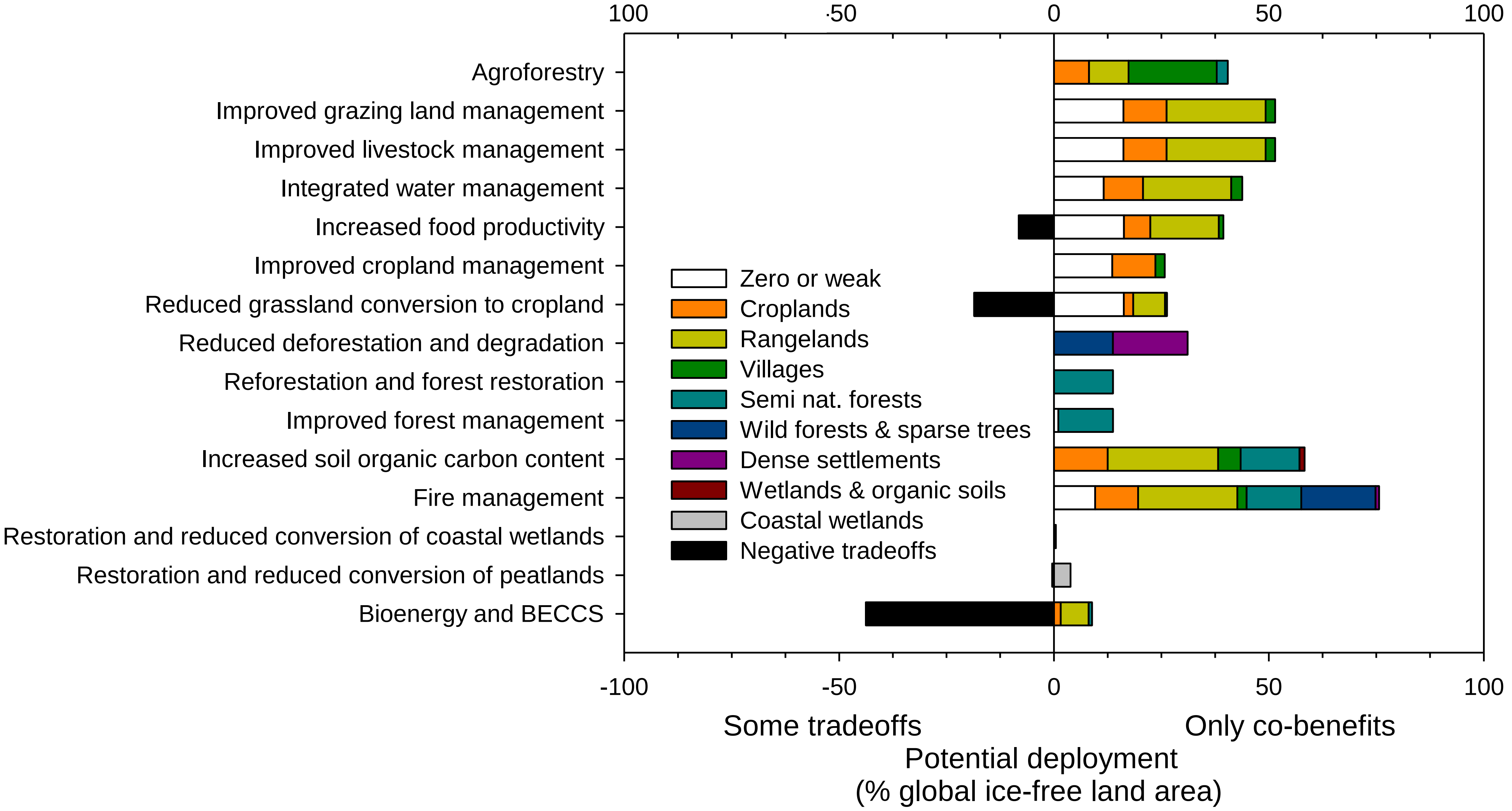


Correlation	Challenges	Responses	HDI
Challenges	-	**-0,57*** **	**-0,45*** **
Responses		-	0,04 (NS)

Barren land

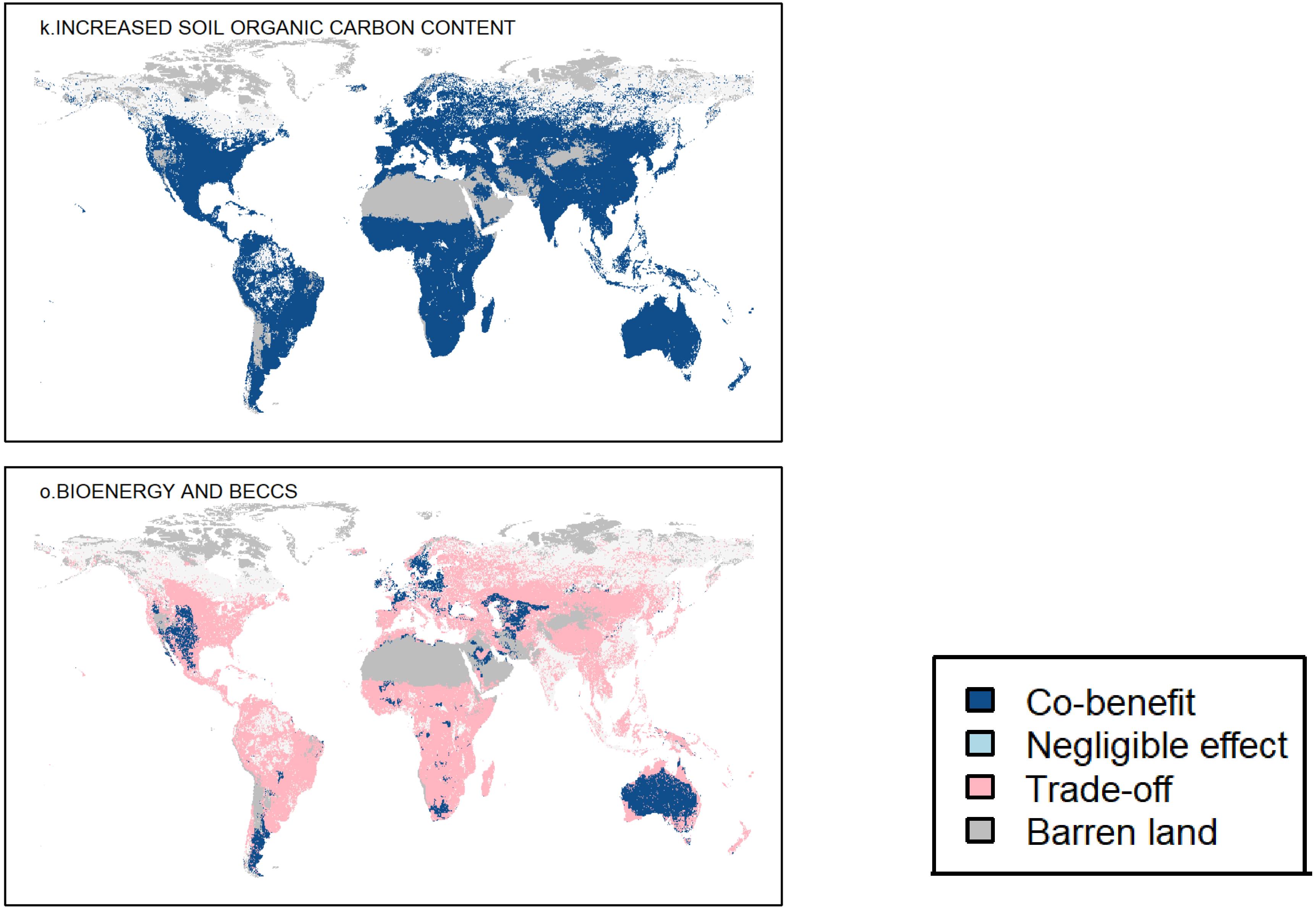
After IPCC, SR CCL, SPM and Chap. 6, 2019

Potential deployment area of land management responses with only co-benefits, or with some tradeoffs, for local challenges



After IPCC, SR CCL, SPM and Chap. 6, 2019

Co-benefits and trade-offs across challenges for two contrasted land management responses



Combating desertification and land degradation: co-benefits for the climate

The fight against land degradation has immediate and long-term co-benefits for adaptation and mitigation (high confidence)

Many activities to combat desertification can contribute to climate change adaptation and reduce biodiversity loss with positive spin-offs for sustainable development

Avoiding, limiting and reversing desertification would improve soil fertility, increase carbon storage in soils and biomass, while promoting agricultural productivity and food security (high confidence)

Some answers are not appropriate to all local challenges

Large-scale deployment of mitigation options such as bioenergy and afforestation would have negative impacts on food security, biodiversity and land degradation:

- From 0.1 to 1 million km2 in scenarios with high population and low environmental policies (SSP3)

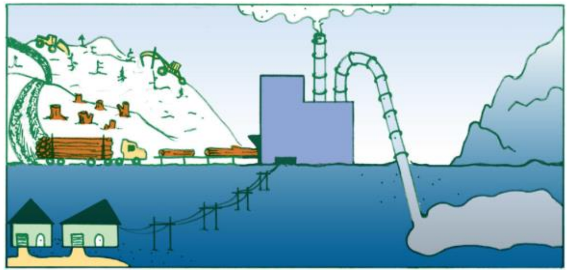
- From 1 to 4 million km2 in low population scenarios and strong environmental policies (SSP1)

INTERGOVERNMENTAL PANEL ON climate change

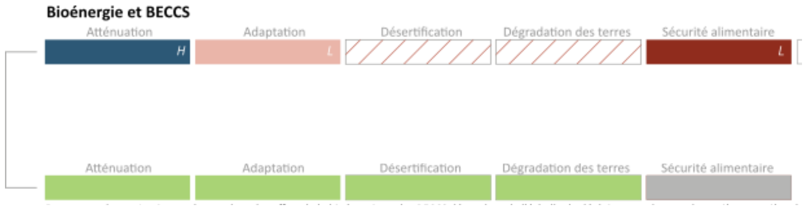
WMO UNEP

Four options related to the energy sector consume land: their impacts depend on the scale of deployment and practices

Mitigation | Adaptation | Desertification | Land degradation | Food security



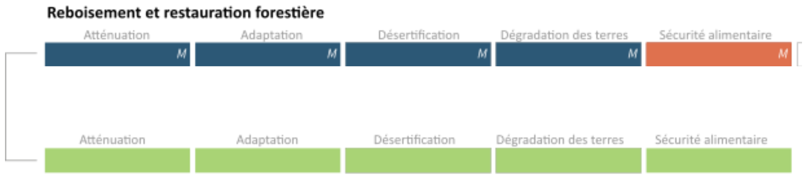
Bioenergy and BECCS



Several millions of km²

Best practices

Reforestation



Several millions of km²

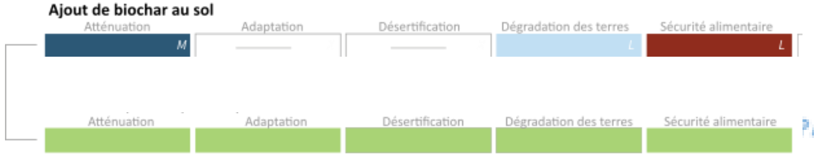
Best practices

Afforestation

Several millions of km²

Best practices

Biochar



ipcc
PANEL ON climate change
WMO UNEP

Value chain and risk management response options

		Mitigation	Adaptation	Desertification	Land degradation	Food security
Response options based on value chain management						
Demand	Reduced post-harvest losses	H	M	L	L	H
Demand	Dietary change	H	—	L	H	H
Demand	Reduced food waste (consumer or retailer)	H	—	L	M	M
Supply	Sustainable sourcing	—	L	—	L	L
Supply	Improved food processing and retailing	L	L	—	—	L
Supply	Improved energy use in food systems	L	L	—	—	L
Response options based on risk management						
Risk	Livelihood diversification	—	L	—	L	L
Risk	Management of urban sprawl	—	L	L	M	L
Risk	Risk sharing instruments	L	L	—	L	L

Food

Food losses and waste contribute to 8-10% of anthropogenic GHG emissions. 25 to 30% of food production is lost or wasted (average confidence). A reduction of these losses and wastes could release millions of km2 of land by 2050

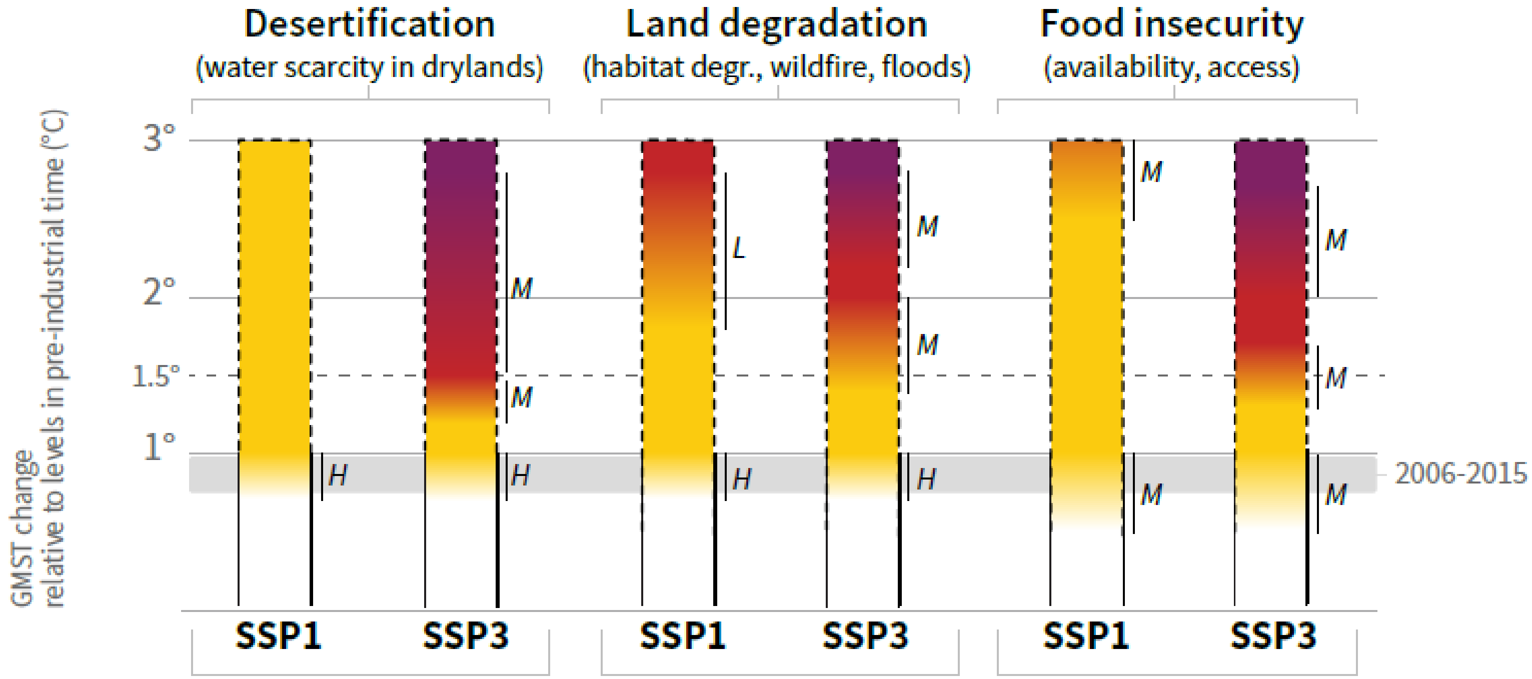
Diversification of diets (more fruits, vegetables, protein crops and nuts) and production systems (integrated systems, diversified rotations, genetic diversity, resilient and low-emission livestock) supports climate change adaptation and 'mitigation

By 2050, food transitions could release millions of km2 of land with co-benefits for the environment and health and bring about an emission reduction of between 0.7 and 8.0 Gt CO2eq

ipcc INTERGOVERNMENTAL PANEL ON climate change WMO UNEP

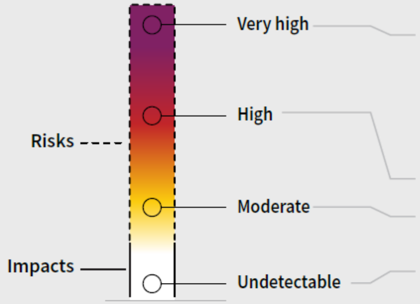
Risks to humans and ecosystems of changes in land based processes as a result of climate change

B. Different socioeconomic pathways affect levels of climate related risks



Socio-economic choices can reduce or exacerbate climate related risks as well as influence the rate of temperature increase. The **SSP1** pathway illustrates a world with low population growth, high income and reduced inequalities, food produced in low GHG emission systems, effective land use regulation and high adaptive capacity. The **SSP3** pathway has the opposite trends. Risks are lower in SSP1 compared with SSP3 given the same level of GMST increase.

Legend: **Level of impact/risk**



Purple: Very high probability of severe impacts/ risks and the presence of significant irreversibility or the persistence of climate-related hazards, combined with limited ability to adapt due to the nature of the hazard or impacts/risks.
Red: Significant and widespread impacts/risks.
Yellow: Impacts/risks are detectable and attributable to climate change with at least medium confidence.
White: Impacts/risks are undetectable.

IPCC, SR CCL, SPM, 2019

INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

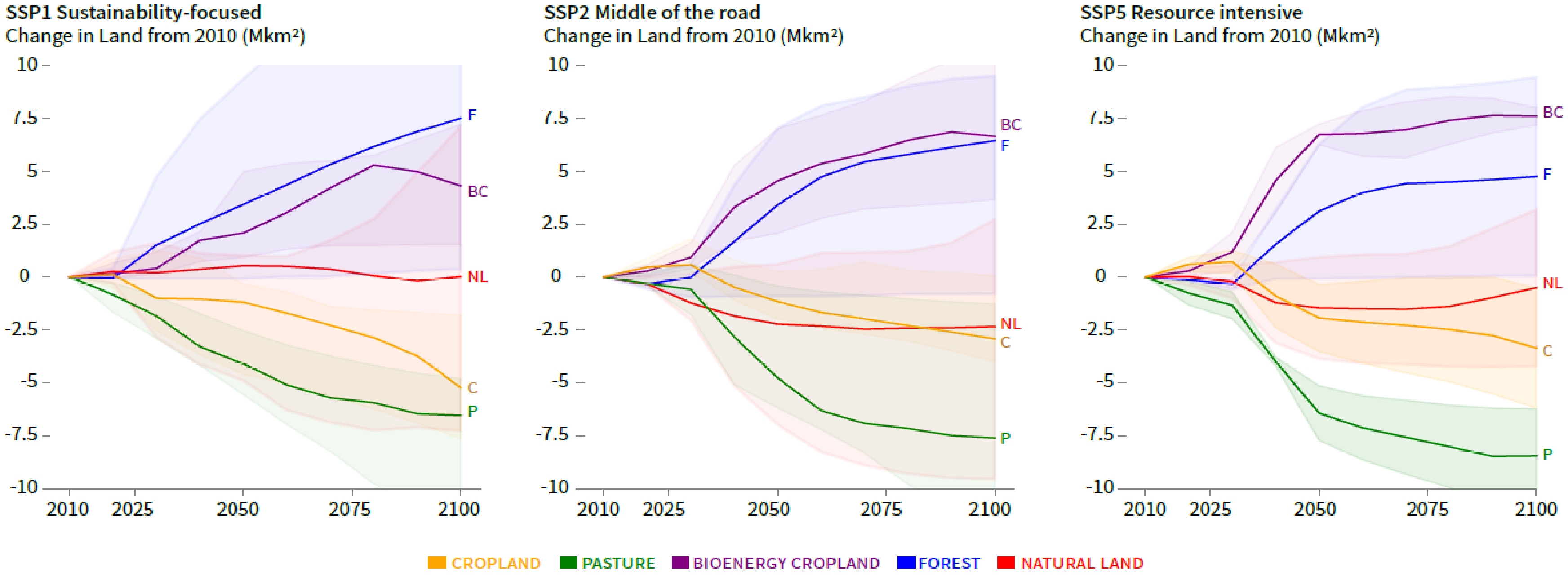
Pathways linking socioeconomic development, mitigation responses and land

Socioeconomic development and land management influence the evolution of the land system including the relative amount of land allocated to CROPLAND, PASTURE, BIOENERGY CROPLAND, FOREST, and NATURAL LAND. The lines show the median across Integrated Assessment Models (IAMs) for three alternative shared socioeconomic pathways (SSP1, SSP2 and SSP5 at RCP1.9); shaded areas show the range across models. Note that pathways illustrate the effects of climate change mitigation but not those of climate change impacts or adaptation.

A. Sustainability-focused (SSP1)
Sustainability in land management, agricultural intensification, production and consumption patterns result in reduced need for agricultural land, despite increases in per capita food consumption. This land can instead be used for reforestation, afforestation, and bioenergy.

B. Middle of the road (SSP2)
Societal as well as technological development follows historical patterns. Increased demand for land mitigation options such as bioenergy, reduced deforestation or afforestation decreases availability of agricultural land for food, feed and fibre.

C. Resource intensive (SSP5)
Resource-intensive production and consumption patterns, results in high baseline emissions. Mitigation focuses on technological solutions including substantial bioenergy and BECCS . Intensification and competing land uses contribute to declines in agricultural land.

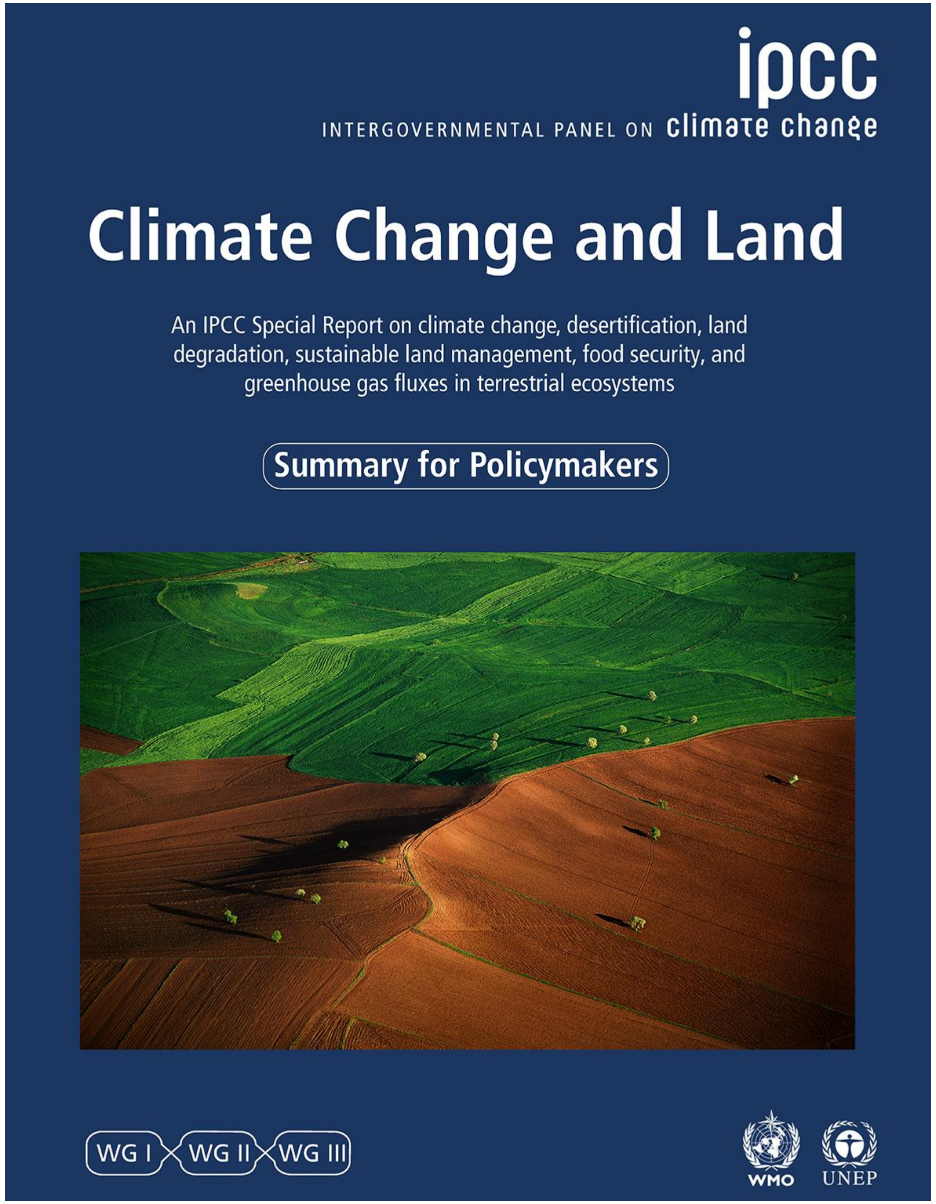


Delaying climate change mitigation and adaptation measures in all sectors will have increasingly negative effects on land and reduce the prospects for sustainable development

Late action in all sectors can reduce the potential of all these options in most parts of the world and limit their effectiveness (high confidence) - could also have irreversible impacts on some ecosystems

Rapid action on climate change mitigation and adaptation, aligned with sustainable land management and sustainable development, will reduce the risks to millions of people from climate extremes, desertification, land degradation and climate change. food insecurity and livelihoods (high confidence)

Postponing GHG emission reductions from all sectors leads to ever greater economic impacts for many countries in many parts of the world (high confidence)



FOR MORE INFORMATION:

Website: http://ipcc.ch

IPCC Secretariat: ipcc-sec@wmo.int

IPCC Press Office: ipcc-media@wmo.int

FIND US ON:

@IPCC_CH

@IPCC

@IPCC

www.vimeo.com/ipcc

www.youtube.com/c/ipccgeneva

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

Pledges for the Paris Agreement

- 128 countries include the Agriculture, Forestry and Land Use sector in their pledges

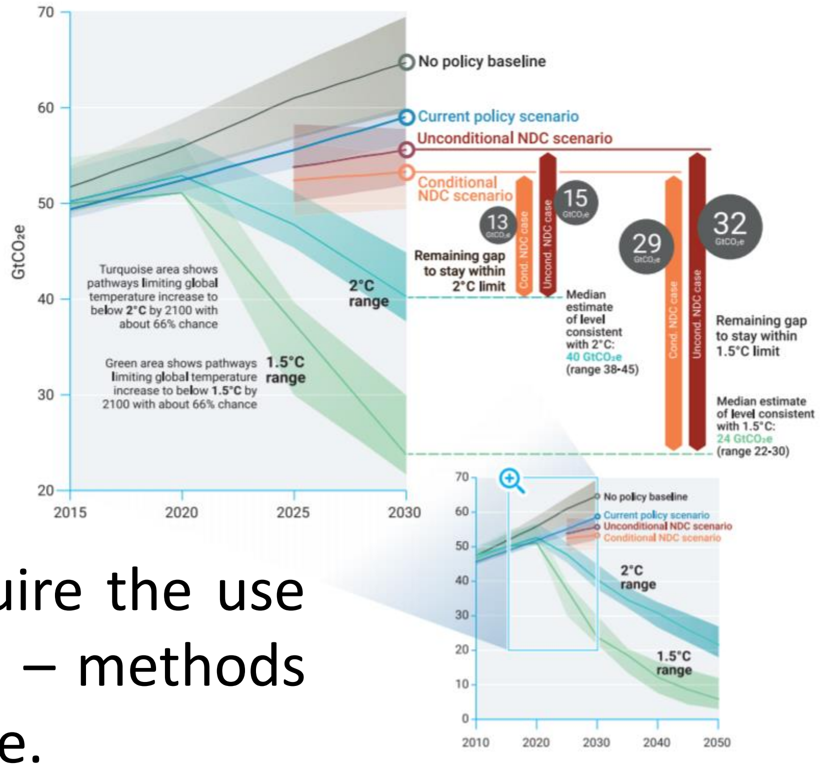
- By 2030, a gap of 13 billion tons CO_2eq prevents reaching the targeted +2℃ maximum global warming threshold (29 $GtCO_2$eq in the case of the 1.5 ℃ target)

- Limiting warming to 1.5° C will require the use of “negative emissions technologies” – methods that remove CO_2 from the atmosphere.

Emissions Gap Report 2018

November 2018

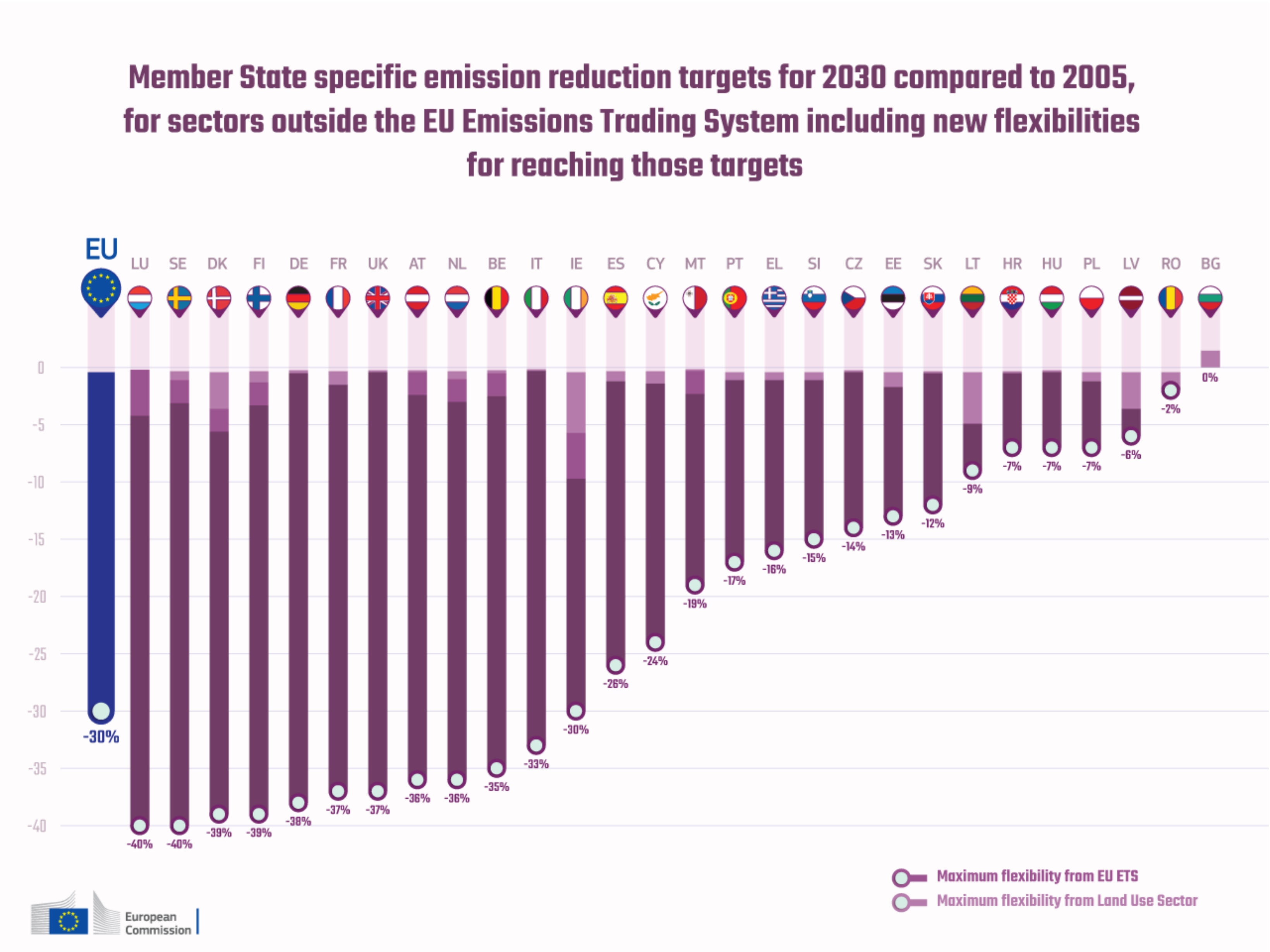
Figure ES.3: Global greenhouse gas emissions under different scenarios and the emissions gap in 2030 (median estimate and 10th to 90th percentile range).



[UNEP, 2018]

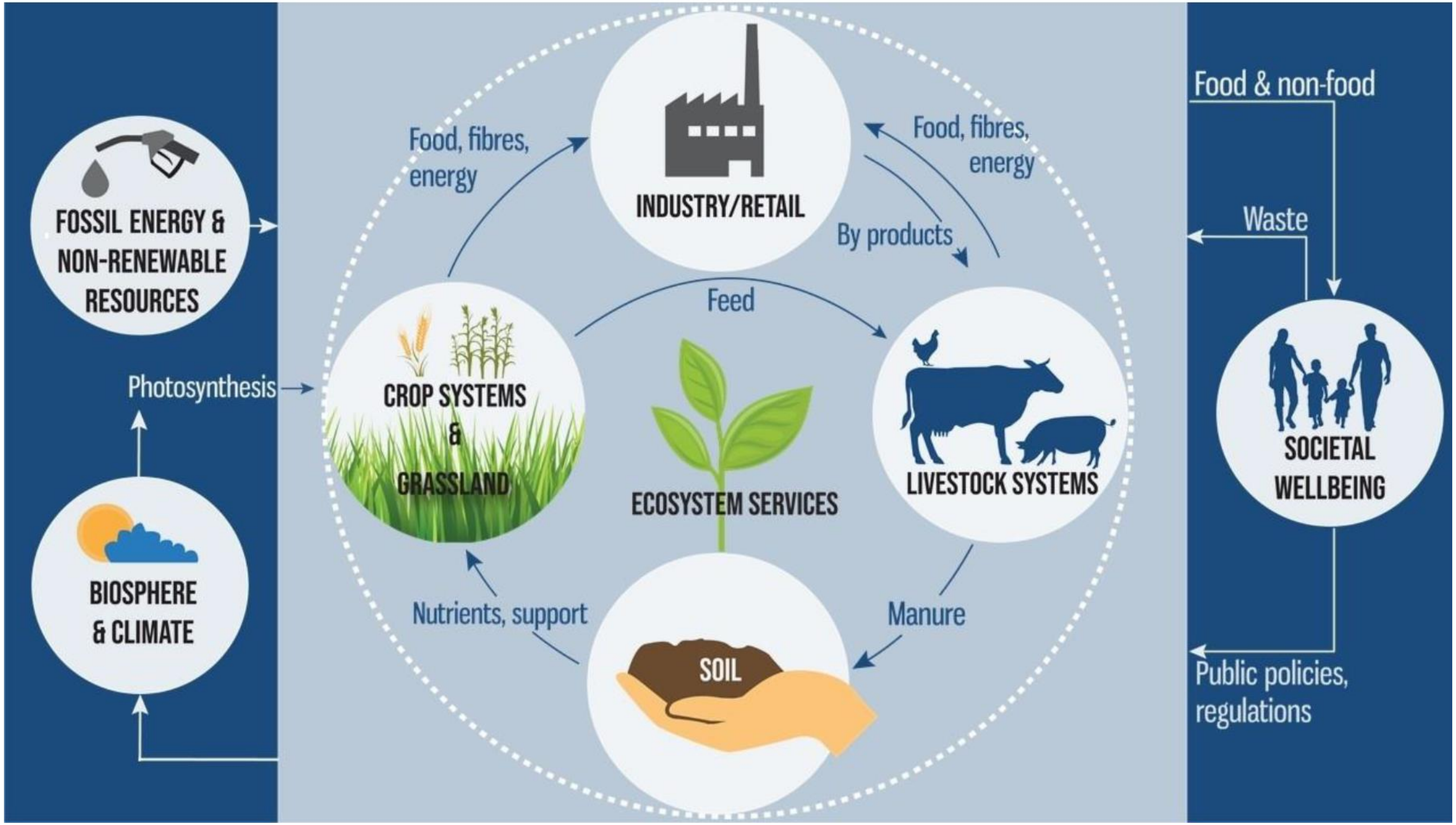
CIRCASA

Mitigation goals in EU for agriculture and other non ETS sectors



In France, the national strategy for C neutrality in 2050 asks for a 1.5% annual reduction in ag. GHG emissions from 2021 to 2025

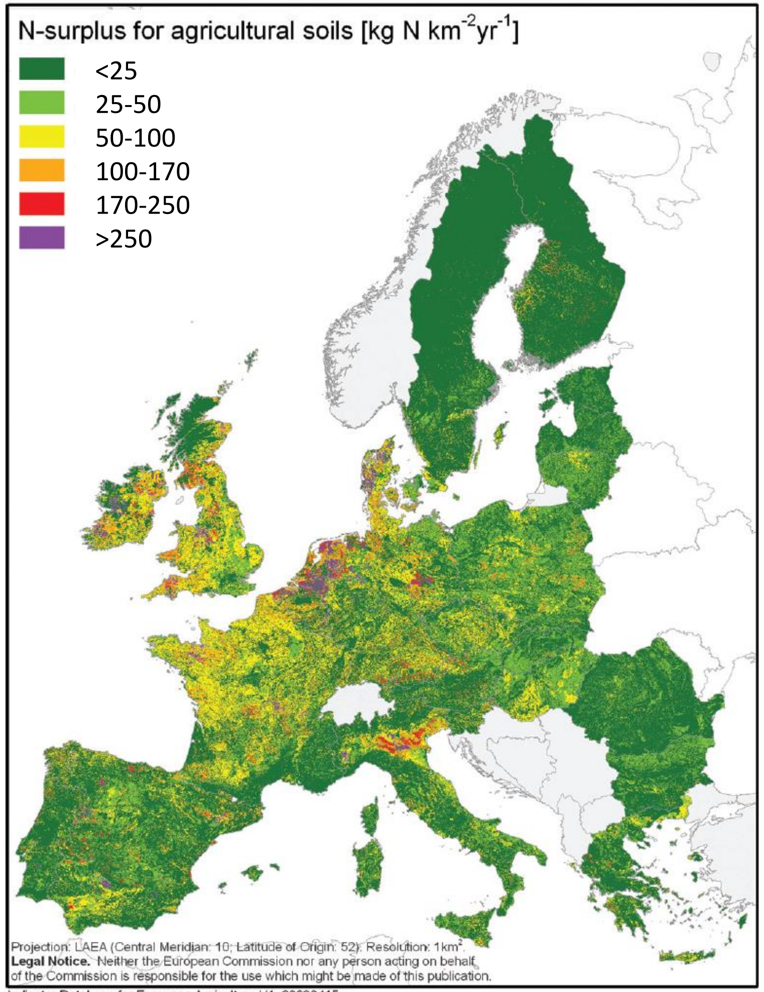
Circular bieconomy framework



(Animal Task Force, 2019)

Nitrogen surplus from European agricultural soils and soil organic carbon (SOC)

Potential to immobilize N by restocking SOC in intensive cropping systems



Indicator Database for European Agriculture V1_20090415

Fig. 3. Soil organic carbon prediction map which represents the present conditions simulated by the base model (background

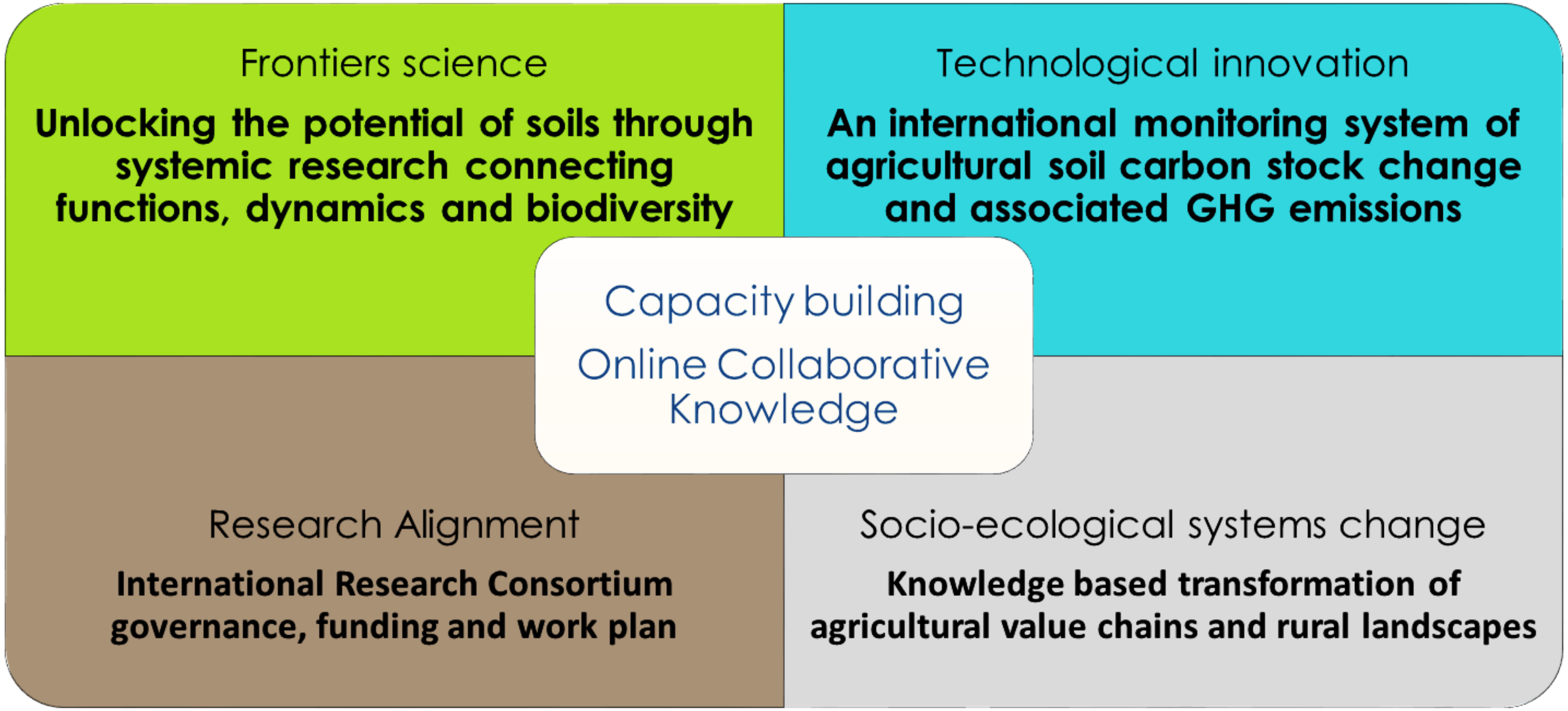
(Yiginini & Panagos, SOSTEN, 2016)

- CIRCASA has **22 partners** including the research secretariats of **4p1000**, **GRA** and **FACCE-JPI**

- Together with these initiatives and with CCAFS-CGIAR, it has direct outreach to a total of **82 countries** accounting for **85% of the world's total research on soil C sequestration in agriculture**

Countries partners of CIRCASA, 4p1000, GRA, FACCE-JPI and CCAFS

Vision: CIRCASA project



Thank you for your attention!