

IPCC Special Report on Climate Change and Land: Land Responses

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Land is where we live

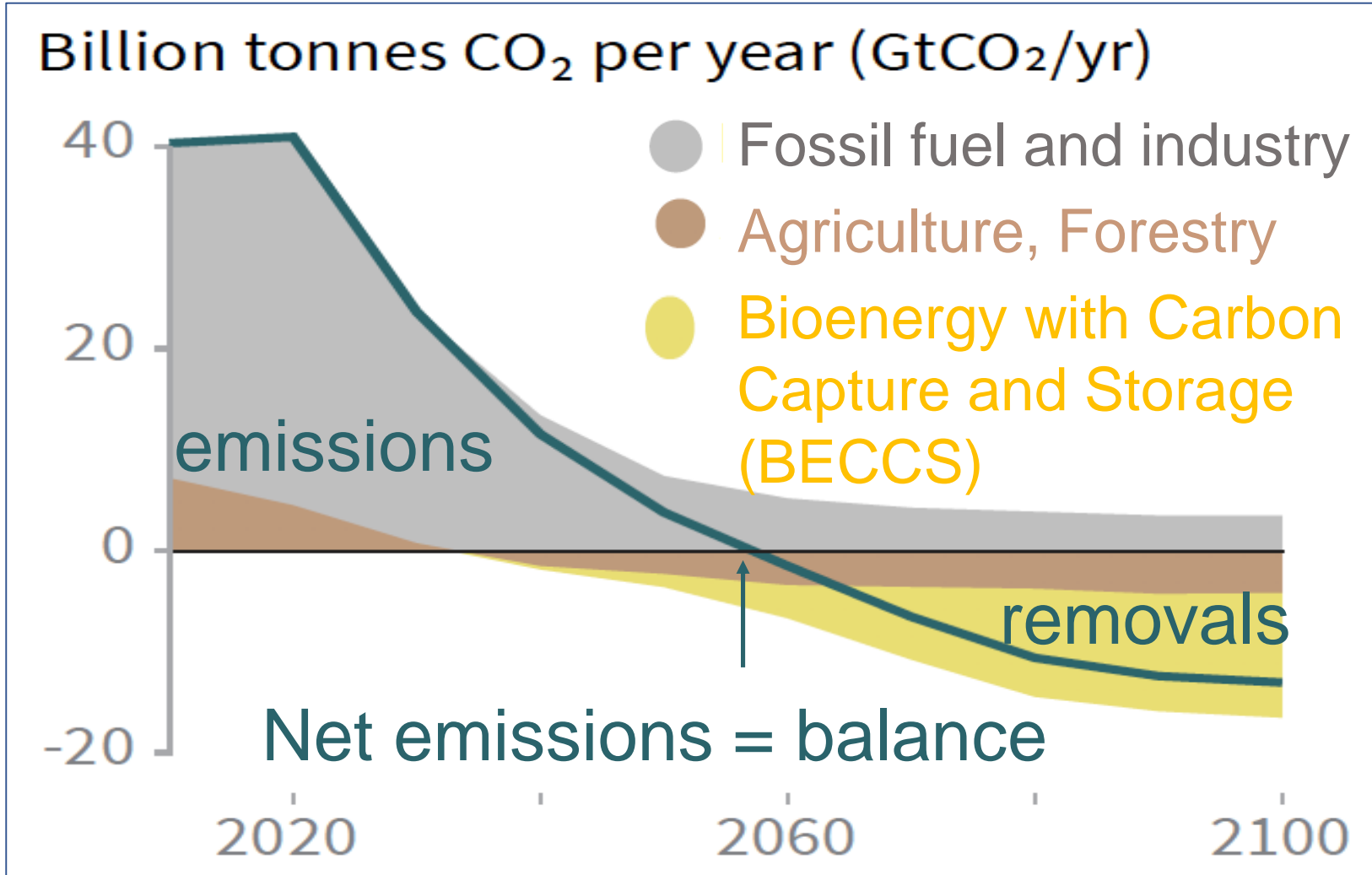
Land is under
growing human
pressure

Land is a part
of the solution

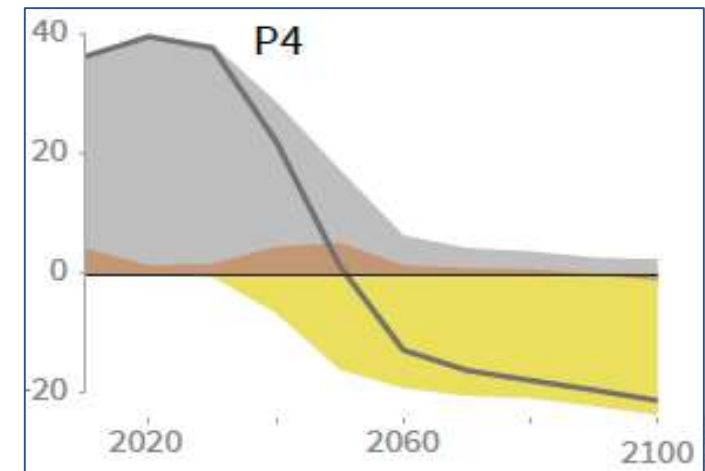
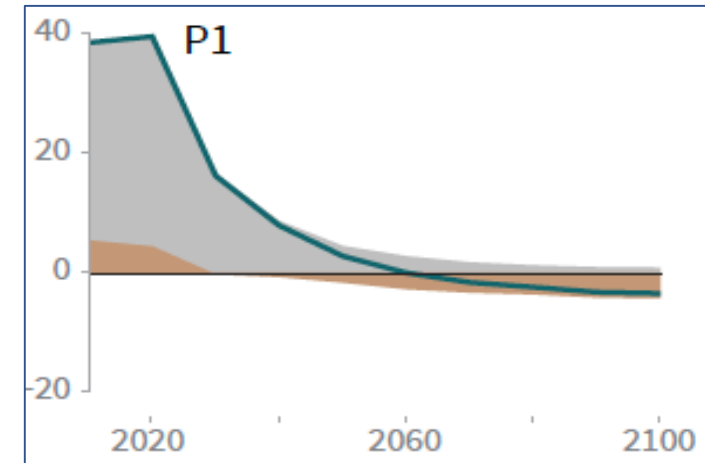
Land can't do it
all

2

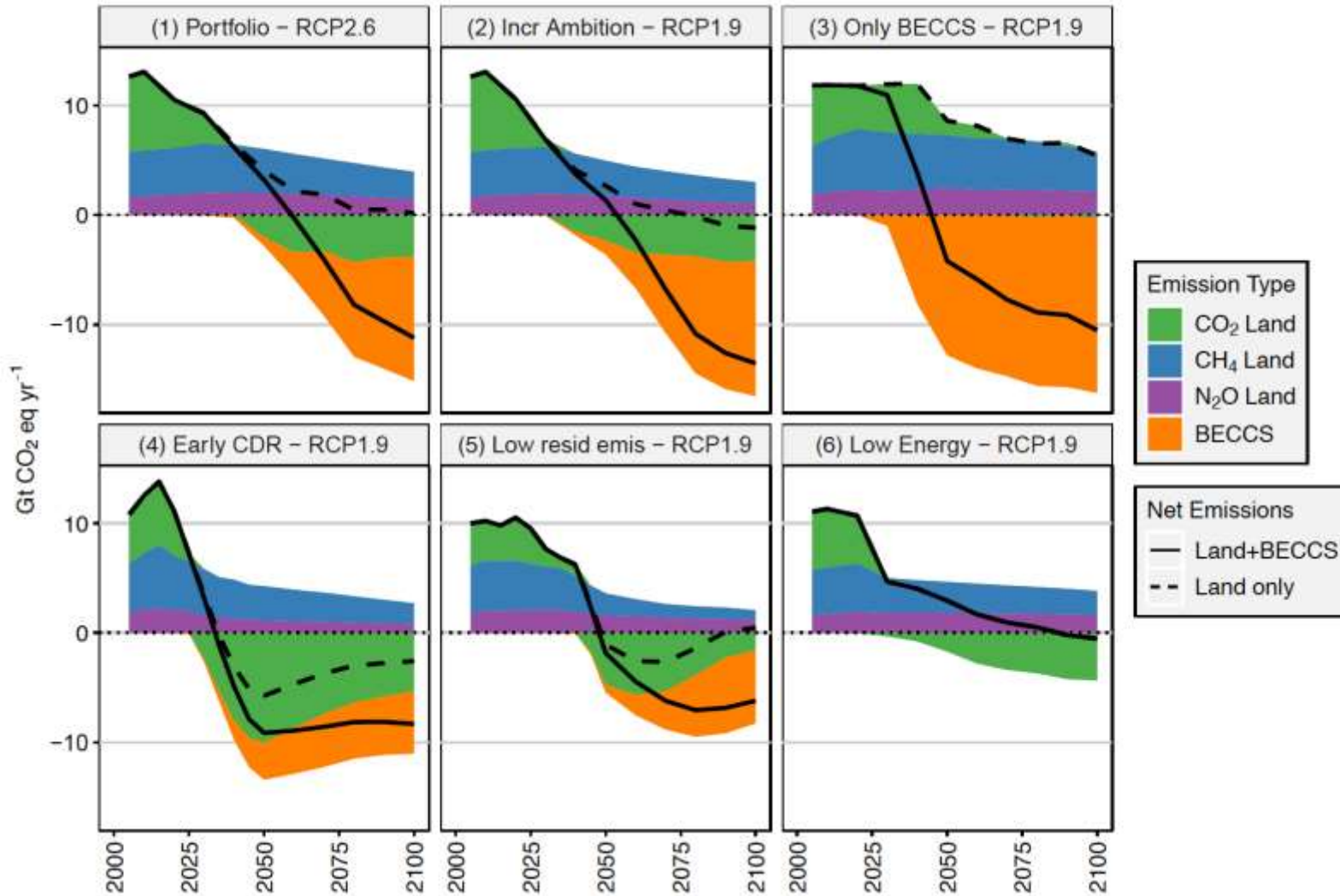
How do we get to 1.5 degrees?



Multiple different pathways: Less fossil fuel action requires more BECCS



Land use Change in 1.5 and 2 °C consistent pathways



There are multiple different pathways that can limit warming

Less bioenergy would require more afforestation to meet targets

- Bioenergy area change 0-750 Mha (roughly size of India)
- Forest area -200 to 7200 Mha change

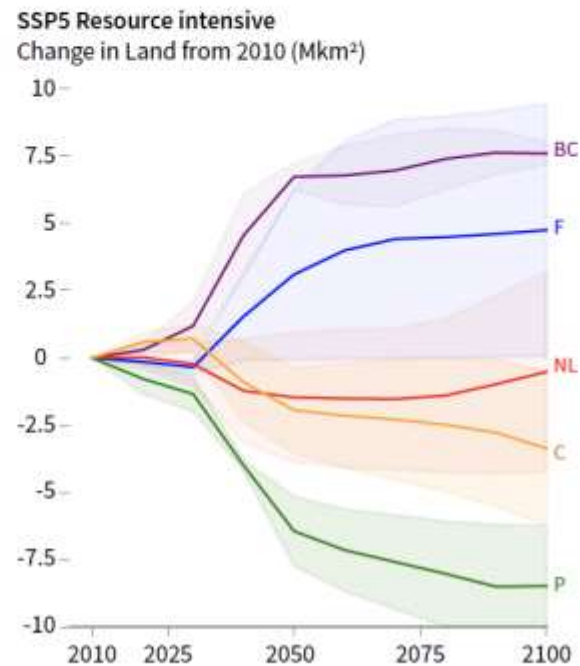
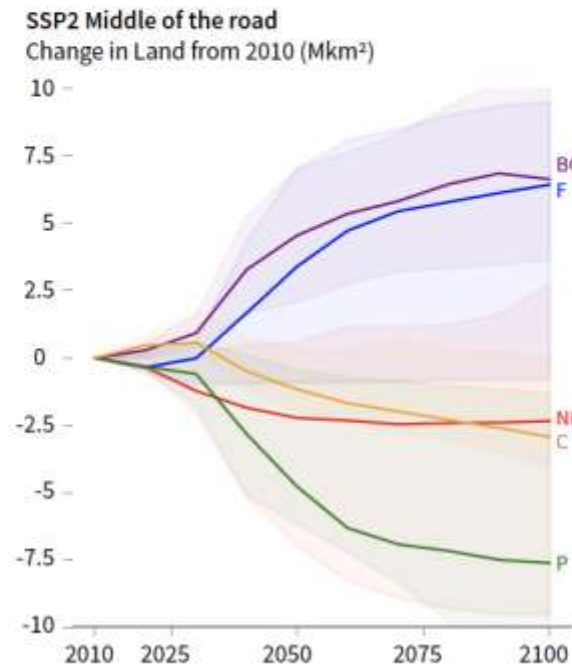
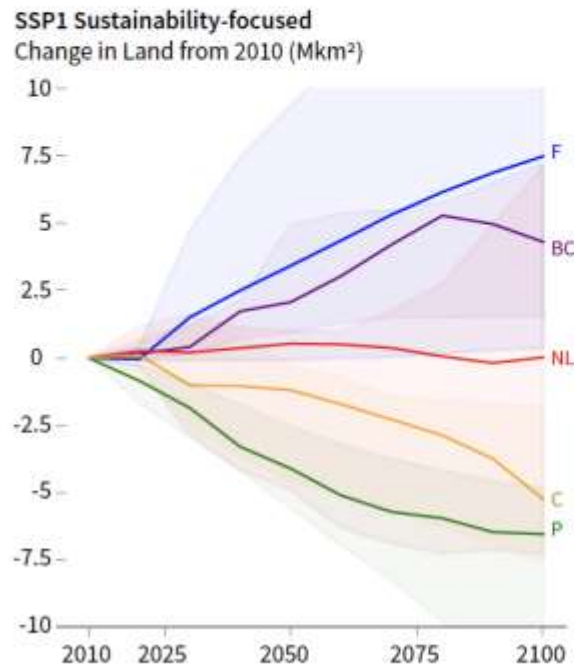
Change in land(Mha) area from 2010 across scenarios RCP 1.9, RCP2.6 RCP4.5 for different SSPs

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.

Multiple pathways:
Less BECCS would require more afforestation to meet targets



■ CROPLAND
 ■ PASTURE
 ■ BIOENERGY CROPLAND
 ■ FOREST
 ■ NATURAL LAND

- Bioenergy area change 0-750 Mha (roughly size of India)
- Forest area -200 to 7200 Mha change

Response options

from SPM fig 3 A

Response options based on land management

Agriculture	Increased food productivity
	Agro-forestry
	Improved cropland management
	Improved livestock management
	Agricultural diversification
	Improved grazing land management
	Integrated water management
Forests	Reduced grassland conversion to cropland
	Forest management
Soils	Reduced deforestation and forest degradation
	Increased soil organic carbon content
	Reduced soil erosion
	Reduced soil salinization
Other ecosystems	Reduced soil compaction
	Fire management
	Reduced landslides and natural hazards
	Reduced pollution including acidification
	Restoration & reduced conversion of coastal wetlands
	Restoration & reduced conversion of peatlands

Response options based on value chain management

Demand	Reduced post-harvest losses
	Dietary change
	Reduced food waste (consumer or retailer)
Supply	Sustainable sourcing
	Improved food processing and retailing
	Improved energy use in food systems

Response options based on risk management

Risk	Livelihood diversification
	Management of urban sprawl
	Risk sharing instruments

Mitigation in the land sector

- Wide range of estimates from the literature
- Not additive
- most potential: afforestation; BECCS; Diet change

IPCC SRCCL fig 2.24, from Roe et al Nature climate change 2019

Reduced emissions from agriculture

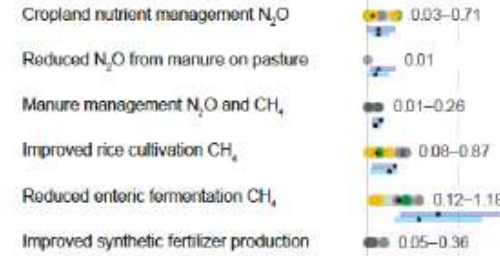
Reduced emissions from forests and other ecosystems

Carbon dioxide removal

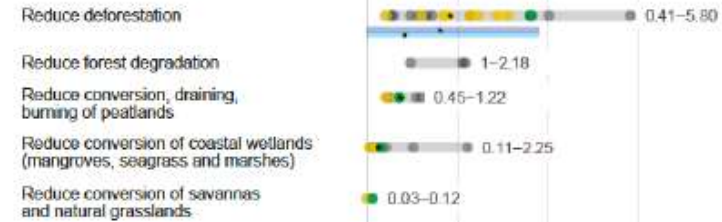
Demand management

LAND MANAGEMENT

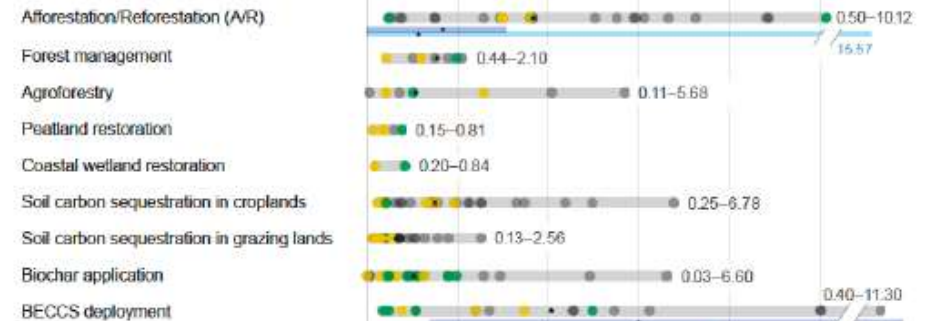
Reduce emissions from Agriculture



Reduce emissions from Forests and other Ecosystems



Carbon Dioxide Removal



DEMAND MANAGEMENT

Waste and Losses

Reduce food and agricultural waste

Diets

Shift to plant-based diets

Wood Products

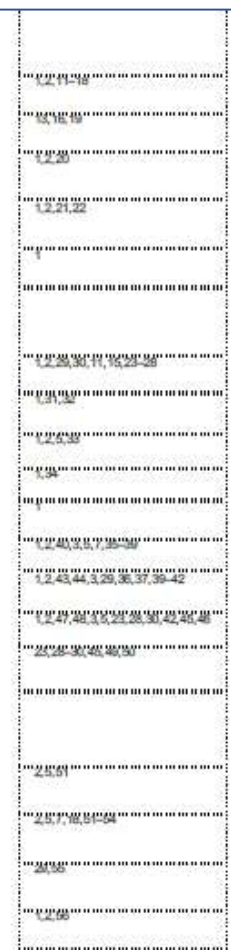
Increase substitution of cement/steel

Wood Fuel

Increase cleaner cookstoves

mitigation potential GtCO₂e/yr

Technical potential
Economic Potential
Sustainable potential
 Model scenarios 1.5°C and 2°C



Carbon Dioxide Removal

Afforestation/Reforestation (AVR)

Forest management

Agroforestry

Peatland restoration

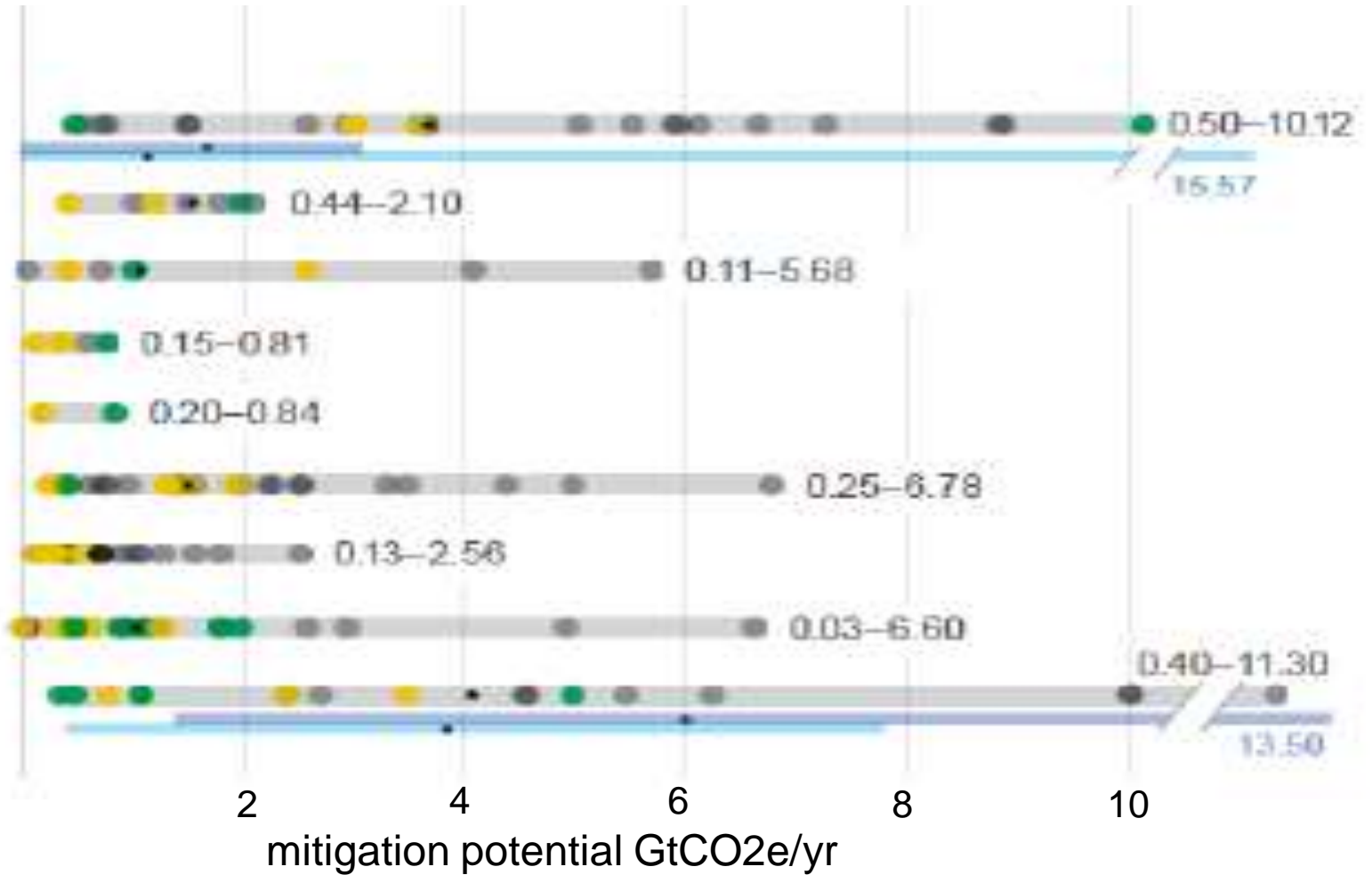
Coastal wetland restoration

Soil carbon sequestration in croplands

Soil carbon sequestration in grazing lands

Biochar application

BECCS deployment



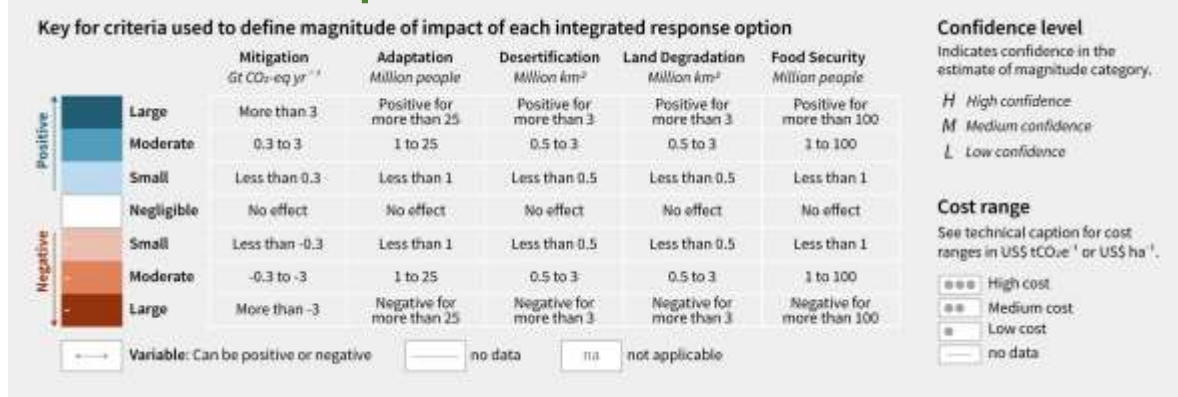
IPCC SRCCL fig 2.24, from Roe et al Nature climate change 2019

Technical potential
Economic Potential
Sustainable potential
 Model scenarios 1.5°C
 and 2°C

CO-benefits and trade-offs

- Lots of options have positive impacts (blue) across all of climate change mitigation and adaptation, delivering food security and tackling land degradation and desertification
- Some free up land, while others take up land

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



Bioenergy and BECCS



High level: Impacts on adaptation, desertification, land degradation and food security are maximum potential impacts, assuming carbon dioxide removal by BECCS at a scale of 11.3 GtCO₂ yr⁻¹ in 2050, and noting that bioenergy without CCS can also achieve emissions reductions of up to several GtCO₂ yr⁻¹ when it is a low carbon energy source [2.7.1.5; 6.4.1.1.5]. Studies linking bioenergy to food security estimate an increase in the population at risk of hunger to up to 150 million people at this level of implementation [6.4.5.1.5]. The red hatched cells for desertification and land degradation indicate that while up to 15 million km² of additional land is required in 2100 in 2°C scenarios which will increase pressure for desertification and land degradation, the actual area affected by this additional pressure is not easily quantified [6.4.3.1.5; 6.4.4.1.5].



Best practice: The sign and magnitude of the effects of bioenergy and BECCS depends on the scale of deployment, the type of bioenergy feedstock, which other response options are included, and where bioenergy is grown (including prior land use and indirect land use change emissions). For example, limiting bioenergy production to marginal lands or abandoned cropland would have negligible effects on biodiversity, food security, and potentially co-benefits for land degradation; however, the benefits for mitigation could also be smaller. [Table 6.5B]

Reforestation and forest restoration



High level: Impacts on adaptation, desertification, land degradation and food security are maximum potential impacts assuming implementation of reforestation and forest restoration (partly overlapping with afforestation) at a scale of 10.1 GtCO₂ yr⁻¹ removal [6.4.1.1.2]. Large-scale afforestation could cause increases in food prices of 80% by 2050, and more general mitigation measures in the AFOLU sector can translate into a rise in undernourishment of 80–300 million people; the impact of reforestation is lower [6.4.5.1.2].



Best practice: There are co-benefits of reforestation and forest restoration in previously forested areas, assuming small scale deployment using native species and involving local stakeholders to provide a safety net for food security. Examples of sustainable implementation include, but are not limited to, reducing illegal logging and halting illegal forest loss in protected areas, reforesting and restoring forests in degraded and desertified lands [Box 6.1C; Table 6.6].

Afforestation



High level: Impacts on adaptation, desertification, land degradation and food security are maximum potential impacts assuming implementation of afforestation (partly overlapping with reforestation and forest restoration) at a scale of 8.9 GtCO₂ yr⁻¹ removal [6.4.1.1.2]. Large-scale afforestation could cause increases in food prices of 80% by 2050, and more general mitigation measures in the AFOLU sector can translate into a rise in undernourishment of 80–300 million people [6.4.5.1.2].



Best practice: Afforestation is used to prevent desertification and to tackle land degradation. Forested land also offers benefits in terms of food supply, especially when forest is established on degraded land, mangroves, and other land that cannot be used for agriculture. For example, food from forests represents a safety-net during times of food and income insecurity [6.4.5.1.2].

Biochar addition to soil



High level: Impacts on adaptation, desertification, land degradation and food security are maximum potential impacts assuming implementation of afforestation at a scale of 6.6 GtCO₂ yr⁻¹ removal [6.4.1.1.3]. Dedicated energy crops required for feedstock production could occupy 0.4–2.6 Mkm² of land, equivalent to around 20% of the global cropland area, which could potentially have a large effect on food security for up to 100 million people [6.4.5.1.3].



Best practice: When applied to land, biochar could provide moderate benefits for food security by improving yields by 25% in the tropics, but with more limited impacts in temperate regions, or through improved water holding capacity and nutrient use efficiency. Abandoned cropland could be used to supply biomass for biochar, thus avoiding competition with food production; 5–9 Mkm² of land is estimated to be available for biomass production without compromising food security and biodiversity, considering marginal and degraded land and land released by pasture intensification [6.4.5.1.3].

Some NETS have both positive of negative impacts based on the context (location, scale, sustainability).

Negative effects for NETS can occur when applied at scales, ways and in places that lead to high land competition for food and other ecosystem services (e.g biodiversity), or high water demand.

In appropriate contexts and scales, there can be many co-benefits

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 100	
	Moderate	0.3 to 3	1 to 25	0.5 to 3	0.5 to 3	
	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
	Moderate	-0.3 to -3	1 to 25	0.5 to 3	0.5 to 3	1 to 100
	Large	More than -3	Negative for more than 25	Negative for more than 3	Negative for more than 3	Negative for more than 100

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\$ tCO₂e⁻¹ or US\$ ha⁻¹.

- High cost
- Medium cost
- Low cost
- no data

Variable: Can be positive or negative no data not applicable



Interlinkages

- Response options are **interlinked**. Some have co-benefits or are more **effective when paired**. Others may conflict.
- Some response options are **less feasible** than others
- .
- **Delayed action** will mean more of a **need to respond** to land challenges **but less potential for land-based responses** (due to climate change and other pressures).
- **Early action has challenges** related to technology, upscaling and barriers.



The big picture

- Land management interacts with many of the SDGs with benefits or trade-offs e.g, biodiversity
- Lots of potential for land management with multiple benefits
- Land still limited, and under pressure, so cannot cannot offset large emissions in other sectors

Land is where we live

Land is under
growing human
pressure

Land is a part
of the solution

Land can't do it
all

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Thankyou

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