Special Report on Climate Change and Land

Potentials for Nature-Based Solutions

Agricultural landscape between Ankara and Hattusha, Anatolia, Turkey (40°00' N – 33°35' E)

www.ipcc.ch/report/SRCCL

Louis Verchot
International Center Tropical Agriculture
Madrid, 5 December 2019

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INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Table SPM1. Net anthropogenic emissions due to Agriculture, Forestry, and other Land Use (AFOLU) and non-AFOLU (Panel 1)

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Panel 1: Contribution of AFOLU									
		FOLU	Agriculture	Total					
		A	B	C = A + B	D	E = C + D	F = (C/E) *100	G	A + G
CO_2[2]	Gt CO_2 y^{-1}	5.2 ± 2.6	No data[11]	5.2 ± 2.6	33.9 ± 1.8	39.1 ± 3.2	13%	-11.2 ± 2.6	-6.0 ± 3.7
CH_4[3,8]	Mt CH_4 y^{-1}	19.2 ± 5.8	141.6 ± 42.5	160.8 ± 43	201.3 ± 100.6	362 ± 109			
	Gt CO_2e y^{-1}	0.5 ± 0.2	4.0 ± 1.2	4.5 ± 1.2	5.6 ± 2.8	10.1 ± 3.1	44%		
N_2O[3,8]	Mt N_2O y^{-1}	0.3 ± 0.1	8.3 ± 2.5	8.7 ± 2.5	2.0 ± 1.0	10.6 ± 2.7			
	Gt CO_2e y^{-1}	0.09 ± 0.03	2.2 ± 0.7	2.3 ± 0.7	0.5 ± 0.3	2.8 ± 0.7	81%		
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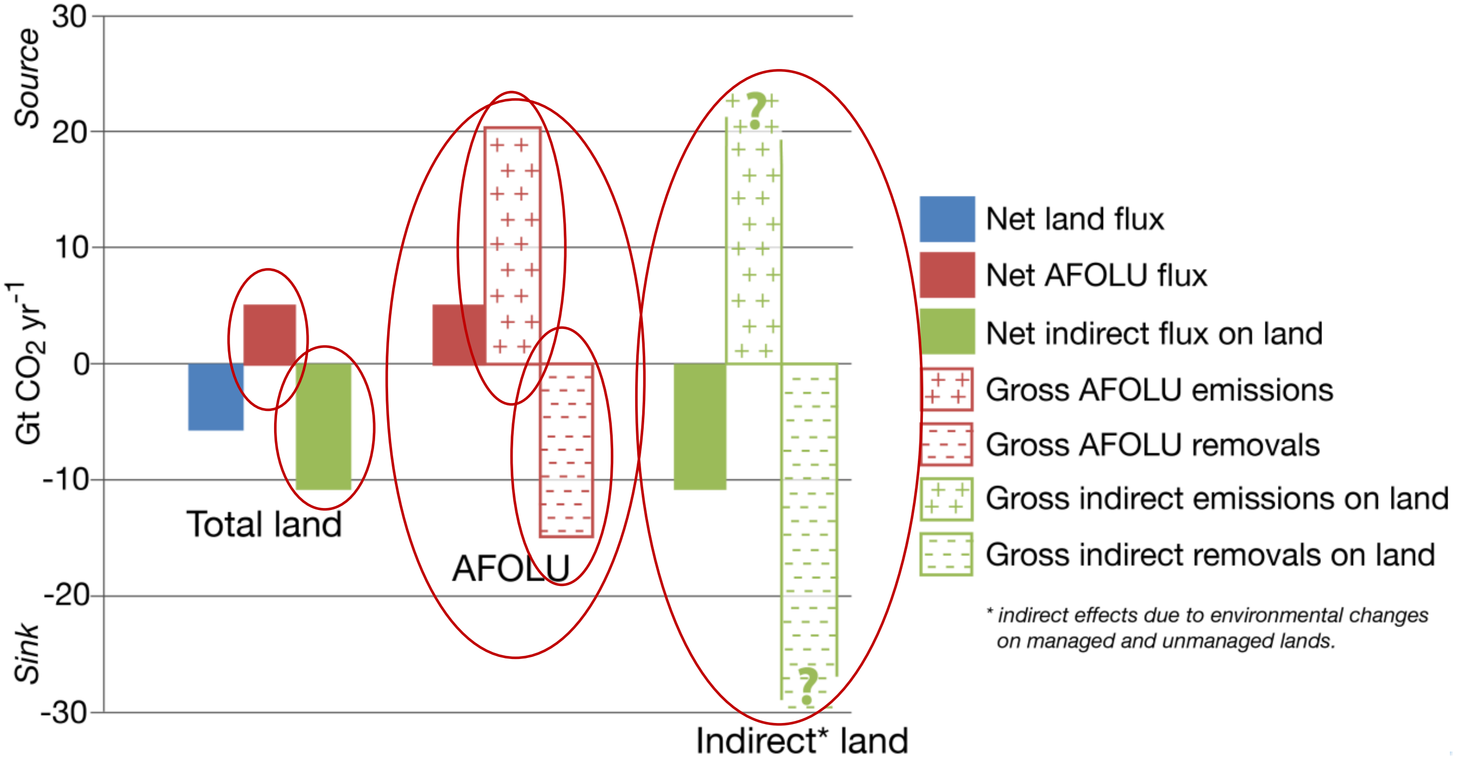
Understanding the gross emissions and removals that underlie the net land emission

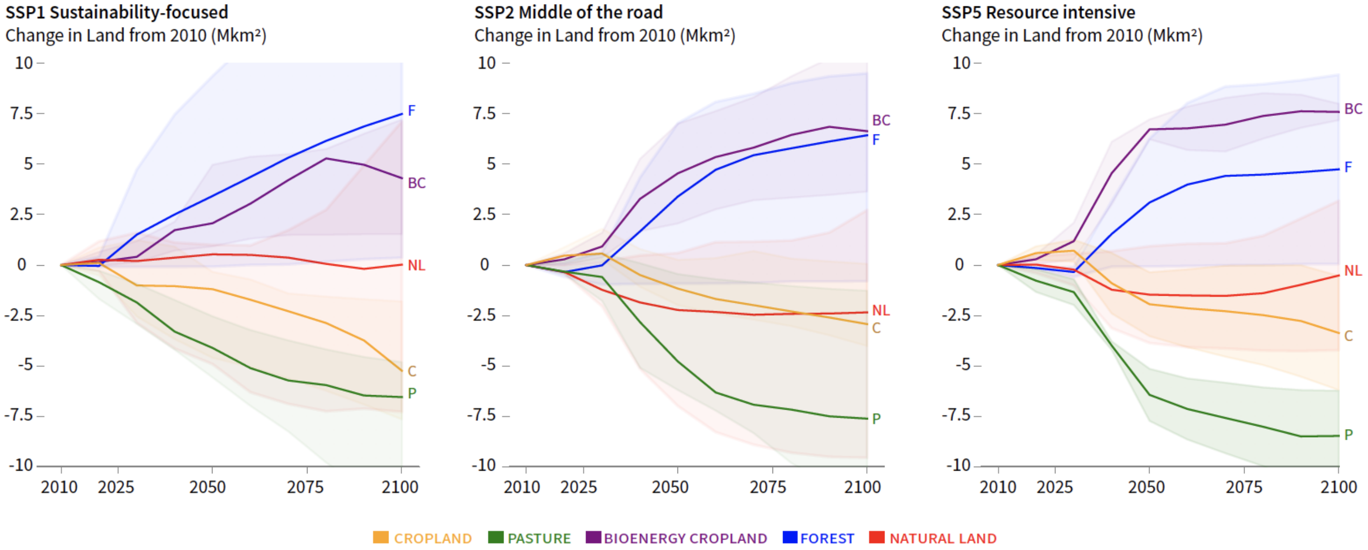


Change in land(Mha) area from 2010 across scenarios RCP 1.9, RCP2.6 RCP4.5 for different SSPs

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

- 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
	Reduced grassland conversion to cropland
Forests	Forest management
	Reduced deforestation and forest degradation
Soils	Increased soil organic carbon content
	Reduced soil erosion
	Reduced soil salinization
	Reduced soil compaction
Other ecosystems	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

Land-based mitigation

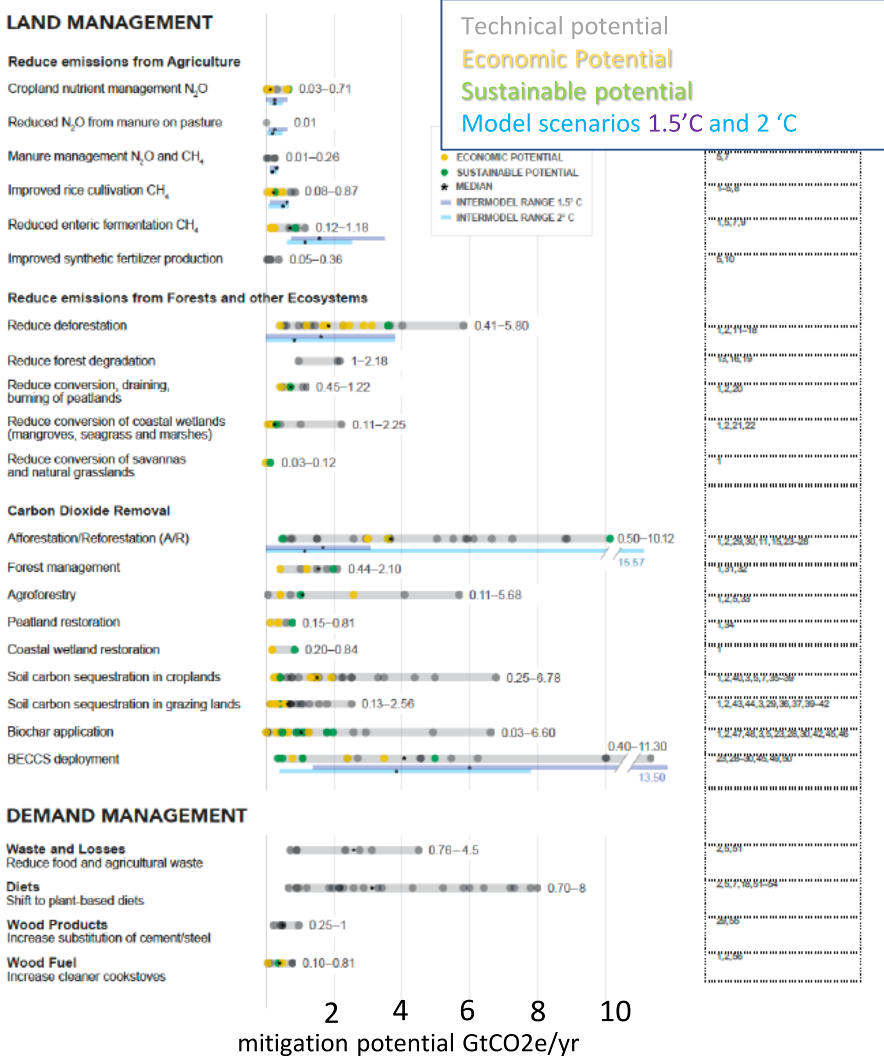
- Not additive
- Greatest potential:
  - Afforestation
  - BECCS
  - Dietary change

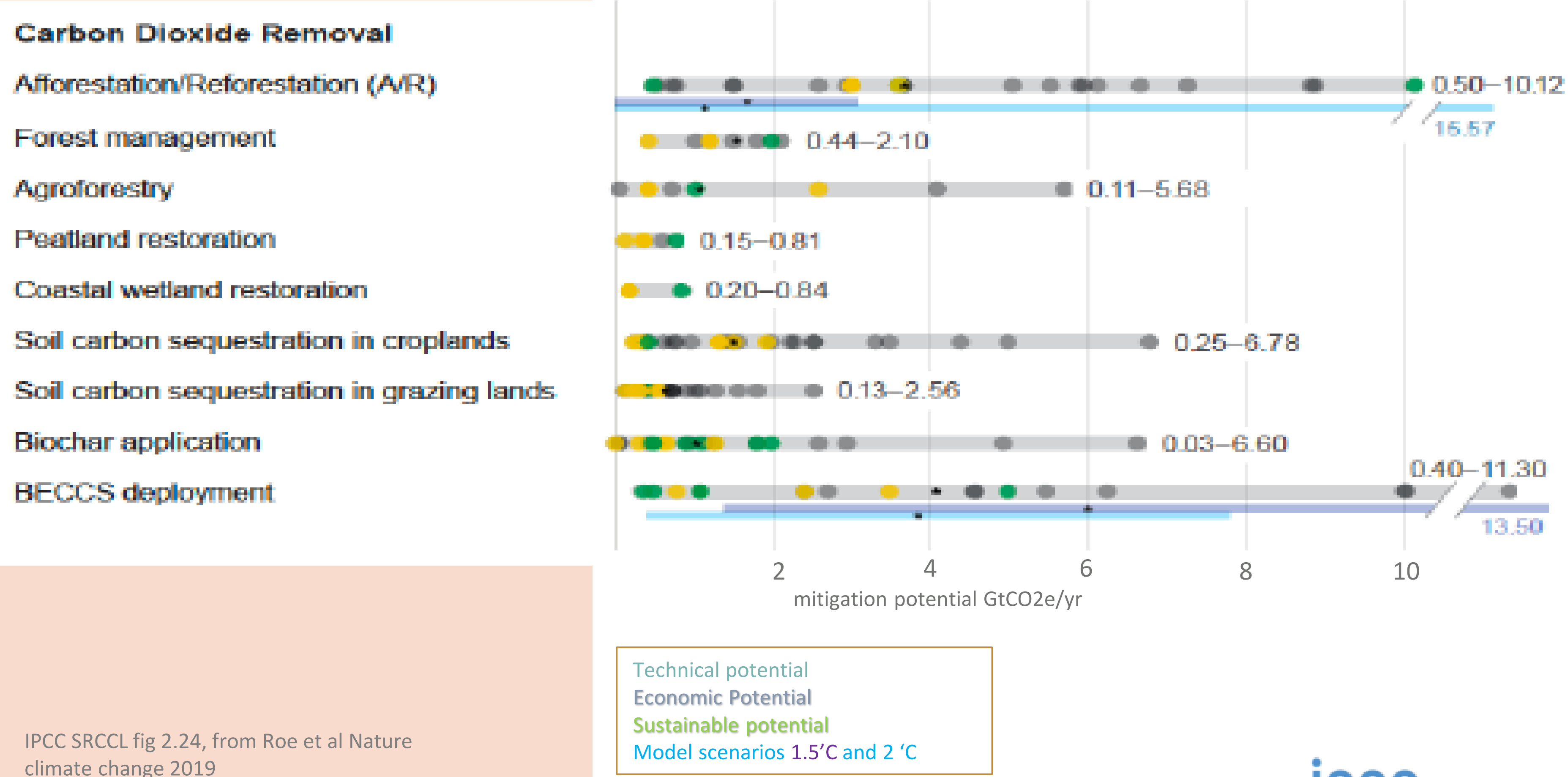
Reduced emissions from agriculture

Reduced emissions from forests and other ecosystems

Carbon dioxide removal

Demand management





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

Some response measures have tradeoffs - context is important (location, scale, sustainability).

Bioenergy and BECCS

Mitigation	Adaptation	Desertification	Land degradation	Food security	Cost
H	L			L	● / ●●●

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 $GtCO_2\ yr^{-1}$ in 2050, and noting that bioenergy without CCS can also achieve emissions reductions of up to several $GtCO_2\ yr^{-1}$ 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 km_2 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}.

Mitigation	Adaptation	Desertification	Land degradation	Food security

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 6.58}

Reforestation and forest restoration

Mitigation	Adaptation	Desertification	Land degradation	Food security	Cost
M	M	M	M	M	●●

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 $GtCO_2\ yr^{-1}$ 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}.

Mitigation	Adaptation	Desertification	Land degradation	Food security

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 {Box6.1C; Table 6.6}.

Afforestation

Mitigation	Adaptation	Desertification	Land degradation	Food security	Cost
M	M	M	L	M	●●

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 $GtCO_2\ yr^{-1}$ 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}.

Mitigation	Adaptation	Desertification	Land degradation	Food security

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

Mitigation	Adaptation	Desertification	Land degradation	Food security	Cost
M	—	—	L	L	●●●

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 $GtCO_2\ yr^{-1}$ removal {6.4.1.1.3}. Dedicated energy crops required for feedstock production could occupy 0.4–2.6 Mkm^2 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}.

Mitigation	Adaptation	Desertification	Land degradation	Food security

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 Mkm^2 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}.

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
	Moderate	0.3 to 3	1 to 25	0.5 to 3	0.5 to 3	1 to 100
	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

←→ **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

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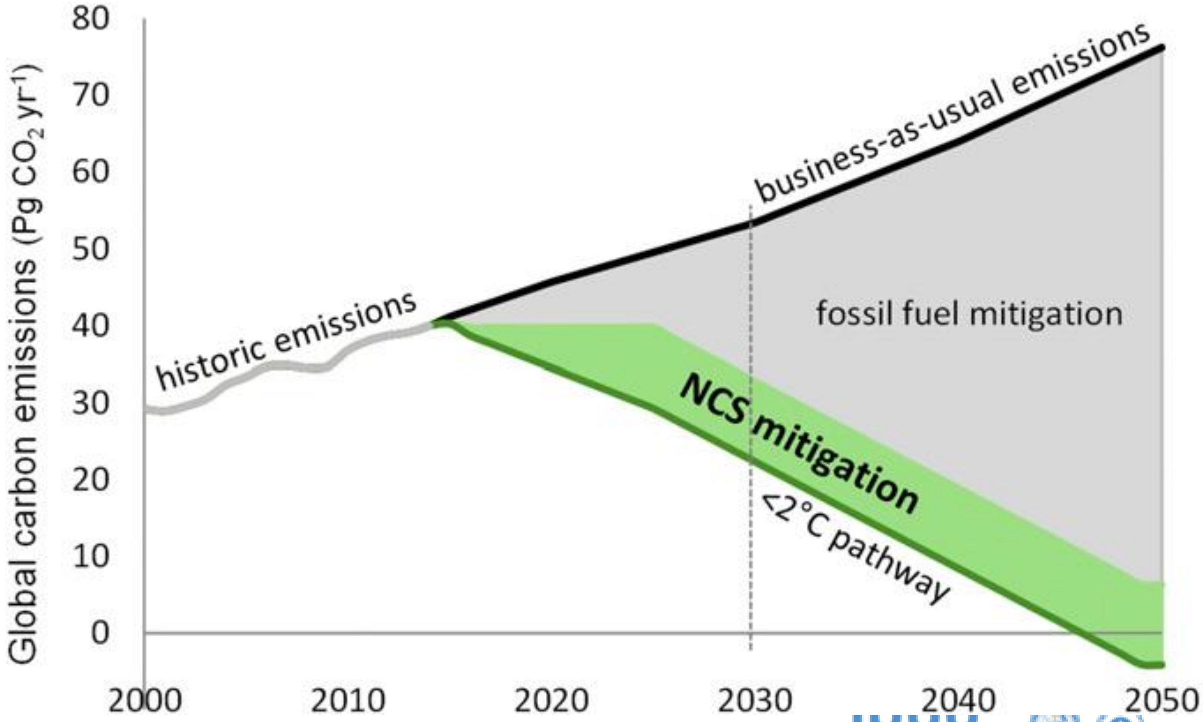
Interlinkages

- Response options are **interlinked.** Some have co-benefits or are more **effective when paired**.
- Some response options are **less feasible** than others.
- **Coordinated action** is required to enable responses.
- **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.
- Some responses don't address **underlying drivers**.

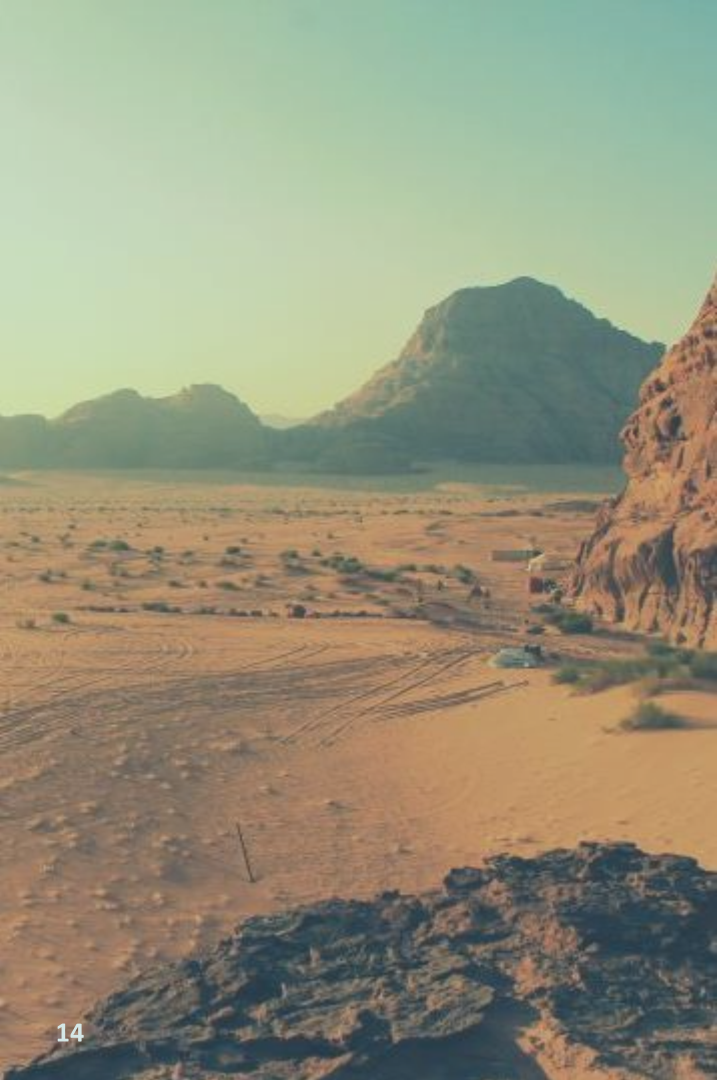
12

The contribution of natural climate solutions decreases over time and the proportion depends on the baseline

- RCP 8.5 trajectory (black line)
- The green area:cost effective NCS (aggregate of 20 pathways)
- % of needed mitigation
  - 37% through 2030
  - 29% at year 2030
  - 20% through 2050
  - 9%through 2100

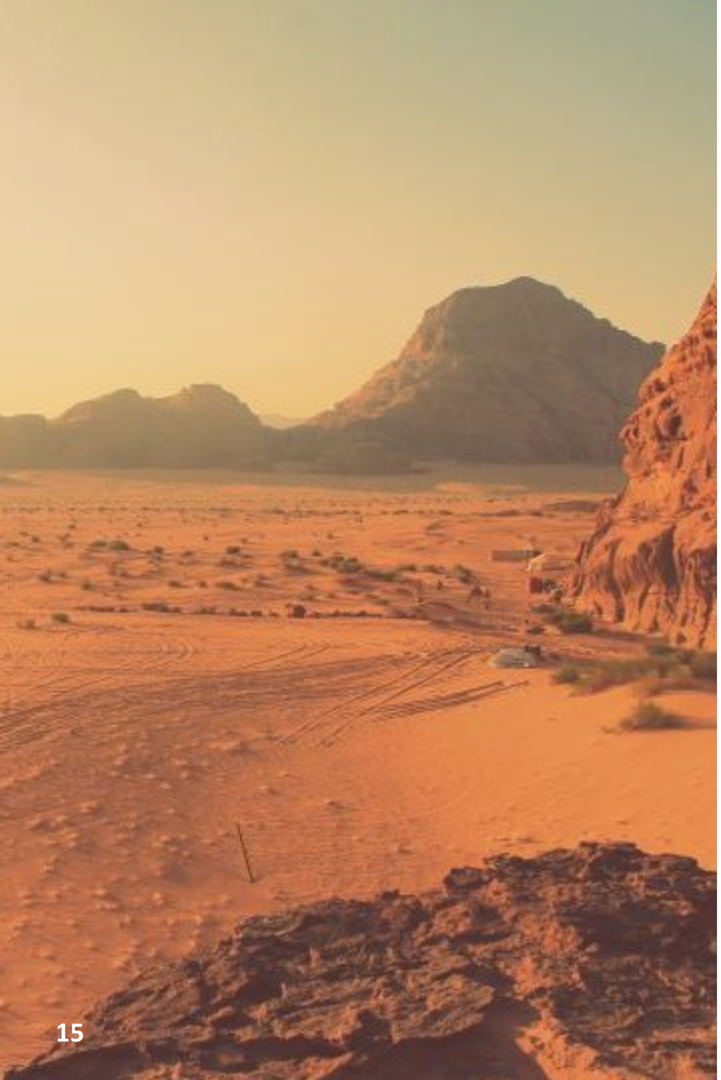


Source: Griscom et al. PNAS 2018



Response Options

- Many land-related responses that contribute to climate change adaptation and mitigation also enhance food security.
- There are limits to the deployment of land-based mitigation measures such as bioenergy crops or afforestation. Use at large scale increases food security risks and sustainable development.
- Avoiding, reducing and reversing desertification would enhance soil fertility, increase carbon storage in soils and biomass, while **benefitting agricultural productivity and food security**.



The big picture

- The potential for mitigating climate can only be realised if **agricultural emissions** are **included in mainstream climate policy**.
- **Acting early** will avert or minimise risks, reduce losses and generate returns on investment.
- **Measuring progress towards goals** is important to decision-making, adaptive governance & policy success.
- A **flexible, adaptive, iterative approach** is needed for the complexity of land and climate interactions and food security.

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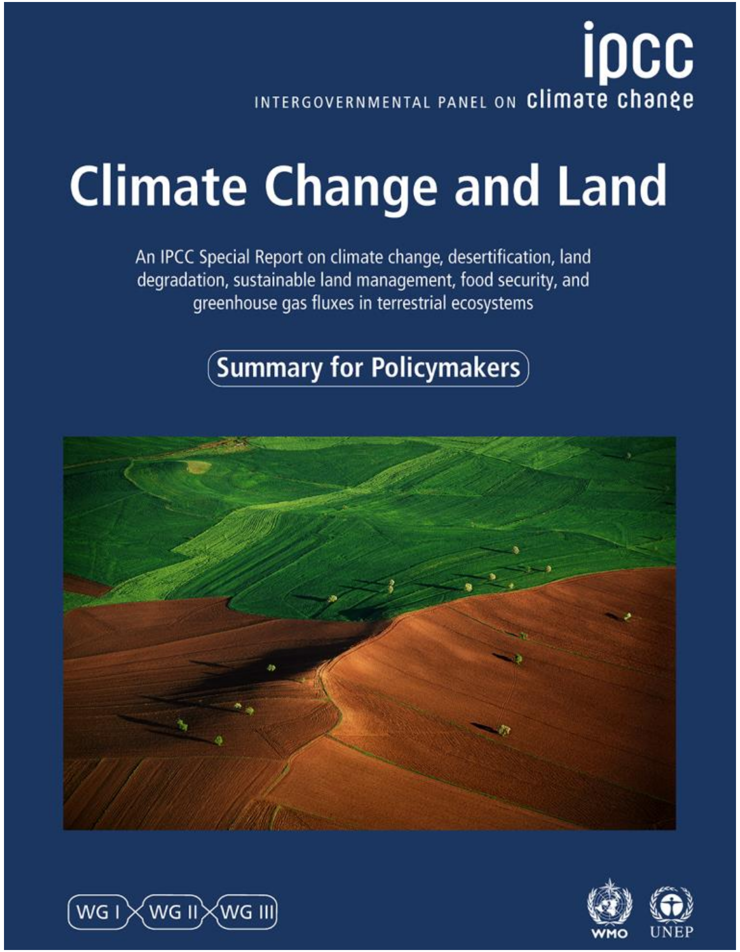

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