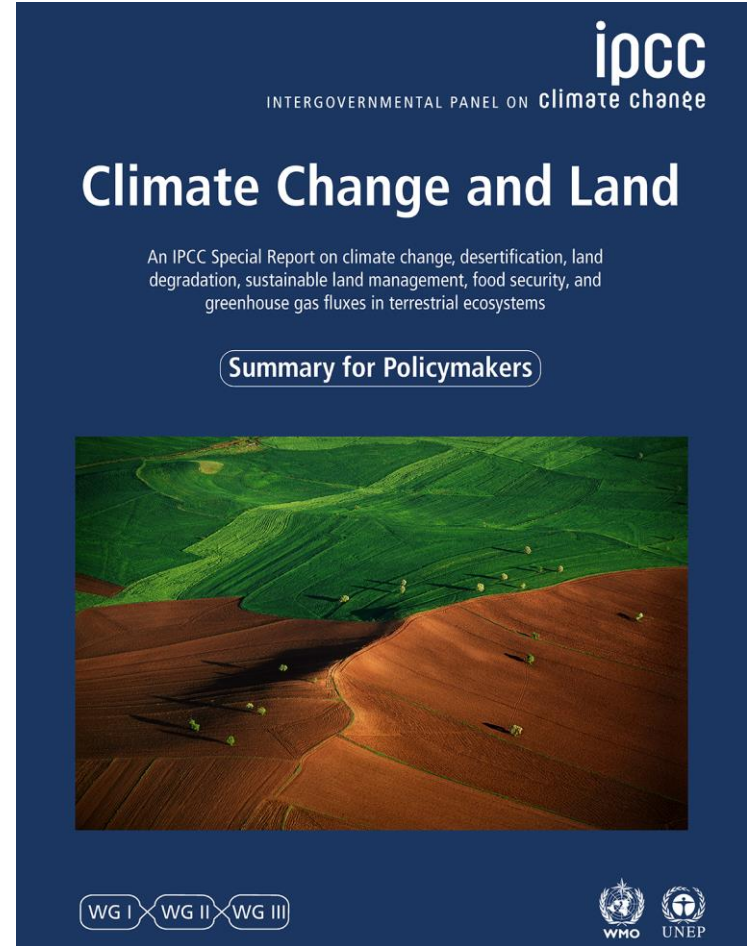


CLIMATE CHANGE AND LAND

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



“ Enabling Response Options and Near-term Action

Appropriate design of policies, institutions and governance systems at **all scales** can contribute to land-related adaptation and mitigation while facilitating the pursuit of **climate-adaptive development pathways**.

Mutually supportive climate and land policies have the potential to **save resources**, amplify social **resilience**, support ecological **restoration**, and foster engagement and **collaboration** between multiple stakeholders.



- Policies that operate across the food system, including those that reduce **food loss** and **waste** and influence **dietary choices**, enable more sustainable land-use management, enhanced food security and **low emissions** trajectories.
- Such policies can contribute to climate change **adaptation** and **mitigation**, reduce land degradation, desertification and poverty as well as improve **public health**.
- The adoption of sustainable land management and poverty eradication can be enabled by:
 - *improving access to markets*
 - *securing land tenure*
 - *factoring environmental costs into food*
 - *making payments for ecosystem services*
 - *enhancing local and community collective action*



- Acknowledging co-benefits and trade-offs when **designing** land and food **policies** can **overcome barriers** to implementation.
- Strengthened **multilevel**, hybrid and cross-sectoral governance, as well as policies developed and adopted in an iterative, coherent, adaptive and flexible manner can **maximise co-benefits** and **minimise trade-offs**
- This is because land management decisions are made from **farm level to national scales**, and both climate and land policies often range across **multiple** sectors, departments and agencies.
- Integration **across sectors** and **scales** increases the chance of **maximising co-benefits** and **minimising trade-offs**.



- The effectiveness of decision-making and governance is **enhanced** by the **involvement of local stakeholders** in the selection, evaluation, implementation and monitoring of policy instruments for land based climate change adaptation and mitigation.
- This applies particularly to those **most vulnerable to climate change**, including indigenous peoples and local communities, women, and the poor and marginalised.

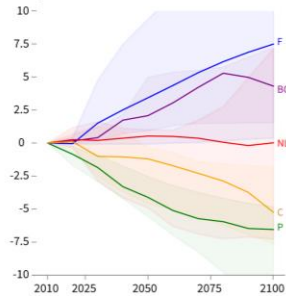
A. Pathways linking socioeconomic development, mitigation responses and land

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.

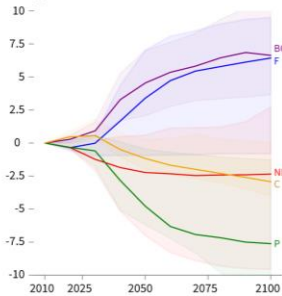
SSP1 Sustainability-focused
Change in Land from 2010 (Mkm²)



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.

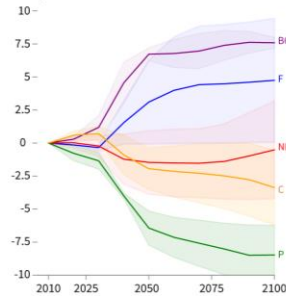
SSP2 Middle of the road
Change in Land from 2010 (Mkm²)



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.

SSP5 Resource intensive
Change in Land from 2010 (Mkm²)



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

We looked at the influences/change to land cover due to different land-management approaches over time.

Three pathways were looked at.

All were for global warming of 1.5 degrees (RCP1.9).

B. Land use and land cover change in the SSPs

Quantitative indicators for the SSPs	Count of models included*	Change in Natural Land from 2010 (Mkm ²)	Change in Bioenergy Cropland from 2010 (Mkm ²)	Change in Cropland from 2010 (Mkm ²)	Change in Forest from 2010 (Mkm ²)	Change in Pasture from 2010 (Mkm ²)	
SSP1	RCP1.9 in 2050	5/5	0.5 (-0.9, 1)	2.1 (0.9, 5)	-1.2 (-0.6, -0.3)	3.4 (-0.1, 9.4)	-4.1 (-5.6, -2.5)
	↳ 2100		0 (-7.3, 7.1)	4.3 (1.5, 7.2)	-5.2 (-7.6, -1.8)	7.5 (0.4, 15.9)	-6.5 (-12.2, -0.8)
	RCP2.6 in 2050	5/5	-0.9 (-2.2, 1.5)	1.3 (0.6, 1.9)	-1 (-4.7, 3)	2.6 (-0.3, 8.4)	-3 (-4, -2.4)
	↳ 2100		0.2 (-3.5, 1.1)	5.1 (1.6, 6.3)	-3.2 (-7.7, -1.8)	6.6 (-0.1, 10.5)	-5.5 (-9.9, -4.2)
	RCP4.5 in 2050	5/5	0.5 (-1, 1.7)	0.8 (0.5, 1.3)	0.1 (-3.2, 1.5)	0.6 (-0.7, 4.2)	-2.4 (-3.3, -0.9)
	↳ 2100		1.8 (-1.7, 6)	1.9 (1.4, 2.7)	-2.3 (-6.4, -1.6)	3.9 (0.2, 8.8)	-4.6 (-7.2, -2)
Baseline in 2050	5/5	0.3 (-1.1, 1.8)	0.5 (0.2, 1.4)	0.2 (-1.6, 1.9)	-0.1 (-0.8, 1.1)	-1.5 (-2.9, -0.2)	
↳ 2100		3.3 (-0.3, 5.9)	1.8 (1.4, 2.4)	-1.5 (-5.7, -0.9)	0.9 (0.3, 3)	-2.1 (-7, 0)	
SSP2	RCP1.9 in 2050	4/5	-2.2 (-7, 0.6)	4.5 (2.1, 7)	-1.2 (-2, 0.3)	3.4 (-0.9, 7)	-4.8 (-6.2, -0.4)
	↳ 2100		-2.3 (-9.6, 2.7)	6.6 (3.6, 11)	-2.9 (-4, 0.1)	6.4 (-0.8, 5.5)	-7.6 (-11.7, -1.3)
	RCP2.6 in 2050	5/5	-3.2 (-4.2, 0.1)	2.2 (1.7, 4.7)	0.6 (-1.9, 1.9)	1.6 (-0.9, 4.2)	-1.4 (-3.7, 0.4)
	↳ 2100		-5.2 (-7.2, 0.5)	6.9 (2.3, 10.8)	-1.4 (-4, 0.8)	5.6 (-0.9, 5.9)	-7.2 (-8, 0.5)
	RCP4.5 in 2050	5/5	-2.2 (-2.2, 0.7)	1.5 (0.1, 2.1)	1.2 (-0.9, 2.7)	-0.9 (-2.5, 2.9)	-0.1 (-2.5, 1.6)
	↳ 2100		-3.4 (-4.7, 1.5)	4.1 (0.4, 6.3)	0.7 (-2.6, 3.1)	-0.5 (-3.1, 5.9)	-2.8 (-5.3, 1.9)
Baseline in 2050	5/5	-1.5 (-2.6, -0.2)	0.7 (0, 1.5)	1.3 (1, 2.7)	-1.3 (-2.5, -0.4)	-0.1 (-1.2, 1.6)	
↳ 2100		-2.1 (-5.9, 0.3)	1.2 (0.1, 2.4)	1.9 (0.8, 2.8)	-1.3 (-2.7, -0.2)	-0.2 (-1.9, 2.1)	
SSP3	RCP1.9 in 2050	Infeasible in all assessed models	-	-	-	-	-
	↳ 2100		-	-	-	-	-
	RCP2.6 in 2050	Infeasible in all assessed models	-	-	-	-	-
	↳ 2100		-	-	-	-	-
	RCP4.5 in 2050	3/3	-3.4 (-4.4, -2)	1.3 (1.3, 2)	2.3 (1.2, 3)	-2.4 (-4, -1)	2.1 (-0.1, 3.8)
	↳ 2100		-6.2 (-6.8, -5.4)	4.6 (1.5, 7.1)	3.4 (1.9, 4.5)	-3.1 (-5.5, -0.3)	2 (-2.5, 4.4)
Baseline in 2050	4/4	-3 (-4.6, -1.7)	1 (0.2, 1.5)	2.5 (1.5, 3)	-2.5 (-4, -1.5)	2.4 (0.6, 3.8)	
↳ 2100		-5 (-7.1, -4.2)	1.1 (0.9, 2.5)	5.1 (3.8, 6.1)	-3.3 (-6, -2.6)	3.4 (0.9, 6.4)	
SSP4	RCP1.9 in 2050	Infeasible in all assessed models**	-	-	-	-	-
	↳ 2100		-	-	-	-	-
	RCP2.6 in 2050	3/3	-4.5 (-6, -2.1)	3.3 (1.5, 4.5)	0.5 (-0.1, 0.9)	0.7 (-0.3, 2.2)	-0.6 (-0.7, 0.1)
	↳ 2100		-5.8 (-10.2, -4.7)	2.5 (2.3, 15.2)	-0.8 (-0.8, 1.8)	1.4 (-1.7, 4.1)	-1.2 (-2.5, -0.2)
	RCP4.5 in 2050	3/3	-2.7 (-4.4, -0.4)	1.7 (1, 1.9)	1.1 (0.1, 1.7)	-1.8 (-2.9, 2.1)	0.8 (-0.5, 1.5)
	↳ 2100		-2.8 (-7.8, -2)	2.7 (2.3, 4.7)	1.1 (0.2, 1.2)	-0.7 (-2.6, 1)	1.4 (-1, 1.8)
Baseline in 2050	3/3	-2.8 (-2.9, -0.2)	1.1 (0.7, 2)	1.1 (0.7, 1.8)	-1.8 (-2.3, -1)	1.5 (-0.5, 2.1)	
↳ 2100		-2.4 (-5, -1)	1.7 (1.4, 2.6)	1.2 (1.2, 1.9)	-2.4 (-2.5, -2)	1.3 (-1, 4.4)	
SSP5	RCP1.9 in 2050	2/4	-1.5 (-3.9, 0.9)	6.7 (6.2, 7.2)	-1.9 (-3.5, -0.4)	3.1 (-0.1, 6.3)	-6.4 (-7.7, -5.1)
	↳ 2100		-0.5 (-4.2, 3.2)	7.6 (7.2, 8)	-3.4 (-6.2, -0.5)	4.7 (0.1, 9.4)	-8.5 (-10.7, -6.2)
	RCP2.6 in 2050	4/4	-3.4 (-6.9, 0.3)	4.8 (3.8, 5.1)	-2.1 (-4, 1)	3.9 (-0.1, 6.7)	-4.4 (-5, 0.2)
	↳ 2100		-4.3 (-8.4, 0.5)	9.1 (7.7, 9.2)	-3.3 (-6.5, -0.5)	3.9 (-0.1, 9.3)	-6.3 (-9.1, -1.4)
	RCP4.5 in 2050	4/4	-2.5 (-3.7, 0.2)	1.7 (0.6, 2.9)	0.6 (-3.3, 1.9)	-0.1 (-1.7, 0.6)	-1.2 (-2.6, 2.3)
	↳ 2100		-4.1 (-4.6, 0.7)	4.8 (2, 8)	-1 (-5.5, 1)	-0.2 (-1.4, 5.1)	-3 (-5.2, 2.1)
Baseline in 2050	4/4	-0.6 (-3.8, 0.4)	0.8 (0, 2.1)	1.5 (-0.7, 3.3)	-1.9 (-3.4, 0.5)	-0.1 (-1.5, 2.9)	
↳ 2100		-0.2 (-2.4, 1.8)	1 (0.2, 2.3)	1 (-2, 2.5)	-2.1 (-3.4, 1.1)	-0.4 (-2.4, 2.8)	

* Count of models included / Count of models attempted. One model did not provide land data and is excluded from all entries.

** One model could reach RCP1.9 with SSP4, but did not provide land data

SPM Figure 4 B

We then looked at 5 different pathways (including SSP1, SSP2 and SSP5).

For each pathway we analysed the change in amount of land cover for each type of land from a 2010 baseline for both 2050 to 2100.

This was completed for global warming scenarios of 1.5 degrees (RCP1.9), 2 degrees (RCP2.6), and 3 degrees (RCP4.5).

The types of land included...

*Change in Natural
Land from 2010
Mkm²*

*Change in Bioenergy
Cropland from 2010
Mkm²*

*Change in Cropland
from 2010
Mkm²*

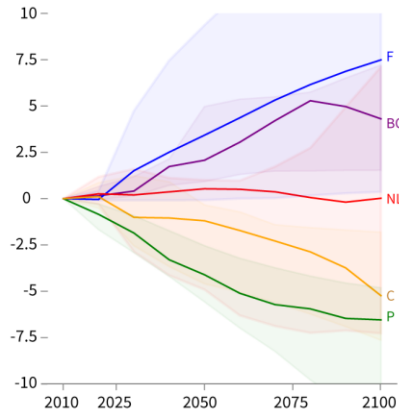
*Change in Forest
from 2010
Mkm²*

*Change in Pasture
from 2010
Mkm²*

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.

SSP1 Sustainability-focused
Change in Land from 2010 (Mkm²)

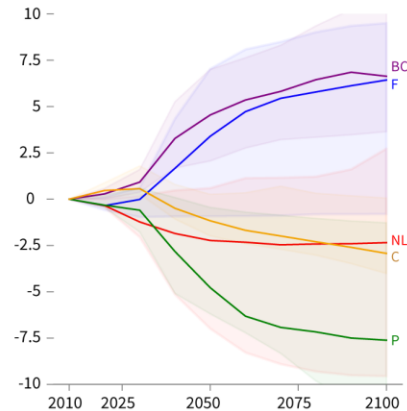


■ CROPLAND ■ PASTURE ■ BIOENERGY CROPLAND ■ FOREST ■ NATURAL LAND

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.

SSP2 Middle of the road
Change in Land from 2010 (Mkm²)



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

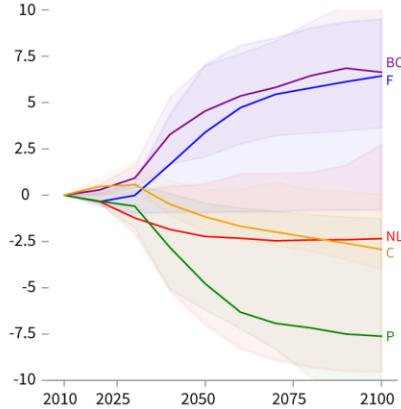
B. Middle of the road (SSP2)

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)

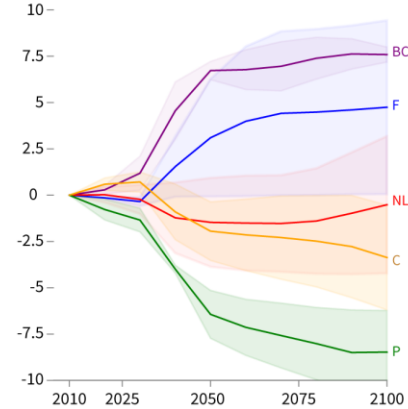
Resource-intensive production and consumption patterns, results in high baseline emissions. Mitigation focuses on technological solutions including substantial bioenergy and BECCS. Intensification and competing land uses contribute to declines in agricultural land.

SSP2 Middle of the road
Change in Land from 2010 (Mkm²)



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

SSP5 Resource intensive
Change in Land from 2010 (Mkm²)



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



Near-term Action

- Actions can be taken in the near-term, based on **existing knowledge**, to address desertification, land degradation and food security while supporting longer-term responses that enable adaptation and mitigation to climate change.
- These include actions to:
 - *build individual and institutional capacity*
 - *accelerate knowledge transfer*
 - *enhance technology transfer and deployment*
 - *enable financial mechanisms*
 - *implement early warning systems*
 - *undertake risk management*
 - *address gaps in implementation and upscaling*
- Near-term action to address adaptation and mitigation, desertification, land degradation and food security can bring **social, ecological, economic and development co-benefits**.
- Co-benefits can contribute to **poverty eradication** and more **resilient livelihoods** for those who are **vulnerable**.



Rapid reductions in anthropogenic GHG emissions across all sectors following ambitious mitigation pathways reduce negative impacts of climate change on land ecosystems and food systems.

Delaying climate mitigation and adaptation responses across sectors would lead to increasingly negative impacts on land and reduce the prospect of sustainable development.

“

Land could feed the world in a changing climate and provide biomass for renewable energy, **but it can't do it all.** It would require early, **far-reaching action across several fronts.**

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INTERGOVERNMENTAL PANEL ON climate change

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

Summary for Policymakers



WG I | WG II | WG III



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