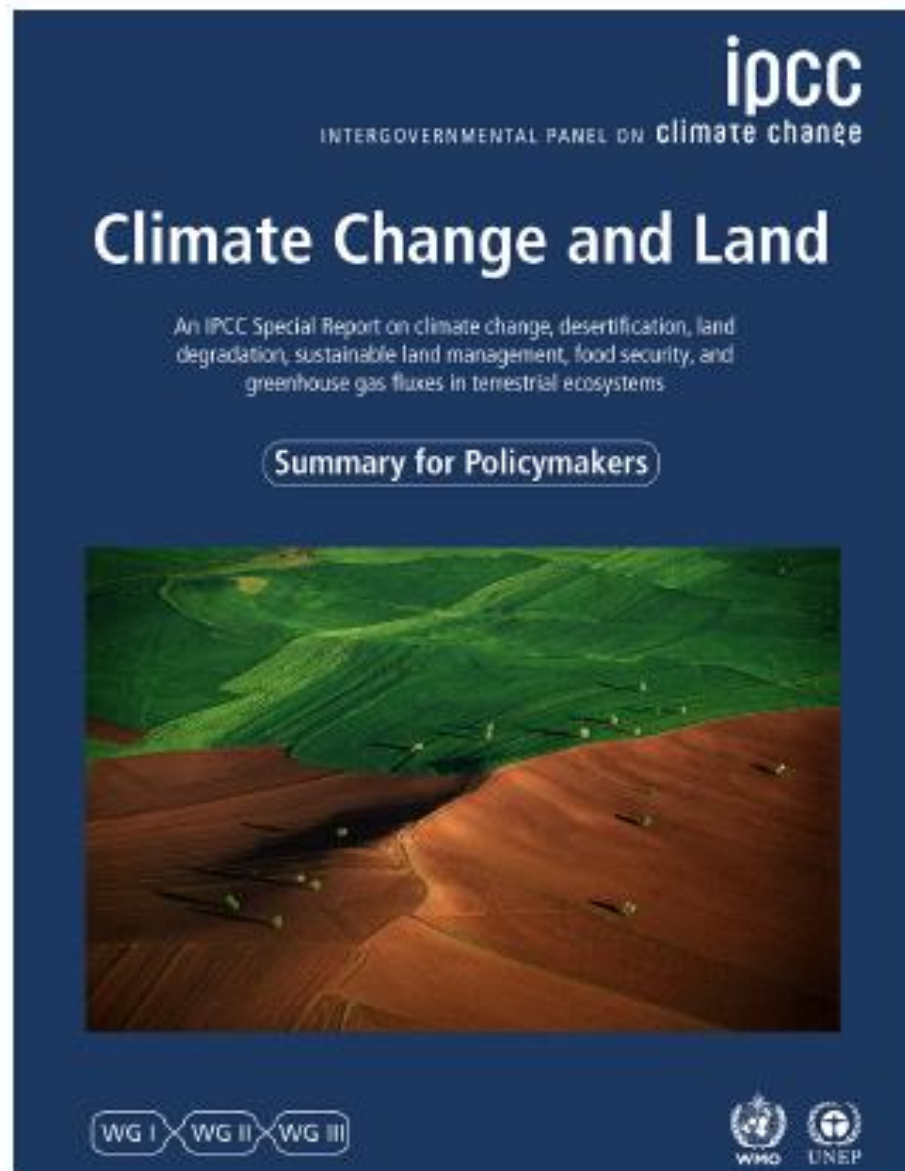


*IPCC Special Report
On Climate Change,
Desertification, land
Degradation,
sustainable land
management, food
security and greenhouse
gas fluxes in terrestrial
ecosystems*

Zinta Zommers

IPCC Lead Author



IPCC reports are the result of extensive work of many scientists from around the world.




107 Authors

52 Countries

53% Developing Countries

7,000 references assessed

More than 28,000 comments

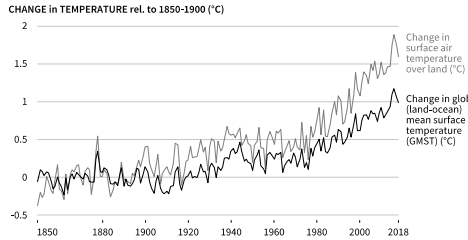
An aerial photograph showing a yellow bulldozer working on a large pile of earth or sand. The bulldozer is positioned in the upper right quadrant, pushing a large amount of material. In the foreground, there is a wooden structure, possibly a ramp or a platform, with some equipment on it. The overall scene is dominated by the earth and the machinery, with a blue tint to the image.

Land is under growing human pressure
Land is part of the solution
But Land can't do it all

Land use and observed climate change

A. Observed temperature change relative to 1850-1900

Since the pre-industrial period (1850-1900) the observed mean land surface air temperature has risen considerably more than the global mean surface (land and ocean) temperature (GMST).

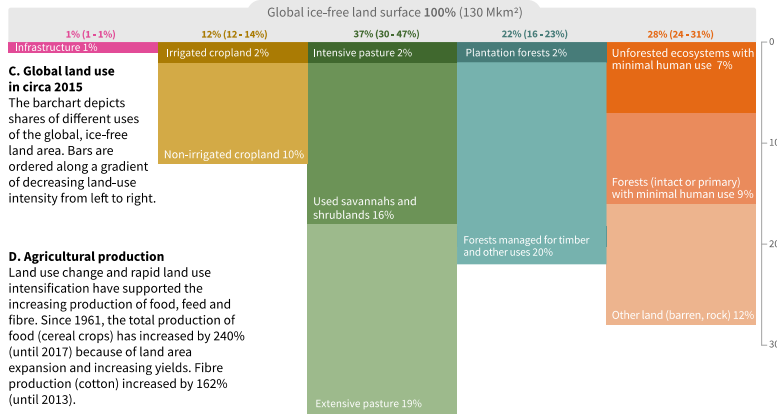
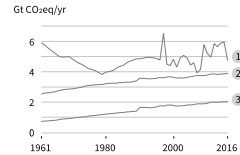


B. GHG emissions

An estimated 23% of total anthropogenic greenhouse gas emissions (2007-2016) derive from Agriculture, Forestry and Other Land Use (AFOLU).

CHANGE in emissions rel. to 1961

- ① Net CO₂ emissions from FOLU (Gt CO₂/yr)
- ② CH₄ emissions from Agriculture (Gt CO₂eq/yr)
- ③ N₂O emissions from Agriculture (Gt CO₂eq/yr)



C. Global land use in circa 2015

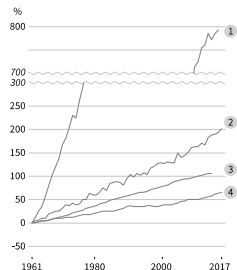
The barchart depicts shares of different uses of the global, ice-free land area. Bars are ordered along a gradient of decreasing land-use intensity from left to right.

D. Agricultural production

Land use change and rapid land use intensification have supported the increasing production of food, feed and fibre. Since 1961, the total production of food (cereal crops) has increased by 240% (until 2017) because of land area expansion and increasing yields. Fibre production (cotton) increased by 162% (until 2013).

CHANGE in % rel. to 1961

- ① Inorganic N fertiliser use
- ② Cereal yields
- ③ Irrigation water volume
- ④ Total number of ruminant livestock



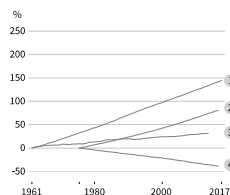
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E. Food demand

Increases in production are linked to consumption changes.

CHANGE in % rel. to 1961 and 1975

- ① Population
- ② Prevalence of overweight + obese
- ③ Total calories per capita
- ④ Prevalence of underweight

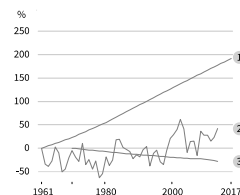


F. Desertification and land degradation

Land-use change, land-use intensification and climate change have contributed to desertification and land degradation.

CHANGE in % rel. to 1961 and 1970

- ① Population in areas experiencing desertification
- ② Dryland areas in drought annually
- ③ Inland wetland extent



Total pages: xx

Figure SPM.1

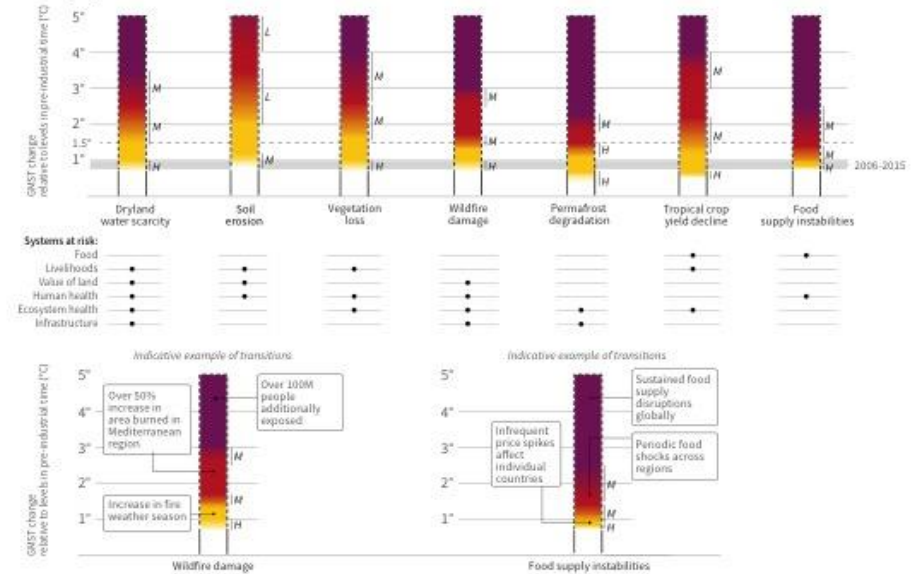
- Observed mean land temp. risen more than GMST
- 23% of total GHG from agriculture, forestry and land use

Figure SPM.2

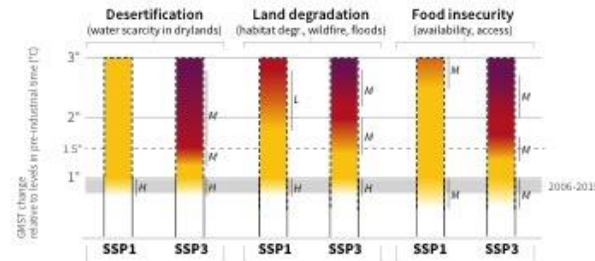
Risks to land-related human systems and ecosystems from global climate change and socio-economic development

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

Increases in global mean surface temperature (GMST), relative to pre-industrial levels, affect processes involved in **desertification** (water scarcity), **land degradation** (soil erosion, vegetation loss, wildfire, permafrost thaw) and **food security** (crop yield and food supply instabilities). Changes in these processes drive risks to food systems, livelihoods, infrastructure, the value of land, and human and ecosystem health. Changes in one process (e.g. wildfire or water scarcity) may result in compound risks. Risks are location-specific and differ by region.



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.

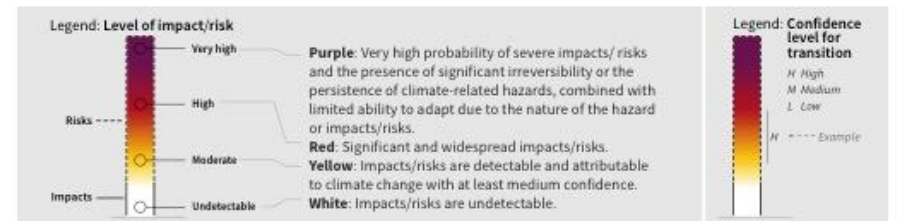
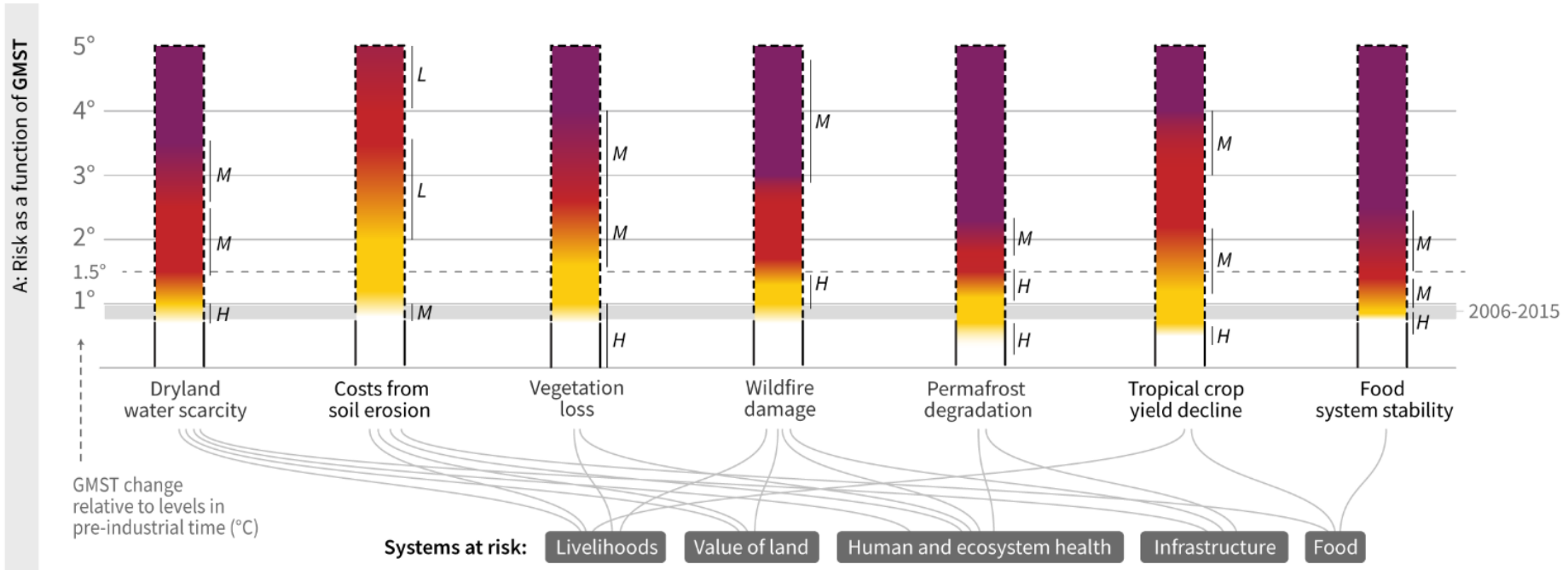


Figure SPM.2: Narrative

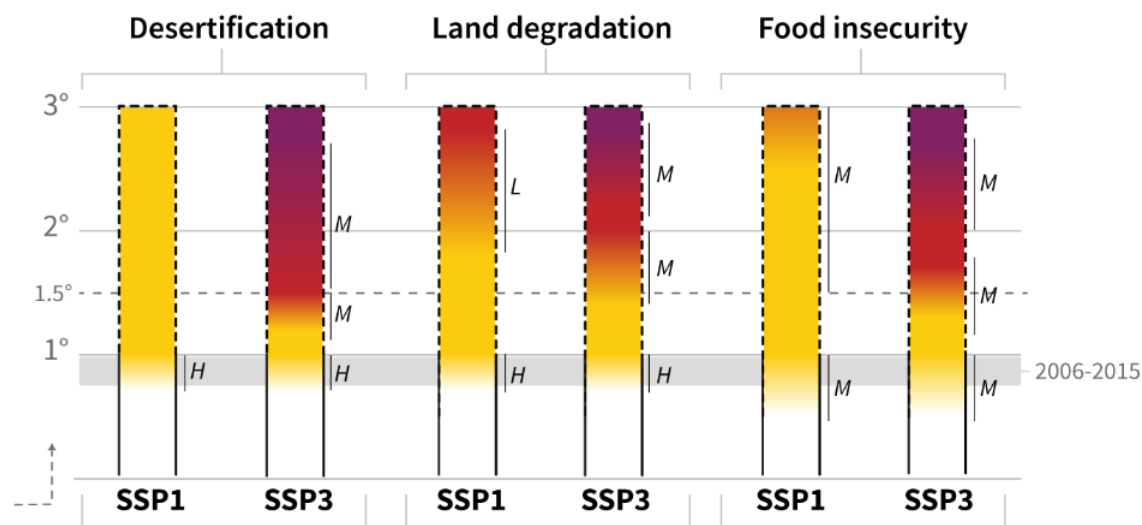
- Impacts across all processes at current levels of GMST increase
- Risks increase rapidly with GMST increase, although the level of risk differs across processes. Severe and irreversible risks with limited capacity to adapt were identified across almost all processes by 3°C GMST increase.
- Cascading risks identified
- Socio-economic development pathways have significant effects on risk. At the same GMST increase, there are lower risks in a world with sustainable land management and consumption patterns, low population, high income.

Figure SPM.2: Panel A



- Around 1.5°C GMST high risks from **dryland water scarcity, fire damage, permafrost degradation and food system instability**
- By 2 degrees **very high risks** are identified from **permafrost degradation and food system instability**

Figure SPM.2: Panel B



- Two contrasting socioeconomic pathways:
 - SSP1 has lower population, higher income, and lower land conversion than SSP3
 - SSP1 has high adaptive capacity, while SSP3 has barriers to adaptation.
 - As a result, SSP1 has lower risks than SSP3 at the same GMST.

Figure SPM.3

Response Options

- Many response options have multiple co-benefits
- Improved management of croplands and forests, increased food productivity, reduction of food waste, increased soil organic content
- Risk management

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

Panel A shows response options that can be implemented without or with limited competition for land, including some that have the potential to reduce the demand for land. Co-benefits and adverse side effects are shown quantitatively based on the high end of the range of potentials assessed. Magnitudes of contributions are categorised using thresholds for positive or negative impacts. Letters within the cells indicate confidence in the magnitude of the impact relative to the thresholds used (see legend). Confidence in the direction of change is generally higher.

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	---	---
	Forest management	M	L	L	L	L	●●●
Soils	Reduced deforestation and forest degradation	M	L	L	L	L	●●●
	Increased soil organic carbon content	---	L	M	M	L	---
	Reduced soil erosion	←---	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	---
	Restoration & reduced conversion of coastal wetlands	M	L	M	M	L	---
Restoration & reduced conversion of peatlands	M	---	na	L	M	●●	
Response options based on value chain management							
Demand	Reduced post-harvest losses	M	M	L	L	M	---
	Dietary change	M	---	L	M	M	---
	Reduced food waste (consumer or retailer)	M	---	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							
Risk	Livelihood diversification	---	L	---	L	L	---
	Management of urban sprawl	---	L	L	M	L	---
	Risk sharing instruments	←---	L	L	---	L	●●●

Options shown are those for which data are available to assess global potential for three or more land challenges. The magnitudes are assessed independently for each option and are not additive.

Key for criteria used to define magnitude of impact of each integrated response option							Confidence level Indicates confidence in the estimate of magnitude category.
	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	H
	Moderate	0.3 to 3	1 to 25	0.5 to 3	0.5 to 3	1 to 100	M
	Small	Less than 0.3	Less than 1	Less than 0.5	Less than 0.5	Less than 1	L
Negative	Negligible	No effect	No effect	No effect	No effect	No effect	
	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

Cost range	
See technical caption for cost ranges in US\$ 100ae ³ or US\$ ha ⁻¹ .	
●●● High cost	●●● Medium cost
● Low cost	--- no data

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.

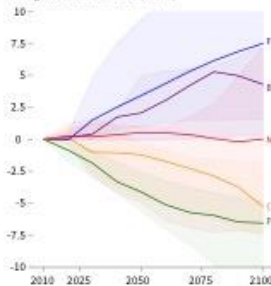
B. Middle of the road (SSP2)

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.

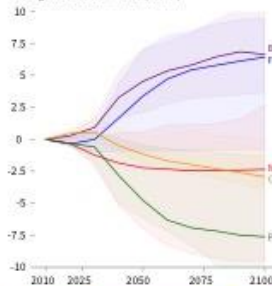
C. Resource intensive (SSP5)

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.

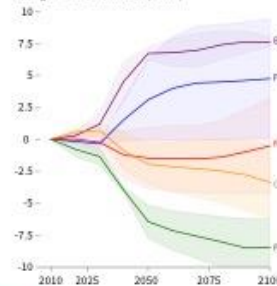
SSP1 Sustainability-focused
Change in Land from 2010 (Mkm²)



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



SSP5 Resource intensive
Change in Land from 2010 (Mkm²)



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

Land use under different socio-economic pathways

Differences in change in forests, bioenergy crops and food production

All assessed pathways that limit warming to well below 2C require land-based mitigation and land-use change



**Thank you for your attention
Questions?**