

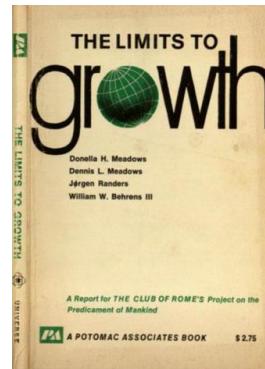
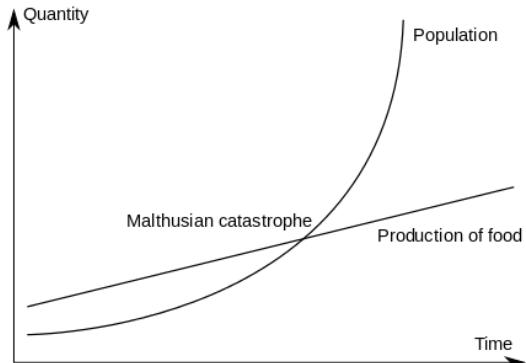
Kan landbruget både brødføde 10 mia. mennesker og blive CO₂-neutralt?

Christian Friis Bach

Kan verden producere mad nok?

Malthus

Exponential population growth
and arithmetic food supply growth



Club of Rome
Global Food per capita reaches a peak around 2020, followed by a rapid decline

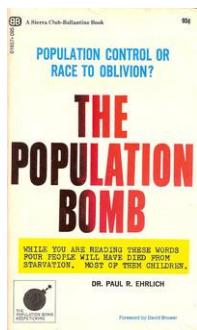
1798



1972



1968



2xEhrlich

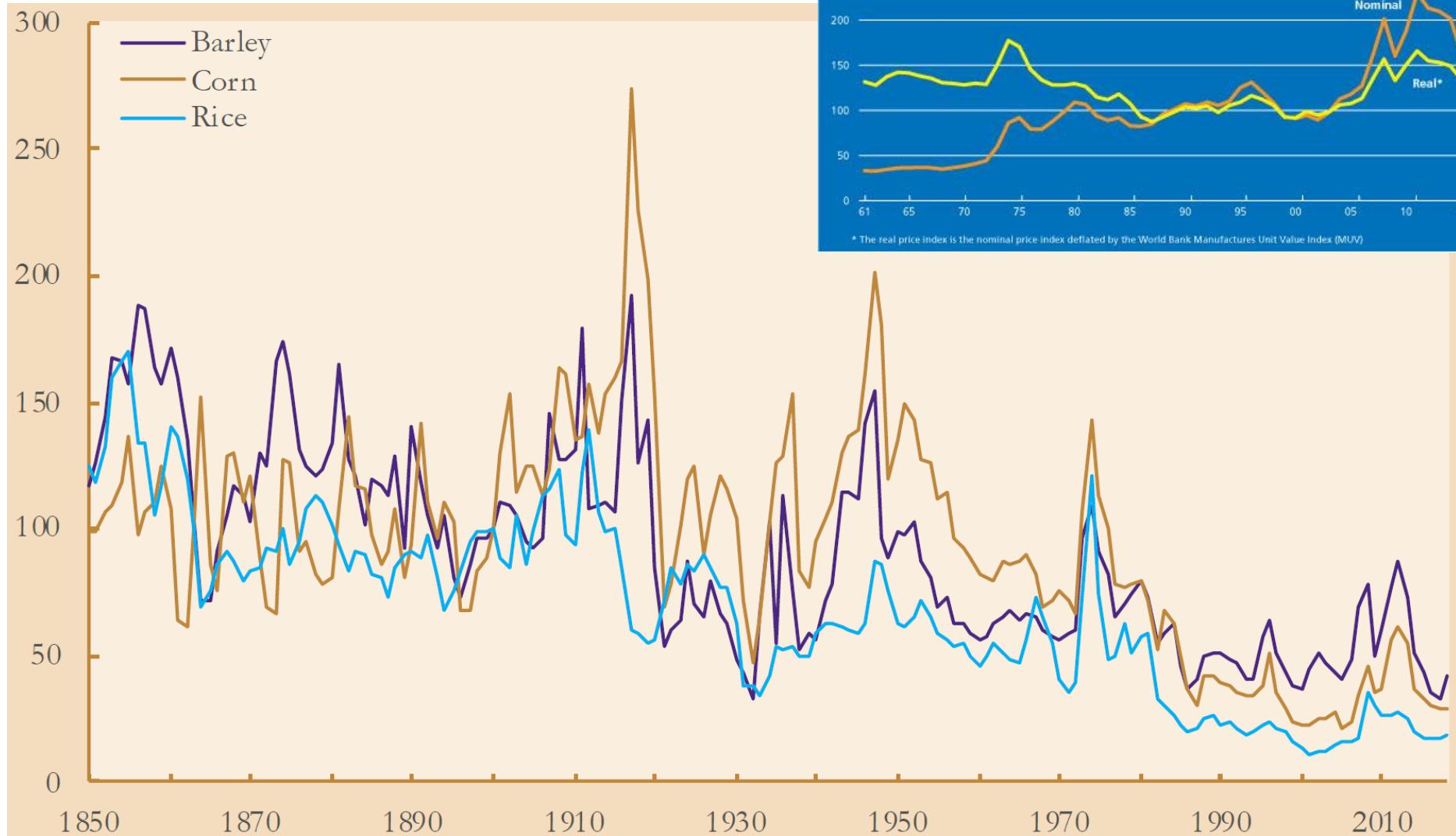
Worldwide famine in the 1970s and 1980s due to overpopulation



Oxfam

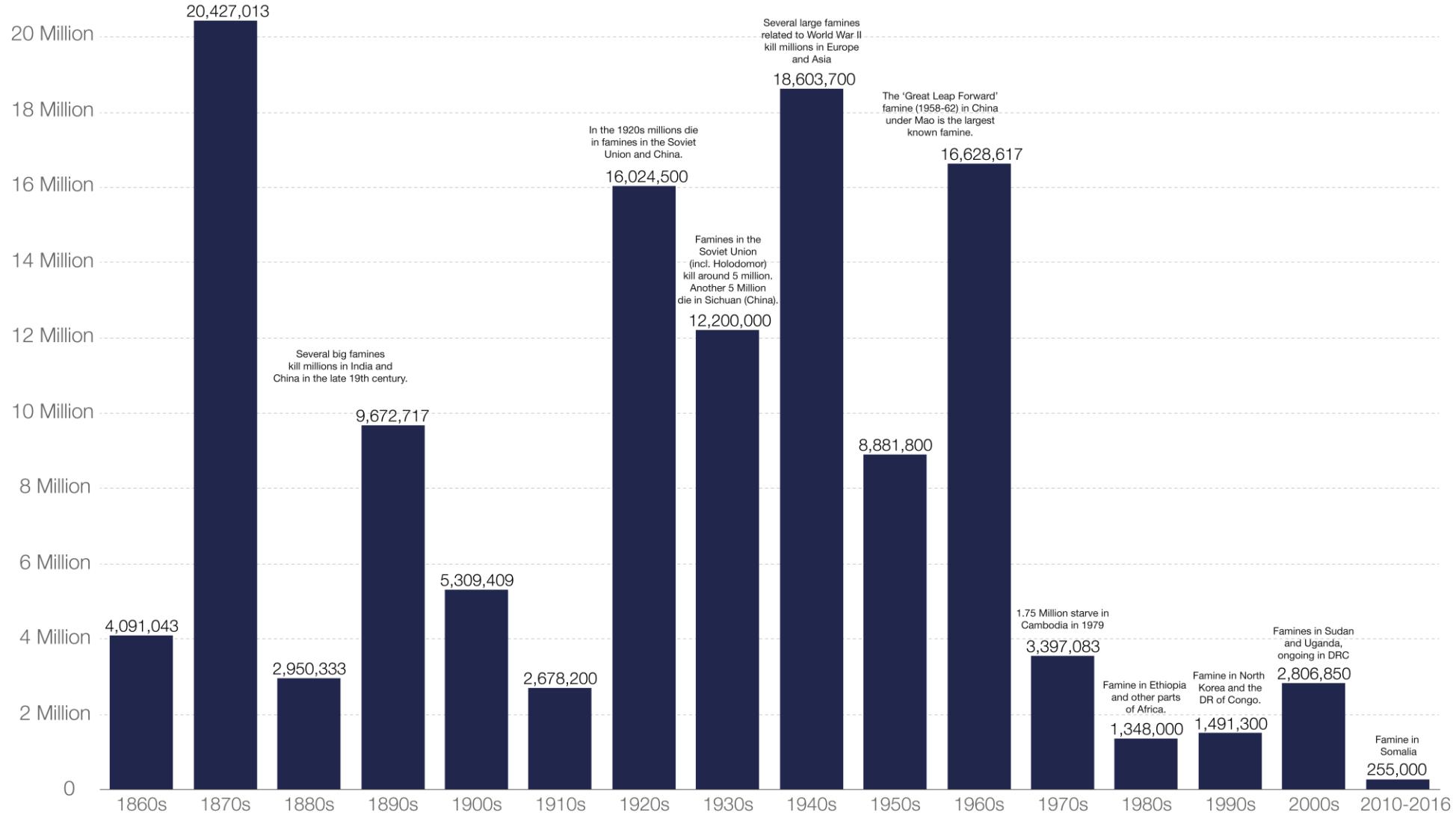
Drastic increase in food prices and hunger over the next two decades

Kornpriser (fastprisindeks, 1900=100)



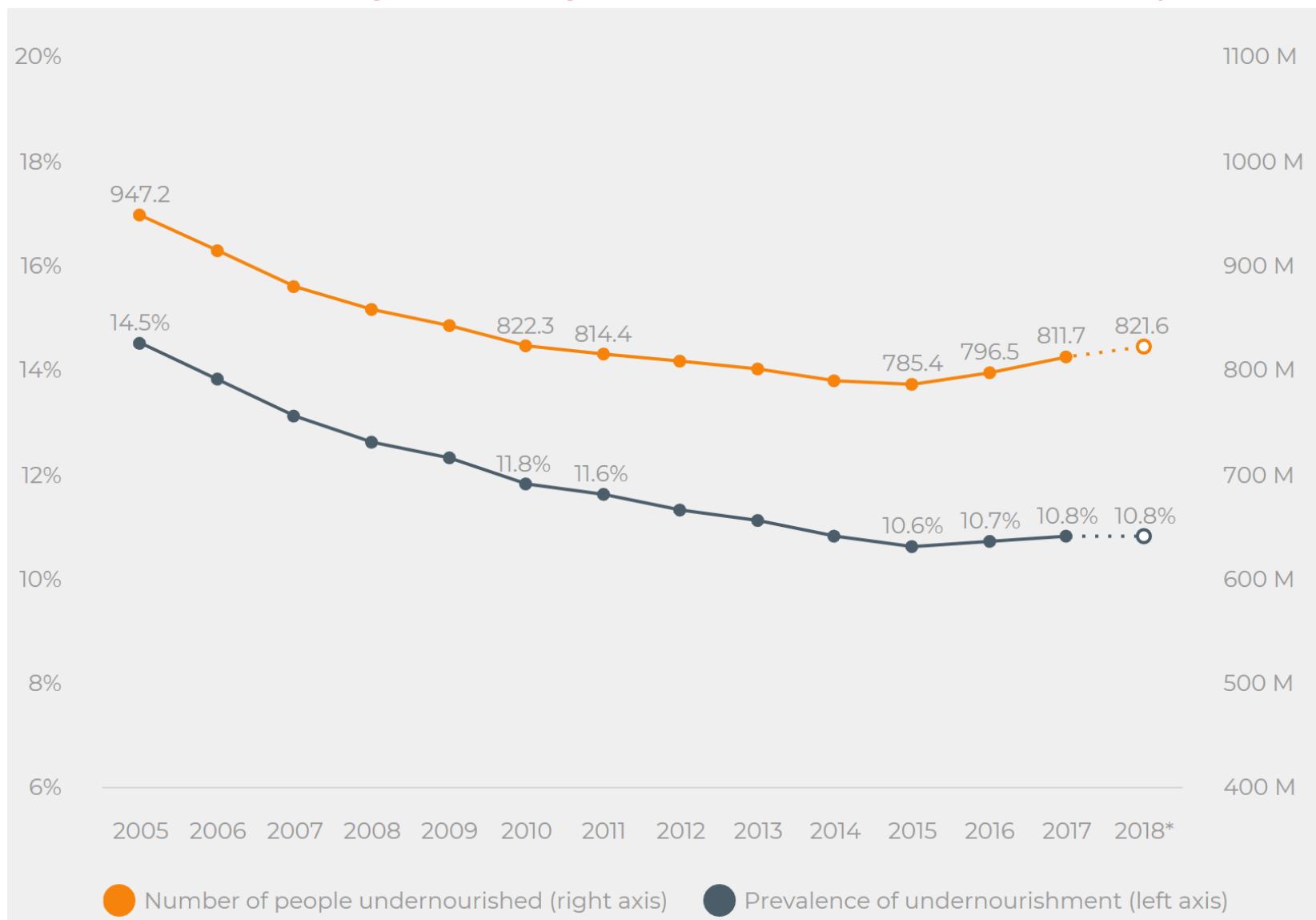
Kilde: Jacks, D.S. (2019), "From Boom to Bust: A Typology of Real Commodity Prices in the Long Run." Cliometrica 13(2), 202-220.

Færre dør i sultkatastrofer



Kilde: Hasell and Roser (2019), https://ourworldindata.org/uploads/2018/03/Famine-victims-since-1860s_March18.png

Tendensen går dog nu den forkerte vej...



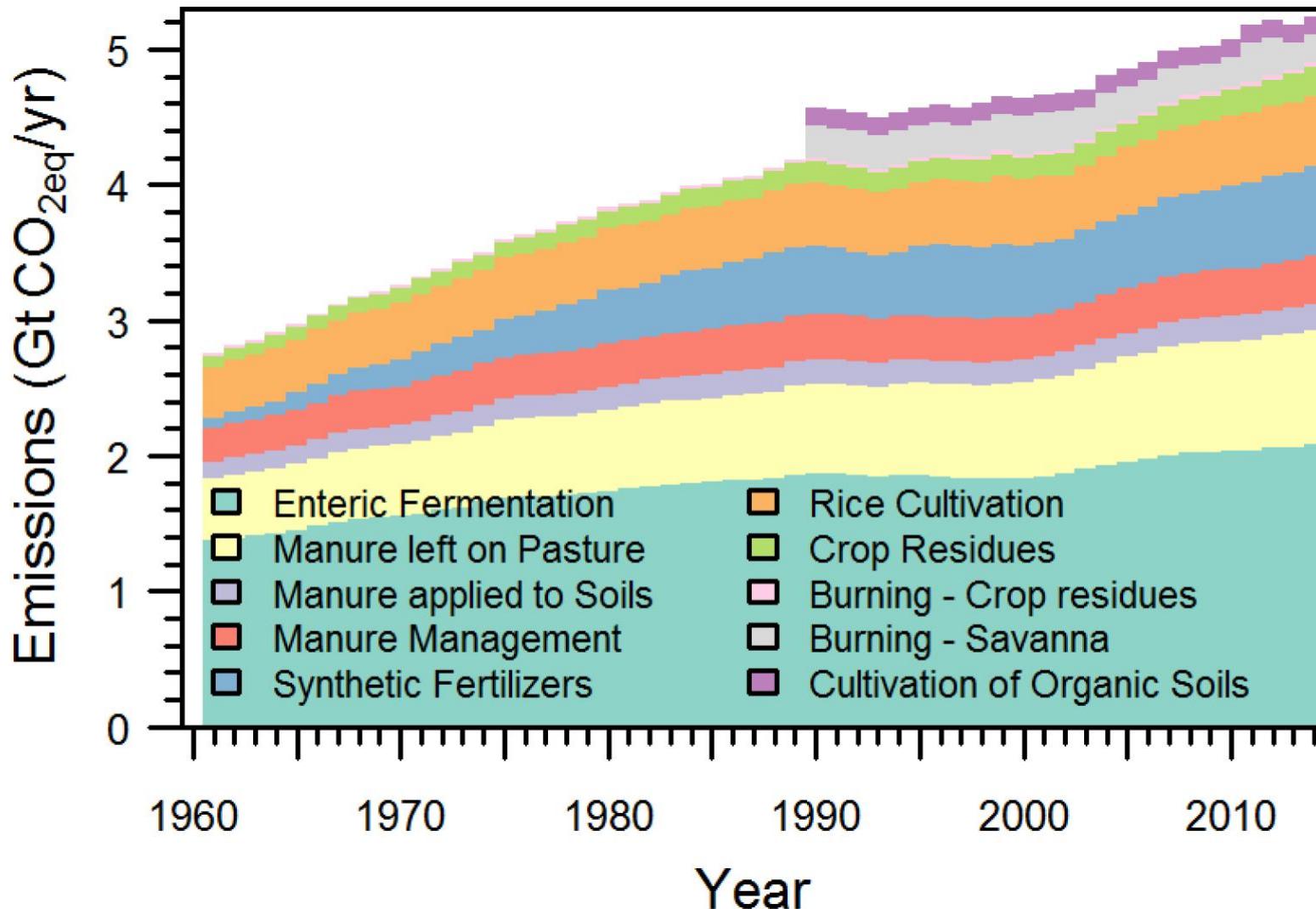
Kilde: FAO (2019), The state of Food Security and Nutrition in the World, <http://www.fao.org/state-of-food-security-nutrition/en/>

Ny IPCC rapport: Hovedkonklusioner

- ✓ Temperaturen over land er staget fra 1850-1900 til 2006-2015 med 1.53 °C mens den gennemsnitlige middeltemperatur er steget 0.87 °C.
- ✓ Landbrug, skovbrug og anden arealanvendelse står for omkring 23 procent af verdens samlede udledning af drivhusgasser ($12.0 \pm 3.0 \text{ GtCO}_2\text{e yr}^{-1}$)
- ✓ Det tekniske potentiale for at reducere udledningerne fra afgrøder, husdyr og skovlandbrug er estimeret til 2.3-9.6 GtCO₂e.yr⁻¹ i 2050
- ✓ Det tekniske potentiale for at reducere udledningerne gennem kostændringer er 0.7-8 GtCO₂e.yr⁻¹ by 2050.
- ✓ Omkring en fjerdedel af jordens isfrie areal bliver allerede i dag utsat for menneskeskabt udpining og erosion.
- ✓ Over 500 millioner mennesker lever i områder der påvirkes af erosion påvirket af klimaforandringerne.
- ✓ 820 millioner mennesker er underernærede.
- ✓ Helt op til 30% af verdens fødevarer bliver tabt eller smidt ud

Landbrugets udledninger stiger

(uden ændringer i anvendelse af jorden)



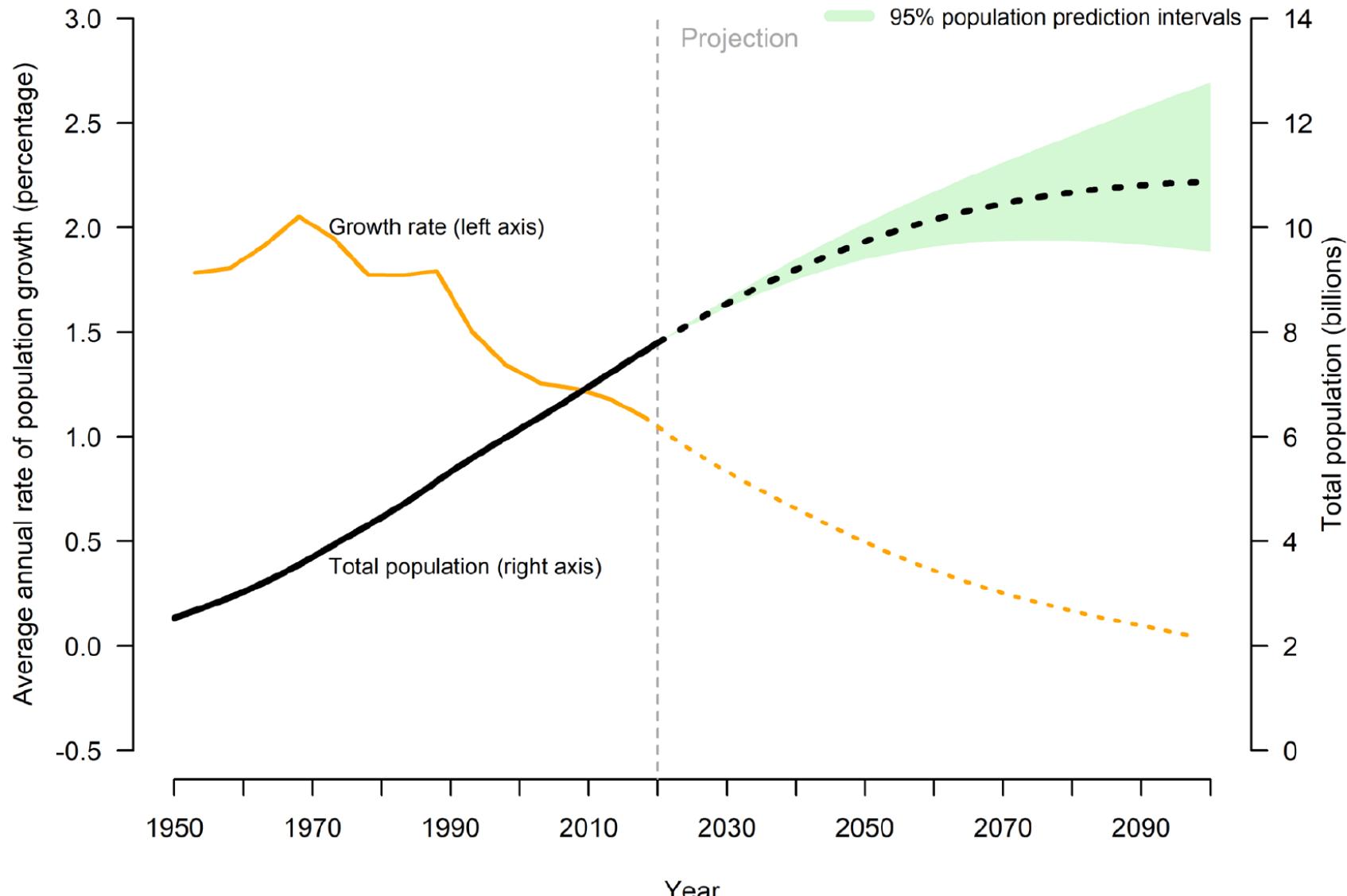
Kilde: IPCC (2019), Climate Change and Land, <https://www.ipcc.ch/report/srccl/>

Klimascenarier (Shared Socioeconomic Pathways)

	Befolkning 2100	Indkomst	Ulighed	Landregulering	Ressource forbrug	Teknologi
SSP1	7 mia.	Høj	Fald	God	Lav	
SSP2	9 mia.	Medium	Lille fald		Uændret	
SSP3	13 mia.	Lav	Uændret		Intensiv	Langsom ændring
SSP4	9 mia.	Medium	Stor			
SSP5	7 mia.	Høj	Fald		Intensiv	

Kilde: IPCC (2019), Climate Change and Land, <https://www.ipcc.ch/report/srccl/>

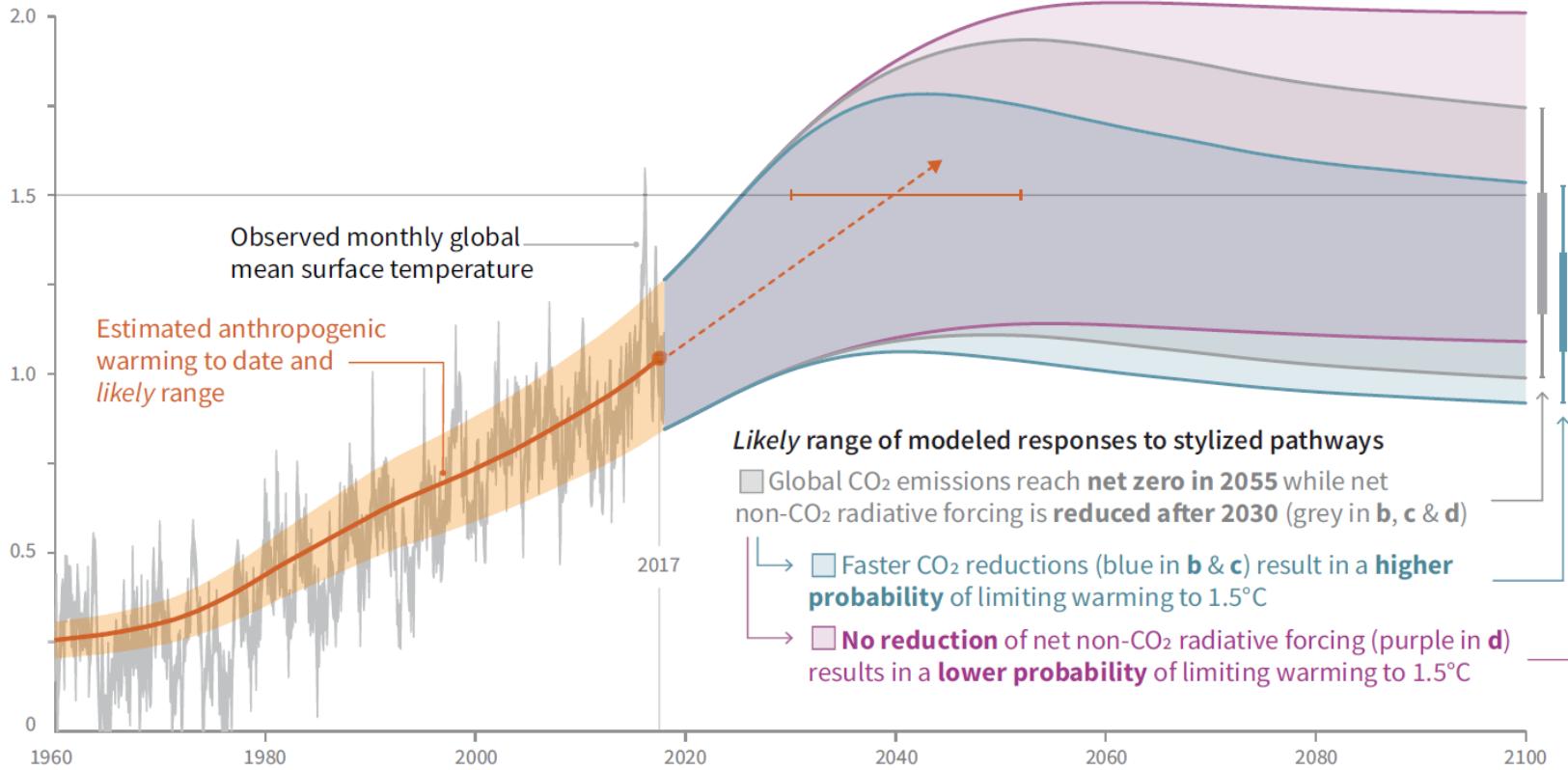
Det tyder på over 10 mia. mennesker i 2100



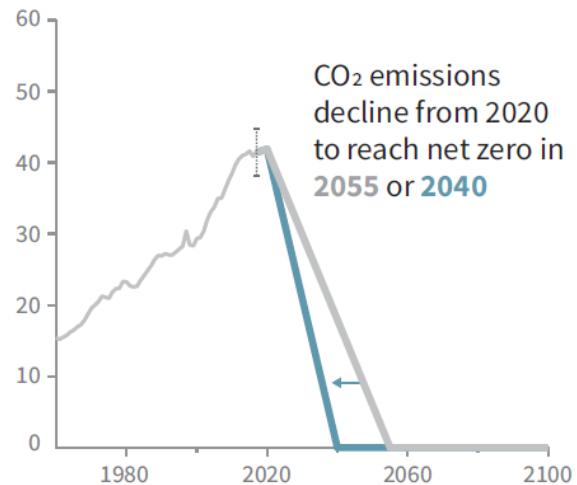
Source: United Nations Department of Economic and Social Affairs/Population Division, http://www.un.org/esa/population/publications/popnews/Newsltr_87.pdf

Og en temperaturstigning på >1,5°

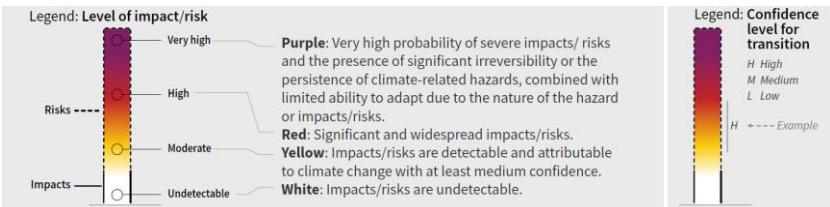
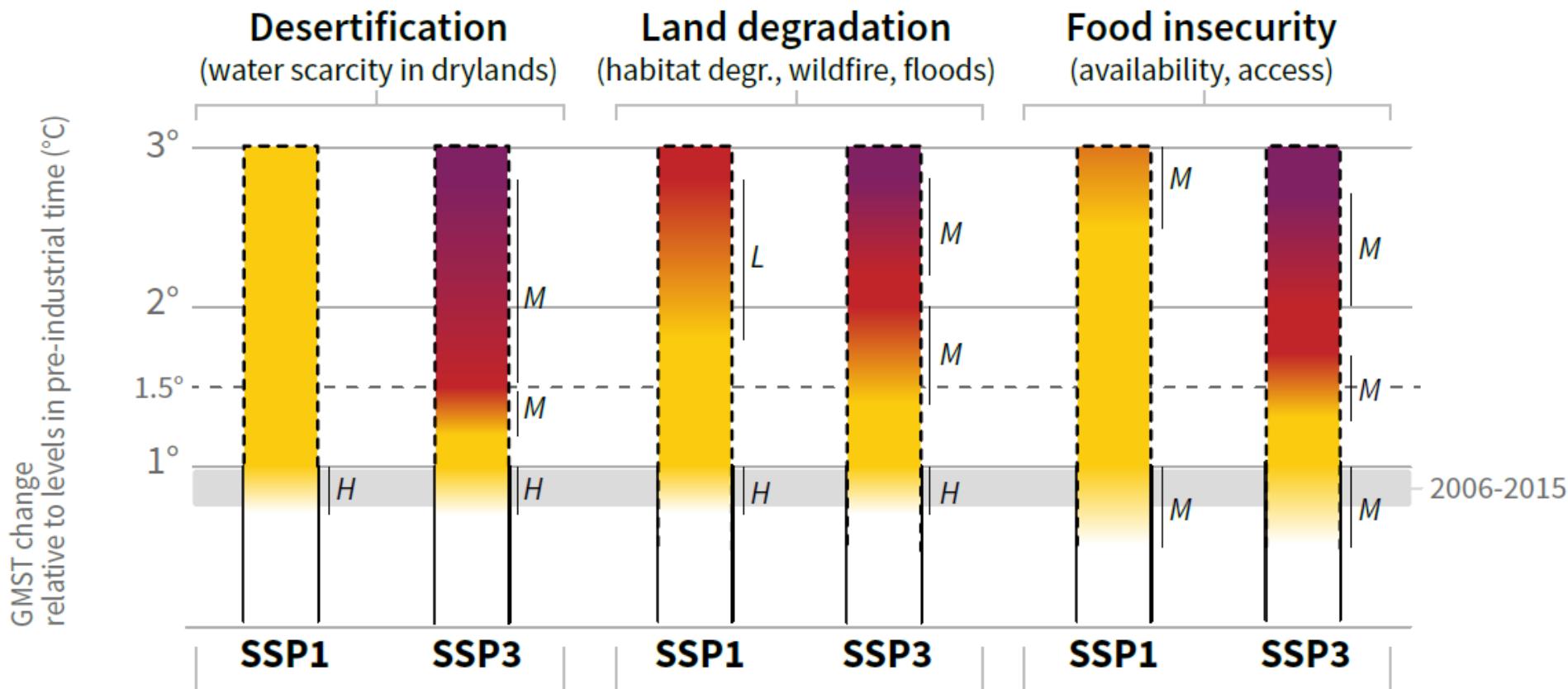
Global warming relative to 1850-1900 (°C)



Kilde: IPCC (2018): Special Report on Global Warming of 1.5 ° C (SR15)



Det vil påvirke verdens fødevareforsyning



Kilde: IPCC (2019), Climate Change and Land,
<https://www.ipcc.ch/report/srccl/>

Og klimatiltag kan have større effekt end klima

År 2050

Effekt af reduktion

Effekt af klimaforandring

Kornpriser



Antal
mennesker i
risiko for sult

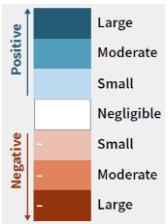
-40% -20% 0% 20% 40% 60%

SSP1

SSP2

SSP3

Kilde: IPCC (2019), Climate Change and Land,
<https://www.ipcc.ch/report/srccl/>



Derfor afgørende, hvordan vi handler

Bioenergi og bioenergi med CCS



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 undernourishment of 150 million people by 2050 {6.4.5.1.5}. The red hatched cells for desertification and land degradation indicate that while under 2°C scenarios will increase pressure for desertification and land degradation, the actual area affected is likely to be smaller than the maximum potential area {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 6.58}

150 mio. mennesker i risiko for underernæring

Skovplantning



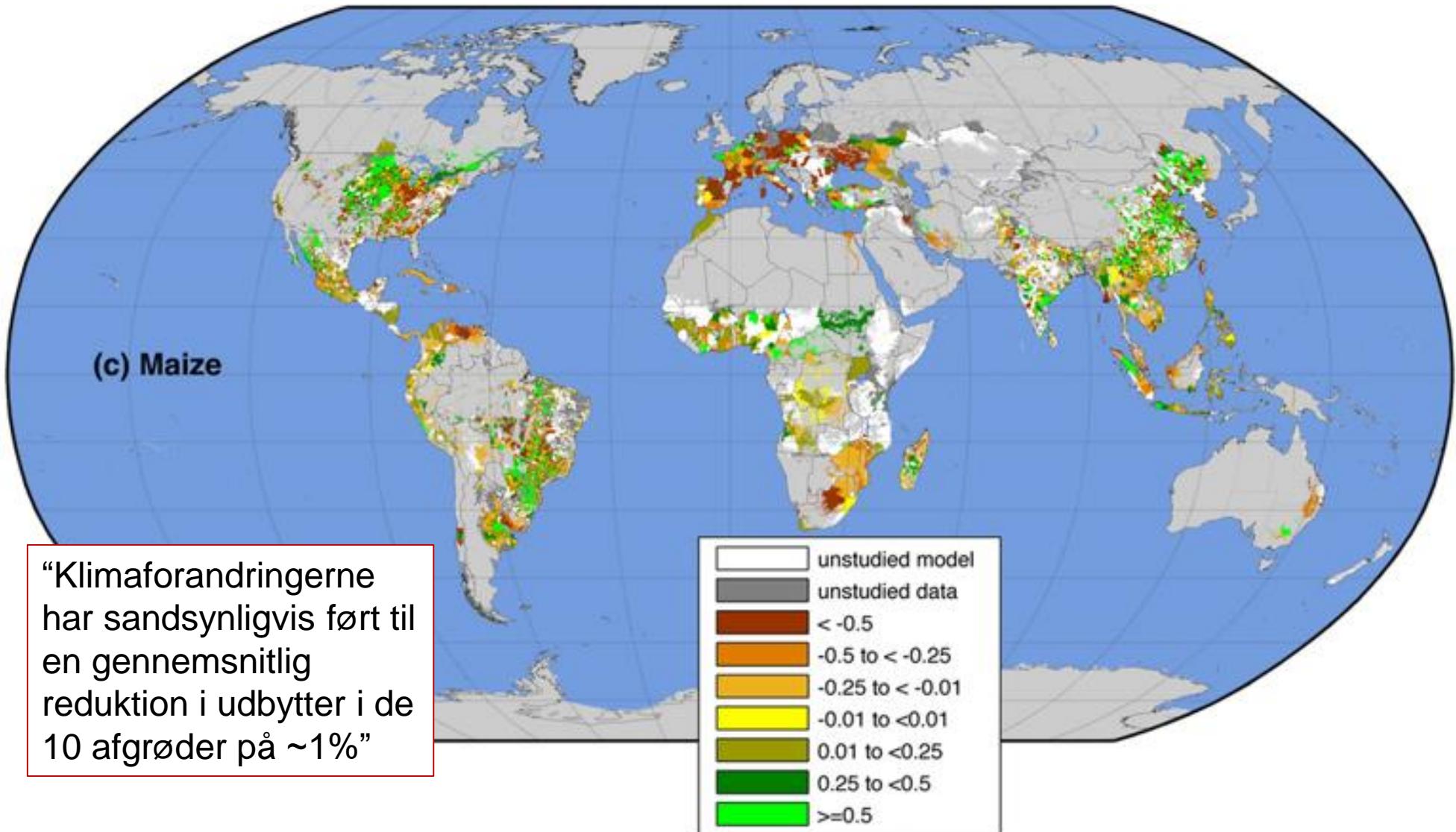
High level: Impacts on adaptation, desertification, land degradation and food security are maximum potential impacts assuming implementation of afforestation (partly overlapping with reforestation and forest restoration) at a scale of 8.9 GtCO₂ yr⁻¹ removal {6.4.1.1.2}. Large-scale afforestation could 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}.



80-150 mio. mennesker i risiko for underernæring

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

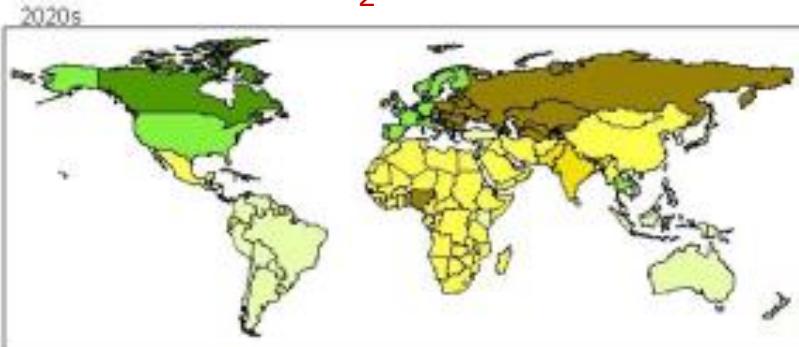
Effekterne på udbytter er der allerede



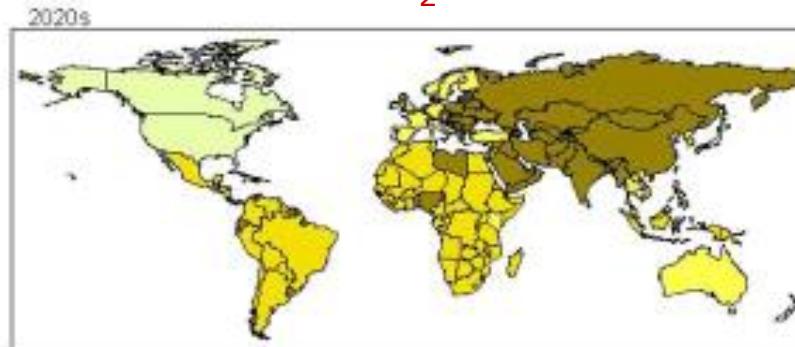
Kilde: Ray et al (2019) Climate change has likely already affected global food production. <https://doi.org/10.1371/journal.pone.0217148/>

Selvom øget CO₂ kan betyde øget plantevækst

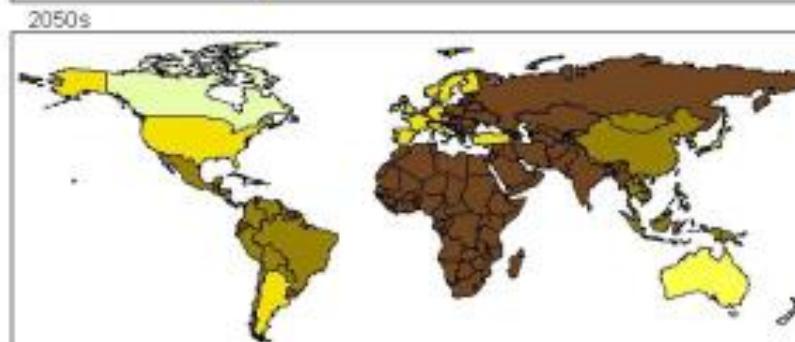
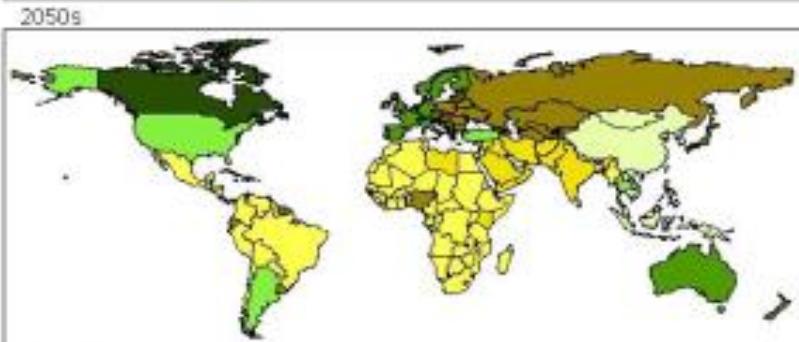
Med CO₂ effekt



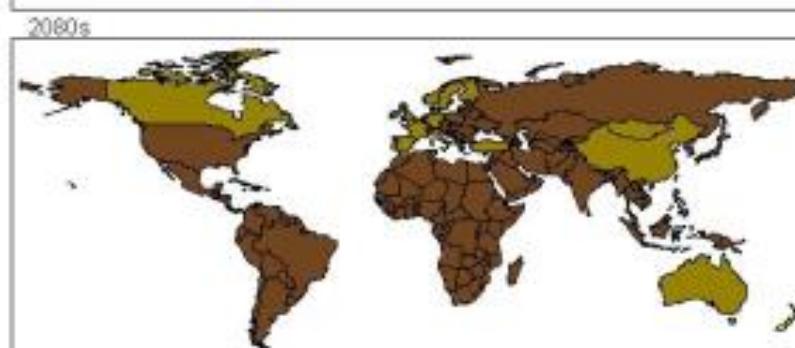
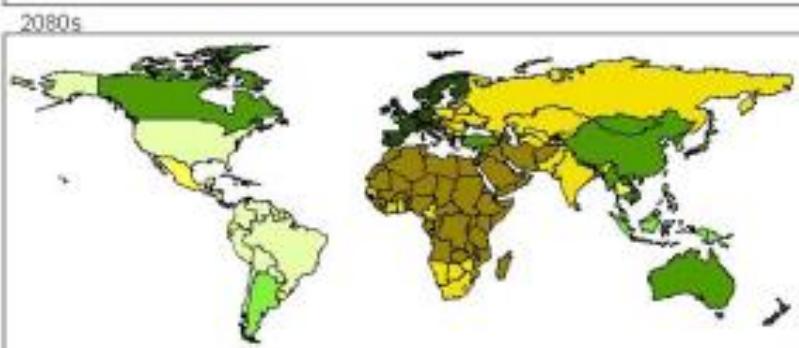
Uden CO₂ effekt



2020s



2050s

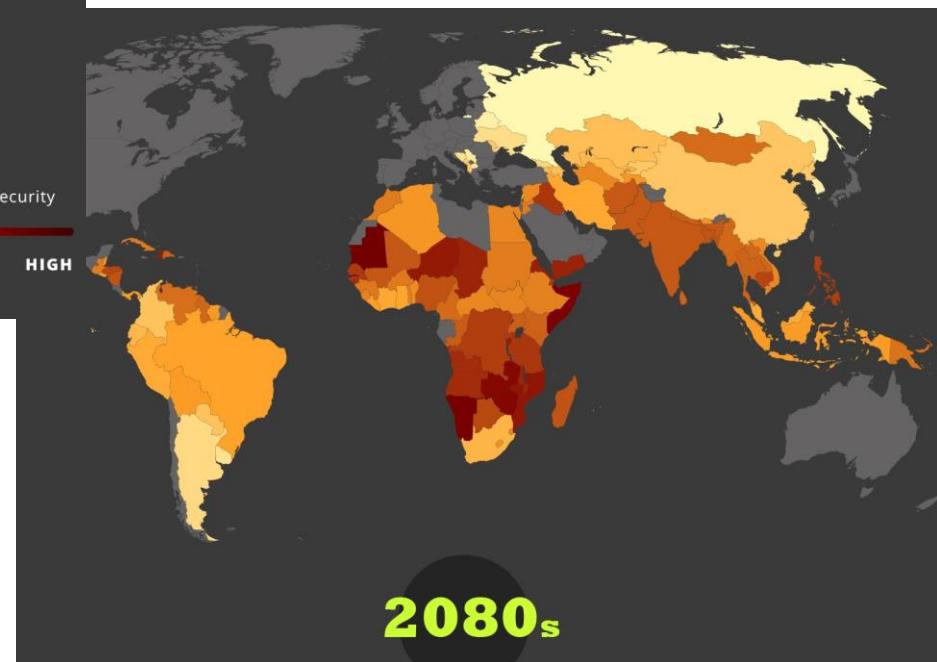
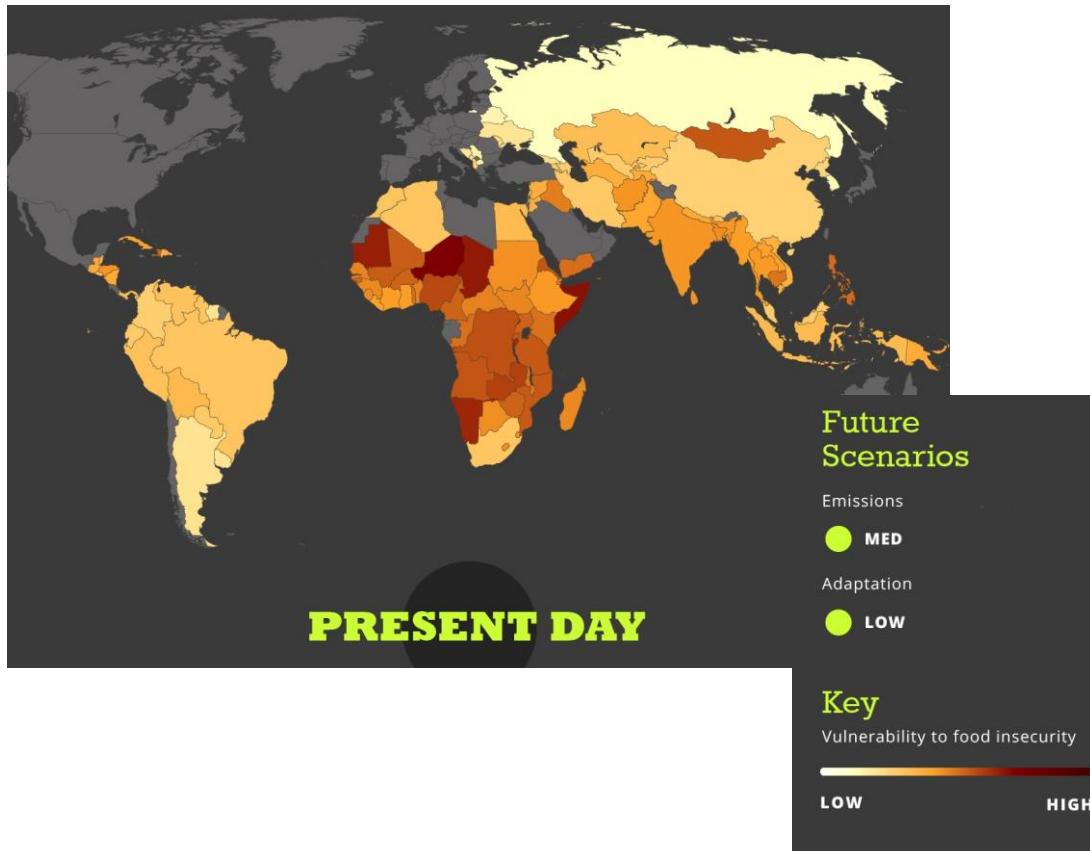


2080s

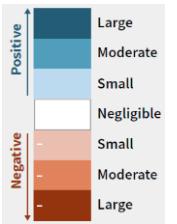


Kilde: M.L. Parry et al. /
Global Environmental
Change 14 (2004) 53–67

Fødevaresikkerheden vil (sandsynligvis) øges



Kilde: Met Office/WFP (2019), Food Insecurity and Climate Change,
<https://www.metoffice.gov.uk/food-insecurity-index/>



Men der er meget der kan gøres

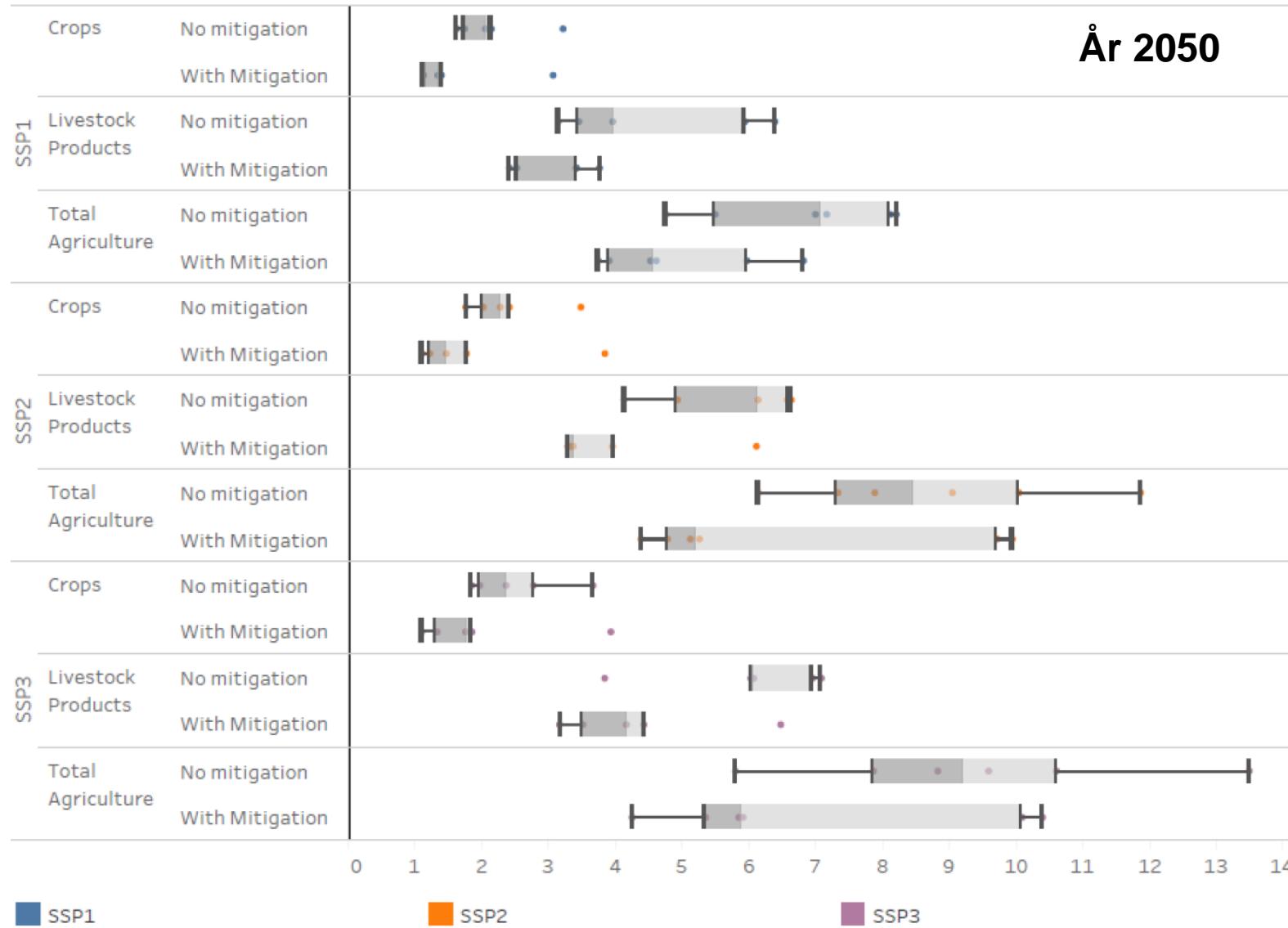
Response options based on land management

	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
	Reduced grassland conversion to cropland	L	—	L	L	L
Forests	Forest management	M	L	L	L	L
	Reduced deforestation and forest degradation	H	L	L	L	L
Soils	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

Kilde: IPCC (2019), Climate Change and Land, <https://www.ipcc.ch/report/srcc/>

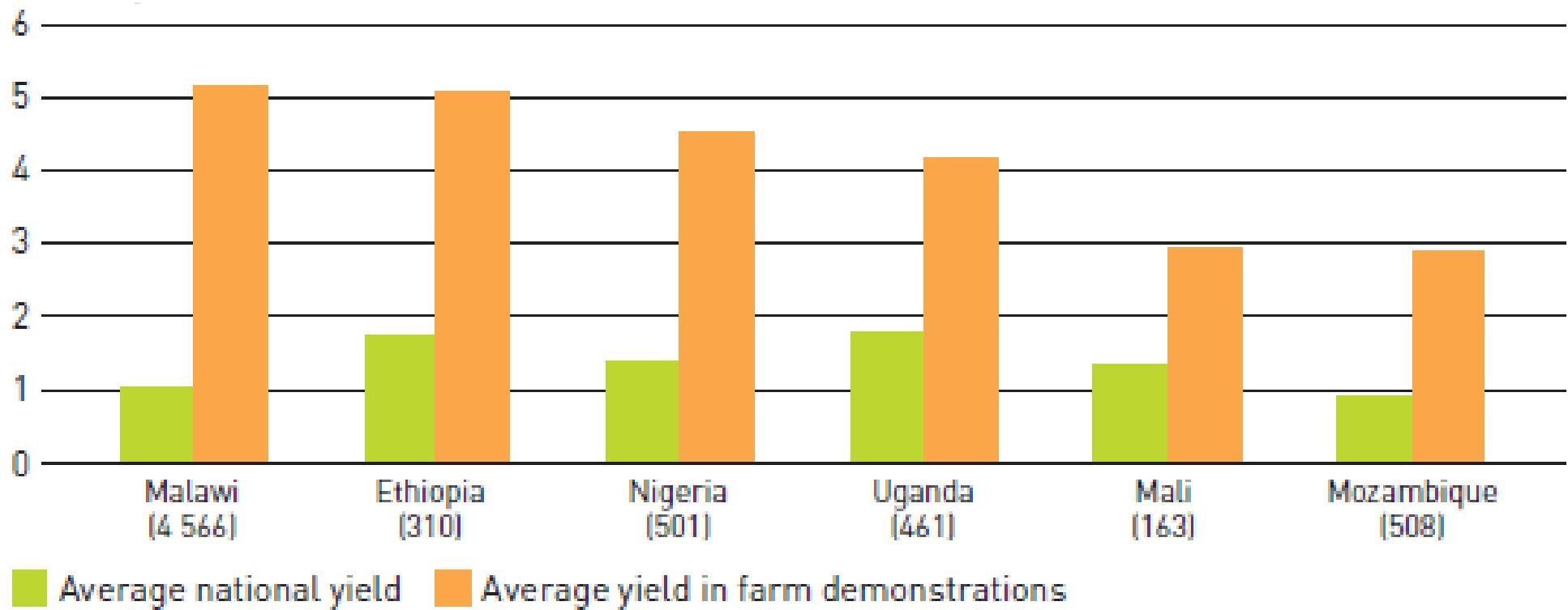
Det kan reducere udledningerne

Global Agricultural Emissions (Billion tons CO₂ eq.)



Kilde: IPCC
(2019), Climate
Change and Land,
<https://www.ipcc.ch/report/srccl/>

Der kan produceres meget mere mad



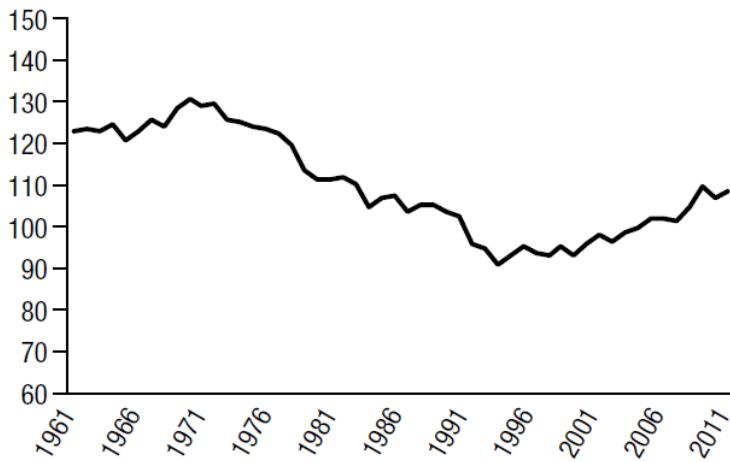
Source: World Bank (2007): World Development Report 2008

Note: Number of plots in parentheses. Open-pollinated varieties (except Nigeria – hybrids). Data from 2001-2004

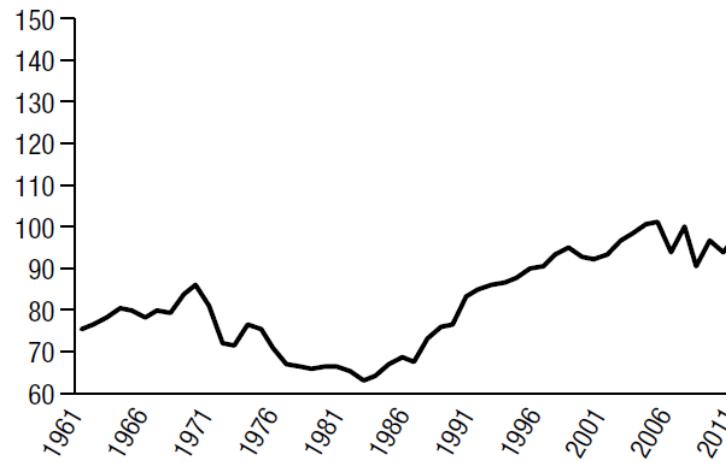
De afrikanske landmænd rykker

Indeks for landbrugsproduktion pr indbygger (2004-2006 = 100)

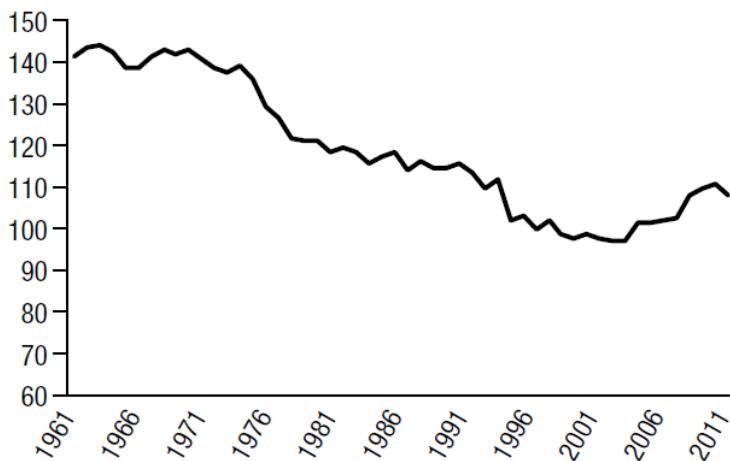
a. East Africa



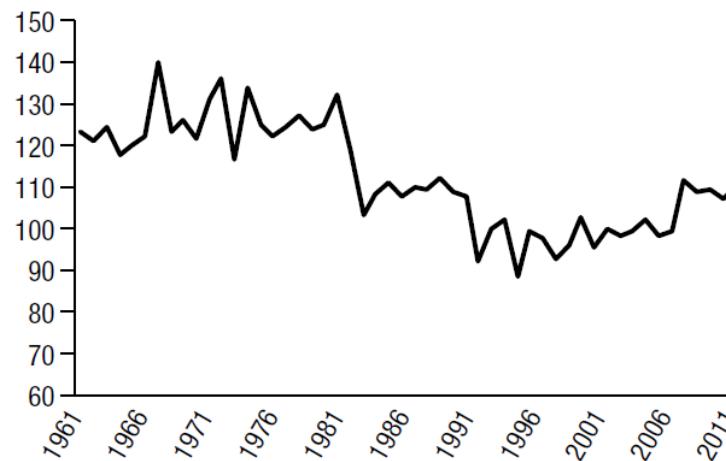
b. West Africa



c. Central Africa



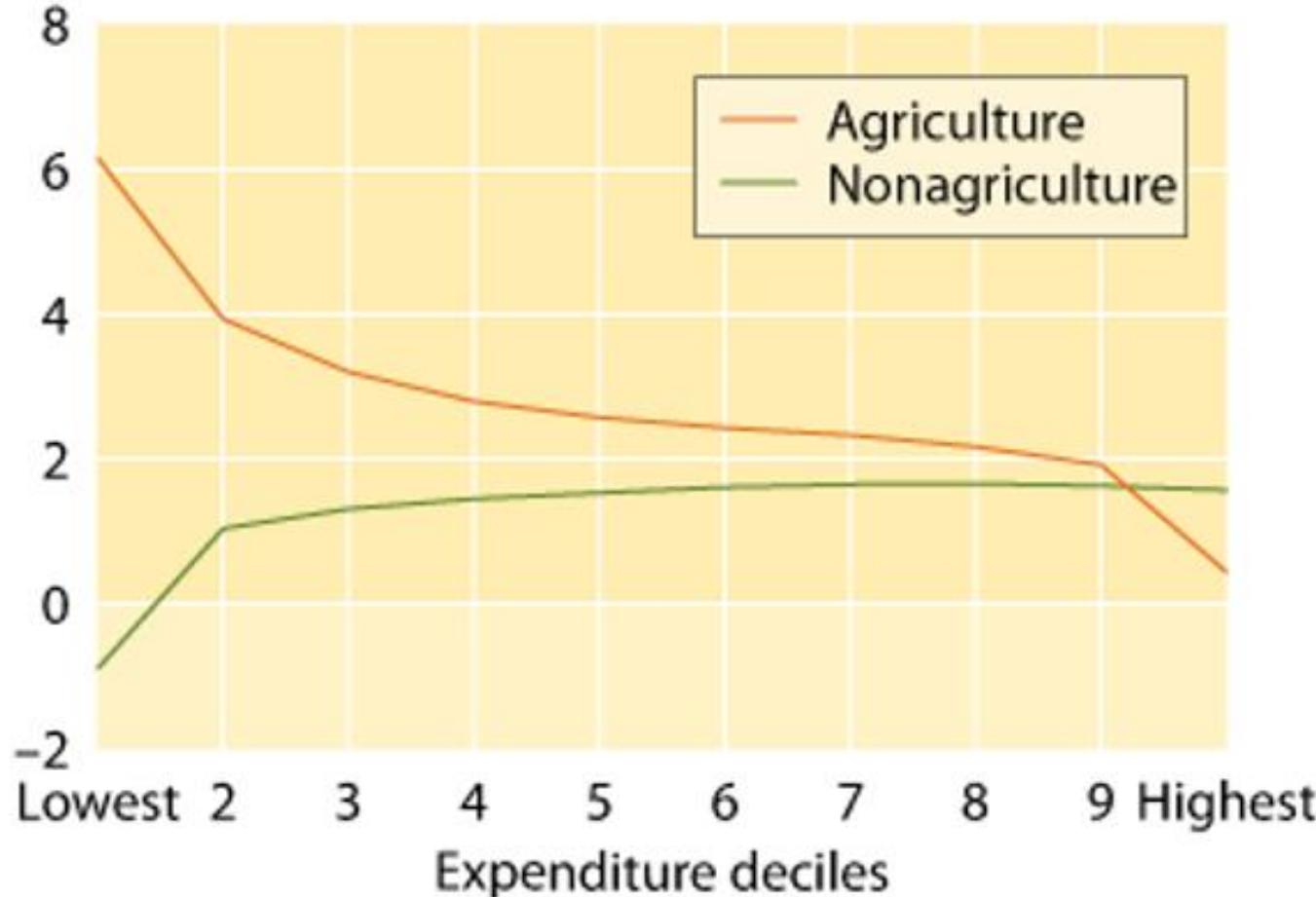
d. Southern Africa



Source: FAOSTAT data in
Badiane and Collins
(2016): Agricultural
growth and productivity in
africa: recent trends and
future outlook . IFPRI

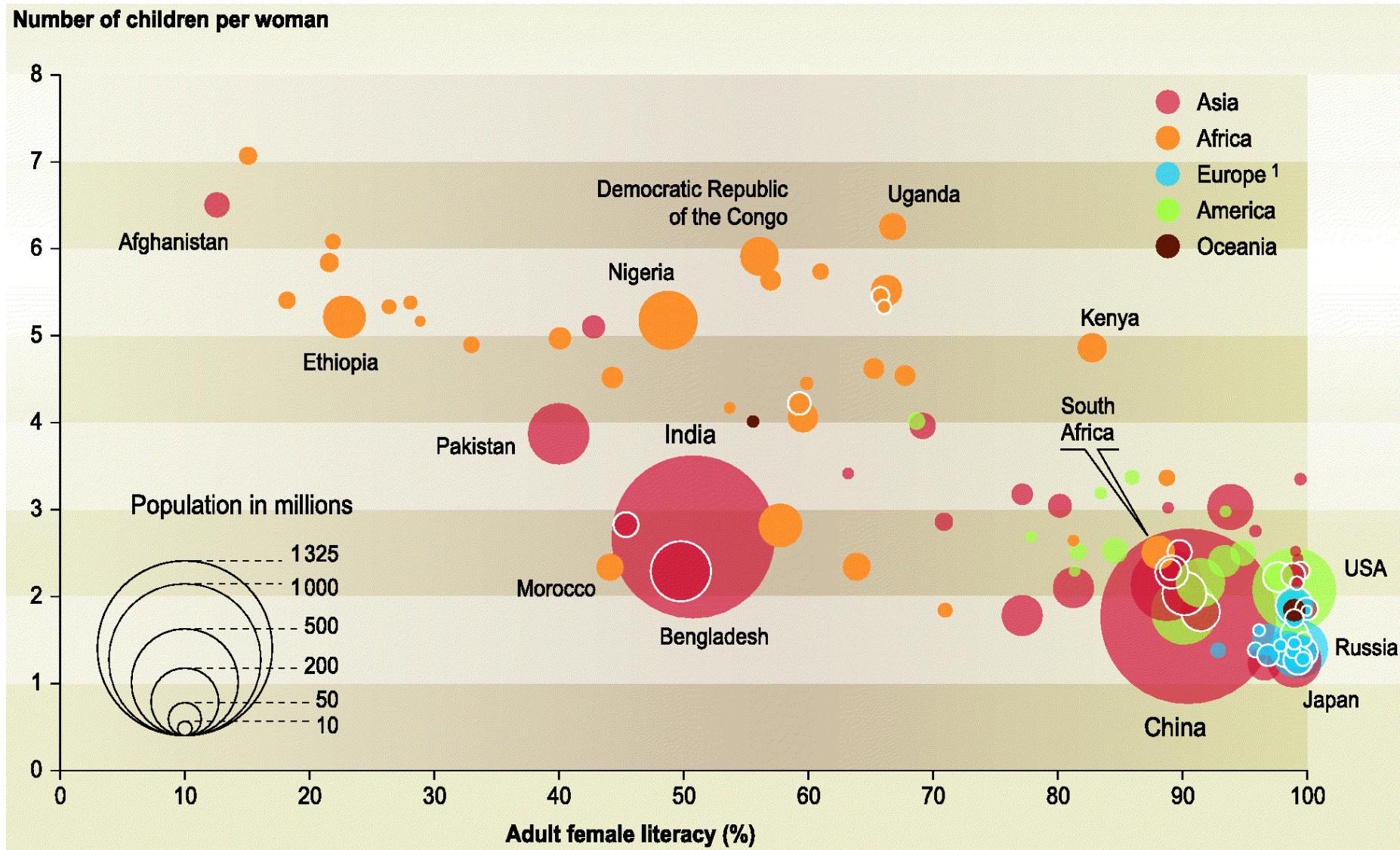
Landbrugsudvikling kan bekæmpe fattigdom

Expenditure gains induced by 1% GDP growth, %



Fattigdom
Vækst
Beskæftigelse
Miljø
Konflikt

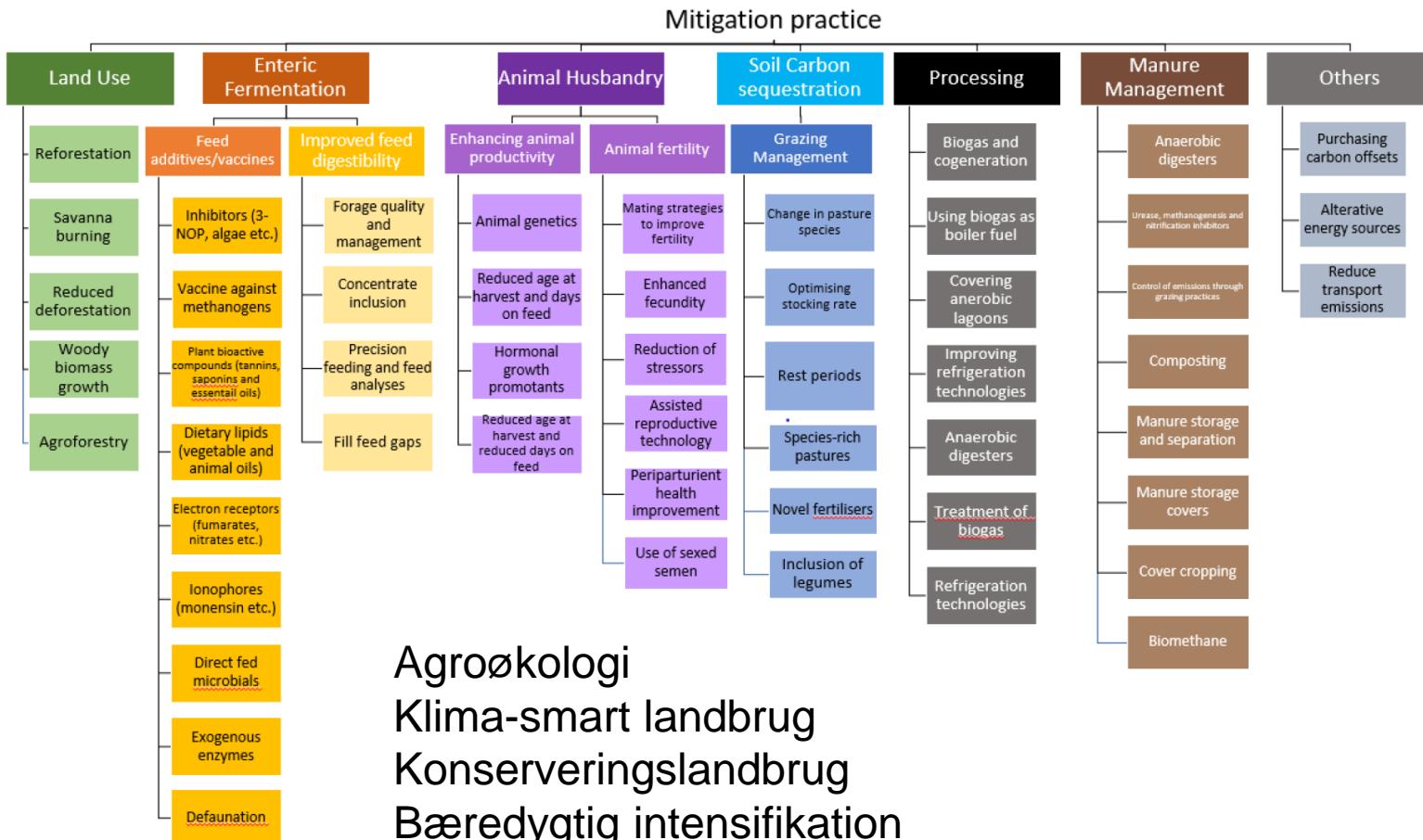
Uddannelse kan mindske befolkningstilvæksten



Source: Gapminder, UNESCO, World Bank, UN,

<http://www.eea.europa.eu/data-and-maps/figures/correlation-between-fertility-and-female-education>

Massive investeringer i klimavenligt landbrug



Agroøkologi
 Klima-smart landbrug
 Konserveringslandbrug
 Bæredygtig intensifikation
 By-landbrug
 og "Naturbaserede løsninger"

Hvor mange mennesker kan jorden bødføde?

Svaret afhænger af hvem man spørger?

Men den største koncentration af studier svarer mellem 8 og 16 mia. mennesker.

Estimates of Earth's carrying capacity

 = one estimate

6 STUDIES SAY
 ≤ 2 billion



7 STUDIES SAY
 ≤ 4 billion



20 STUDIES SAY
 ≤ 8 billion



14 STUDIES SAY
 ≤ 16 billion



6 STUDIES SAY
 ≤ 32 billion



7 STUDIES SAY
 ≤ 64 billion



2 STUDIES SAY
 ≤ 128 billion



1 STUDY SAYS
 ≤ 256 billion



1 STUDY SAYS
 ≤ 512 billion



1 STUDY SAYS
 $\leq 1,024$ billion



Kilde: UNEP (2012): One Planet, How Many People? A Review of Earth's Carrying Capacity
https://na.unep.net/geas/archive/pdfs/g_eas_jun_12_carrying_capacity.pdf

Kan landbruget både brødføde 10 mia. mennesker og blive CO₂-neutralt?



Et forsigtigt ja

Men vil kræve store investeringer i klimavenlig landbrugsudvikling – og ikke mindst i verdens fattige landkvinder og landmænd