Global aspects based on the AR5 of the IPCC
RISKS OF CLIMATE CHANGE INCREASE WITH CONTINUED HIGH EMISSIONS
Climate and Food Production

v. Risk of *food insecurity* and the *breakdown of food systems linked to* warming, drought, flooding, and precipitation variability and *extremes*, particularly for poorer populations in urban and rural settings.
Summary of estimated impacts of observed climate changes on yields over 1960–2013 for four major crops in temperate and tropical regions.

The number of data points analyzed is given within parentheses for each category.
Climate and Food Production
Modelled crop yield

Decreases dominate over increases in future crop yield

IPCC, 2014, SPM
Climate and Food Production

Yield change - 2050

World Development Report 2010
Climate and Food Production

Hunger map - 2013

Largest yield decreases in the poor areas

FAOSTAT (2013)
Climate and Food Production

What can be done?

<table>
<thead>
<tr>
<th>Management option</th>
<th>Cultivar adjustment (n=56)</th>
<th>Planting date adjustment (n=19)</th>
<th>Planting date and cultivar adjustment (n=152)</th>
<th>Irrigation optimisation (n=17)</th>
<th>Fertiliser optimisation (n=10)</th>
<th>Other (n=9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefit (%) from using adaptation</td>
<td>23 (6.8, 35.9)</td>
<td>3 (2.1, 8.3)</td>
<td>17 (9.9, 26.1)</td>
<td>3.2 (2.8, 8.2)</td>
<td>1 (0.25, 4.8)</td>
<td>6.45 (3.2, 12.8)</td>
</tr>
</tbody>
</table>
Climate and Food Production

Yield change without adaptive planting date

Mekong delta

Mainuddin et al. (2011), *Food security*
Climate and Food Production

Yield change with adaptive planting date

Mekong delta

Mainuddin et al. (2011), Food security
Climate and Food Production

Summary

- Risk of food insecurity

- Rural areas: disproportionately affect the welfare of the poor in rural areas

- Human health: increased likelihood of undernutrition resulting from diminished food production in poor regions (high confidence); geographical shifts in food production (medium confidence)
A CHANGING WORLD

WIDESPREAD OBSERVED IMPACTS

A CHANGING WORLD
Climate and biodiversity

Many terrestrial, freshwater, and marine species have shifted their geographic ranges, seasonal activities, migration patterns, abundances, and species interactions in response to ongoing climate change (high confidence).

Some species will adapt to new climates. Those that cannot adapt sufficiently fast will decrease in abundance or go extinct in part or all of their ranges.
Climate and biodiversity
Maximum speed at which species can move (km per decade)

IPCC, 2014, SPM
Climate and biodiversity

A large fraction of both terrestrial and freshwater species faces *increased extinction risk* under projected climate change during and beyond the 21st century, *especially as climate change interacts with other stressors*, such as habitat modification, over-exploitation, pollution, and invasive species (high confidence).

Within this century, .... (RCP4.5, 6.0, and 8.5) pose *high risk of abrupt and irreversible regional-scale change in the composition, structure, and function of terrestrial and freshwater ecosystems*, .... (medium confidence)
Detection and Attribution

Evidence of change in species and ecosystems
1. Changes in evapotranspiration (Section 4.3.2.4)
2. Increased tree mortality (Section 4.3.3.1, Box 4-2)
3. Increased extinctions (Section 4.3.2.5)
4. Increased primary productivity (Section 4.3.2.2) and carbon stocks (Section 4.3.2.3)
5. Changes in phenology (Section 4.3.2.1)
6. Species range shifts (Section 4.3.2.5)
7. Invasive species (Section 4.2.4.6)
8. Flow-related impacts on freshwater ecosystems (Section 4.3.3.3)

Impacts on major systems including early signs of regime shifts
9. Cultural landscapes – species composition changes (Section 4.3.3.5)
10. Tundra – increase in shrubs, melting of permafrost (Section 4.3.3.4, Box 4-4)
11. Boreal – tree mortality (Section 4.3.3.1.1, Box 4-4)
12. Amazon – tree mortality (Section 4.3.3.1.3, Box 4-3)
13. Savannahs – woody encroachment (Section 4.3.3.2.2)

Adaptation
14. Evolutionary and genetic adaptation (Section 4.4.1)
Terrestrial and Inland Water Systems

Management actions, ...., and reduction of other stressors, can reduce, but not eliminate, risks of impacts to terrestrial and freshwater ecosystems due to climate change, ...
Climate and land use intensity

Wild bees

- Pesticides are more severe when temperatures are high
Climate and biodiversity

*Boloria titania* and *Polygonum bistorta*

Schweiger et al. 2008, *Ecology*
Climate, food production and biodiversity

Priority setting – Yield and biodiversity

Hannah at al. 2013, PNAS, Global Climate Change Adaptation Priorities for Biodiversity and Food Security