Water, Adaptation and Food

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Contributors

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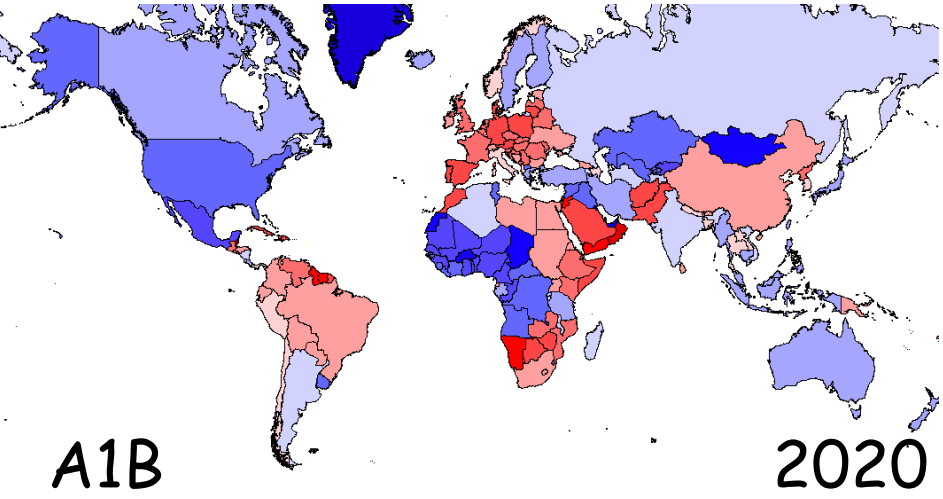
Introduction

- The effect of climate change on water resources is typically listed among the worst impacts
- Water is indeed crucial, but previous research leaves much to be desired
  - Arnell's results are driven by population and water availability only – no adapation, no development, no technological progress
  - Impact of climate change on agriculture is typically driven by precipitation

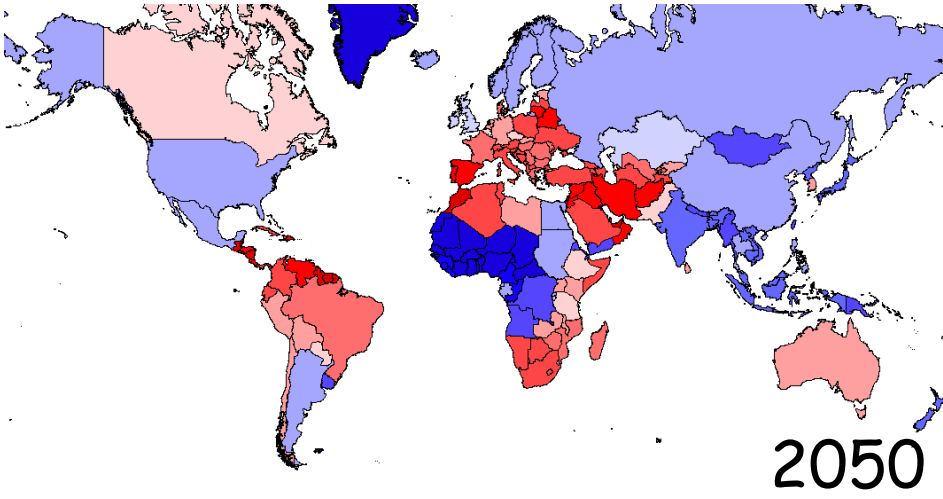
Introduction -2

- We use a General Circulation Model with a River Routing model, that tracks the flows of water from one grid cell to the next, and that includes the moderating effects of reservoirs
- We use the results of this as input to a Computable General Equilibrium model that has rain and irrigation water as explicit factors of production in agriculture – and has all the "autonomous" adaptation of farmers changing behaviour and trade flows adjusting

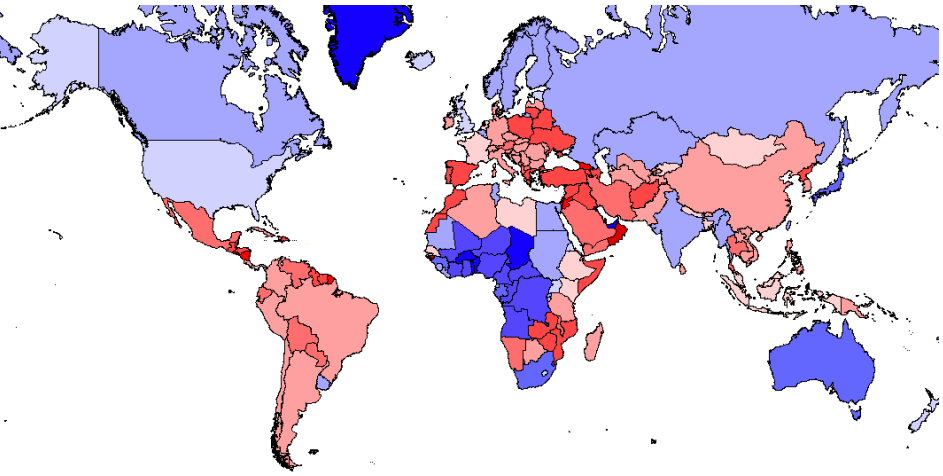


A1B

2020

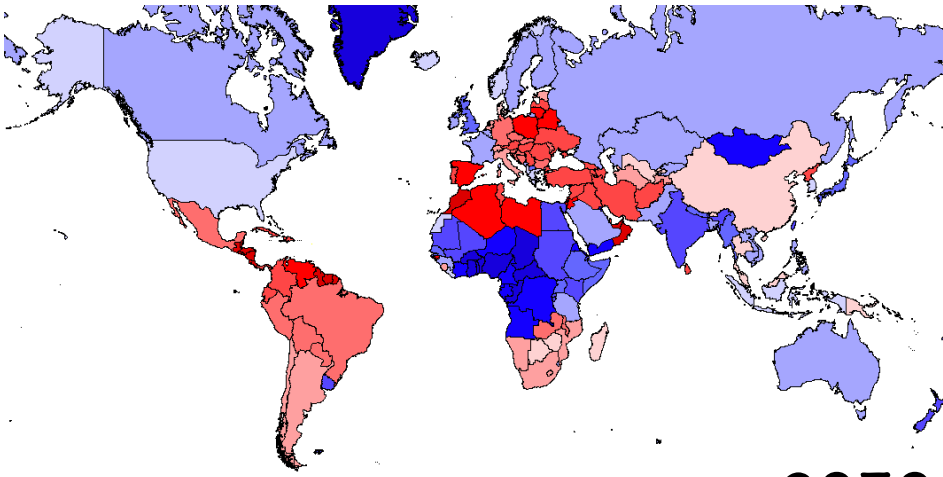


2050

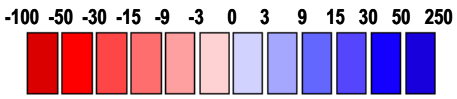


A2

2020



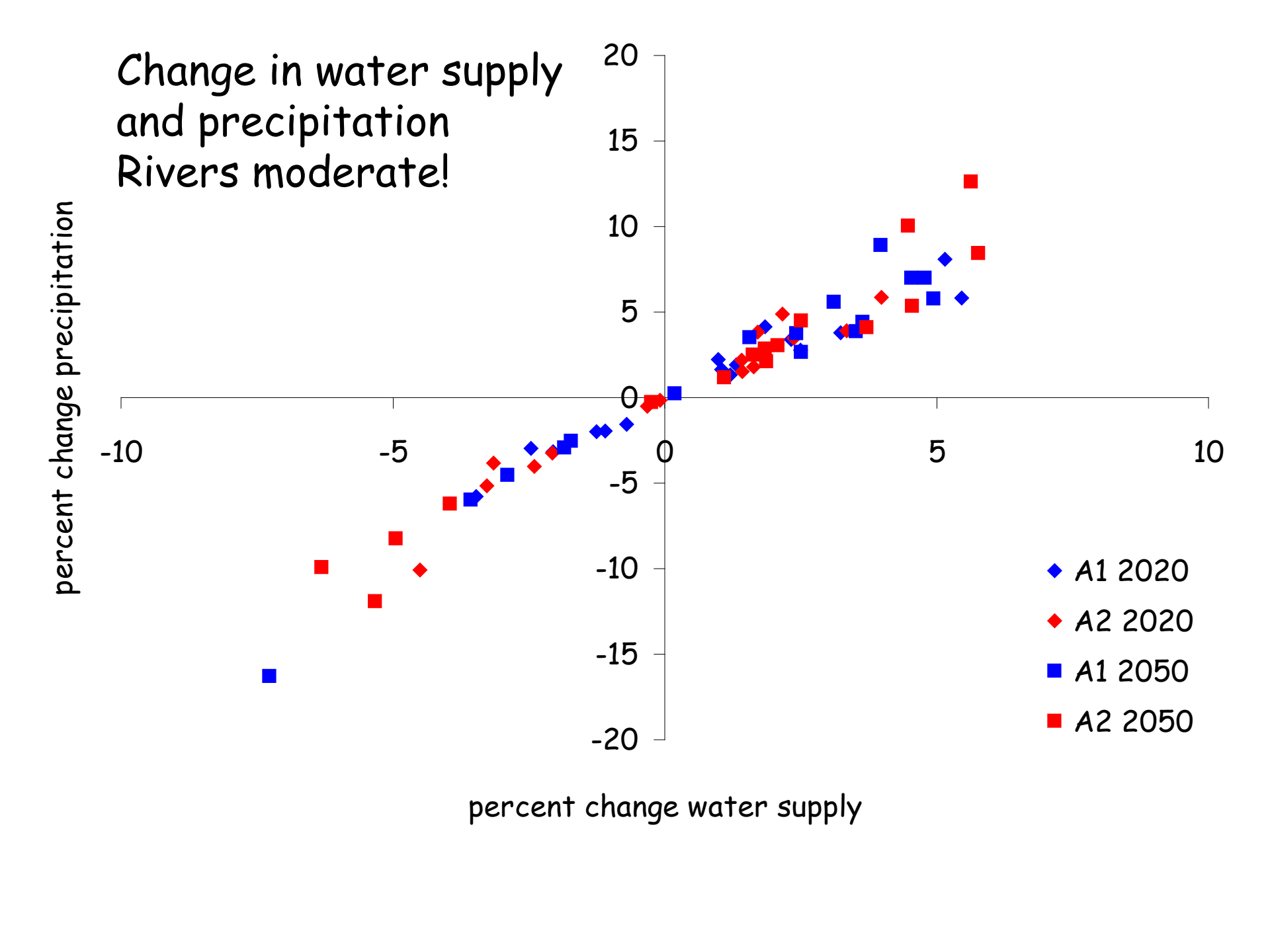
2050



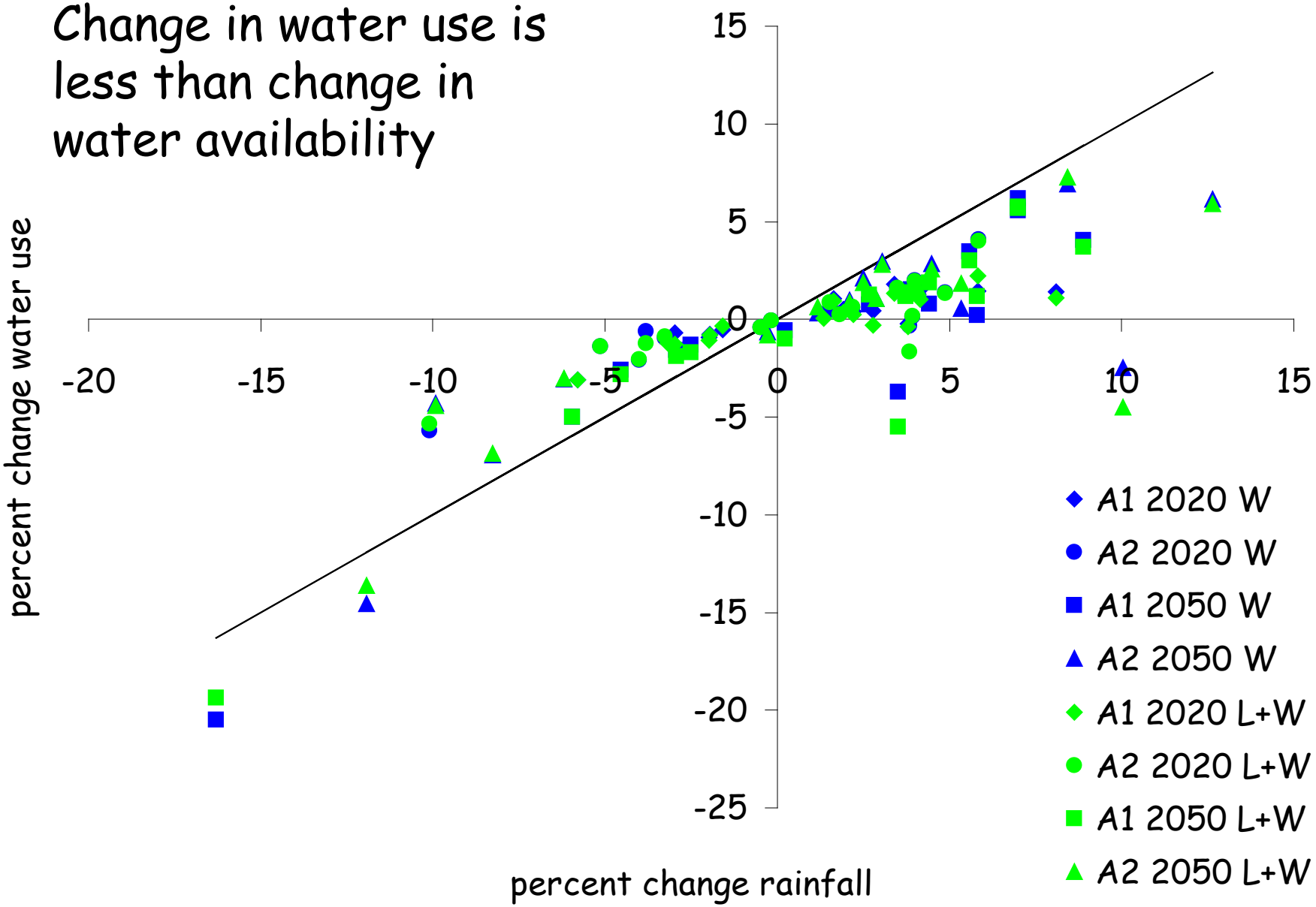
Percent change (from 1961-1990)
in annual average river flow

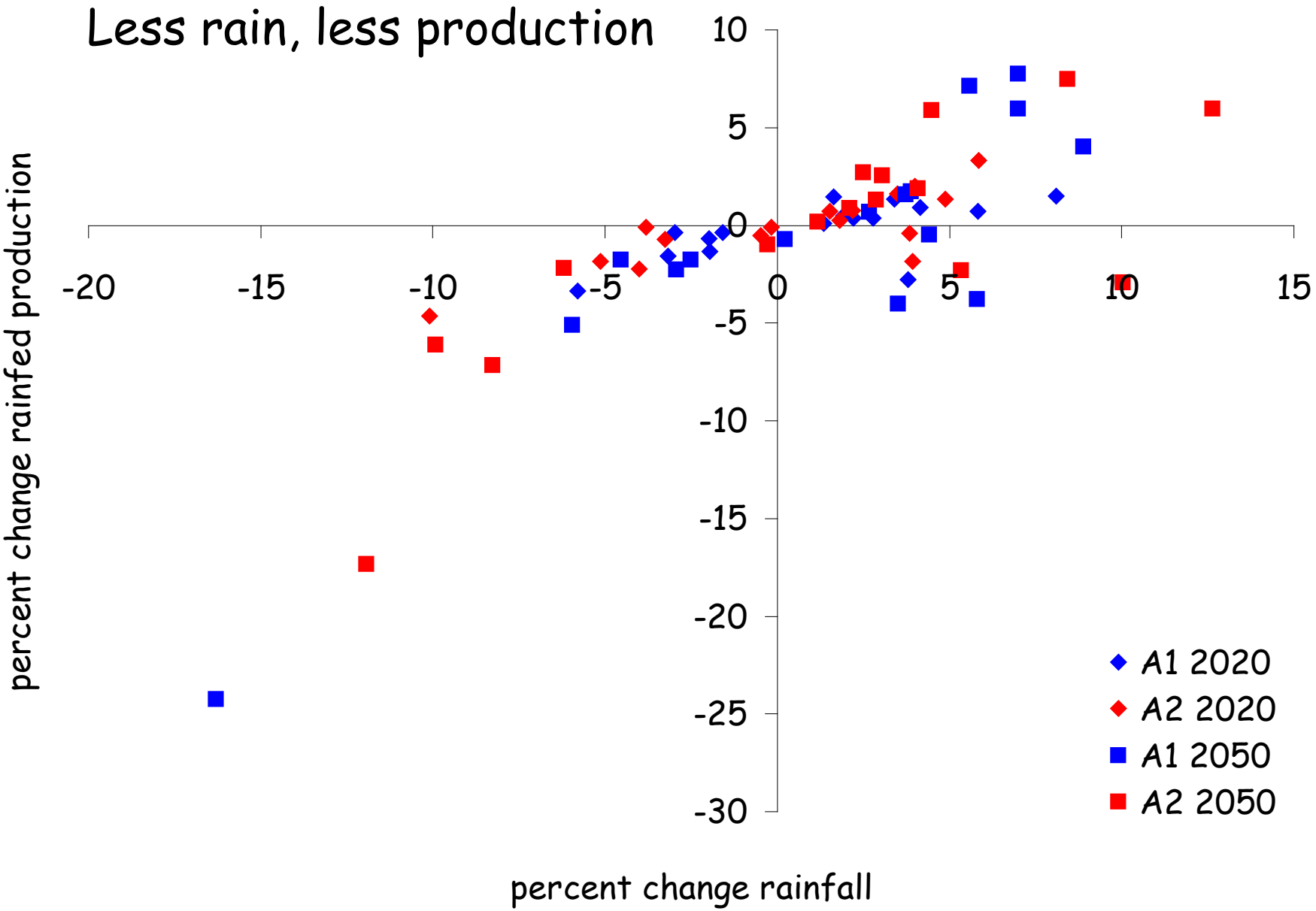
Water in a CGE

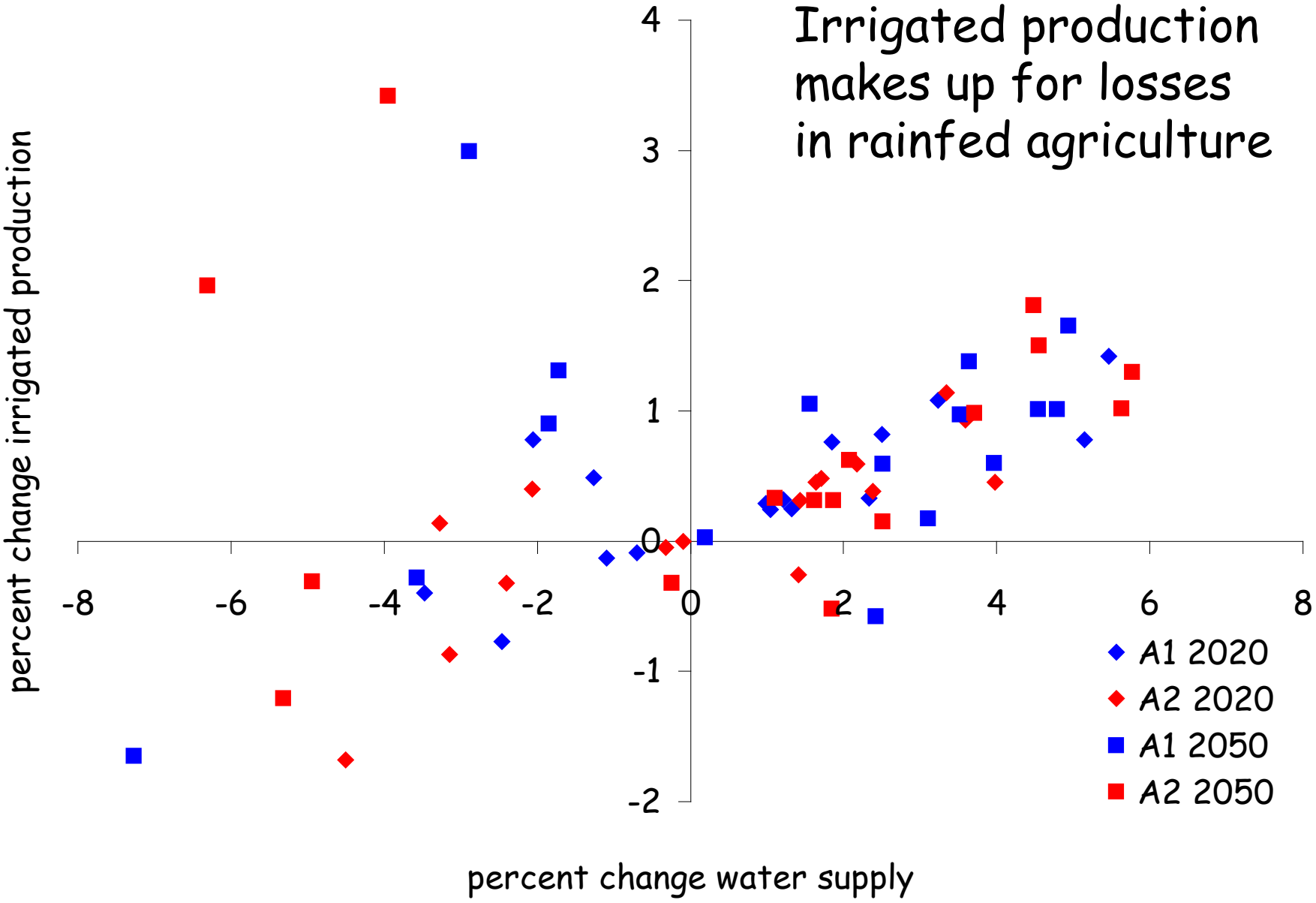
- Constructed water satellite accounts for GTAP-6
- Split rainfed and irrigated agriculture
- Water is a technology of land in rainfed agriculture
- Water is an endowment in irrigated agriculture

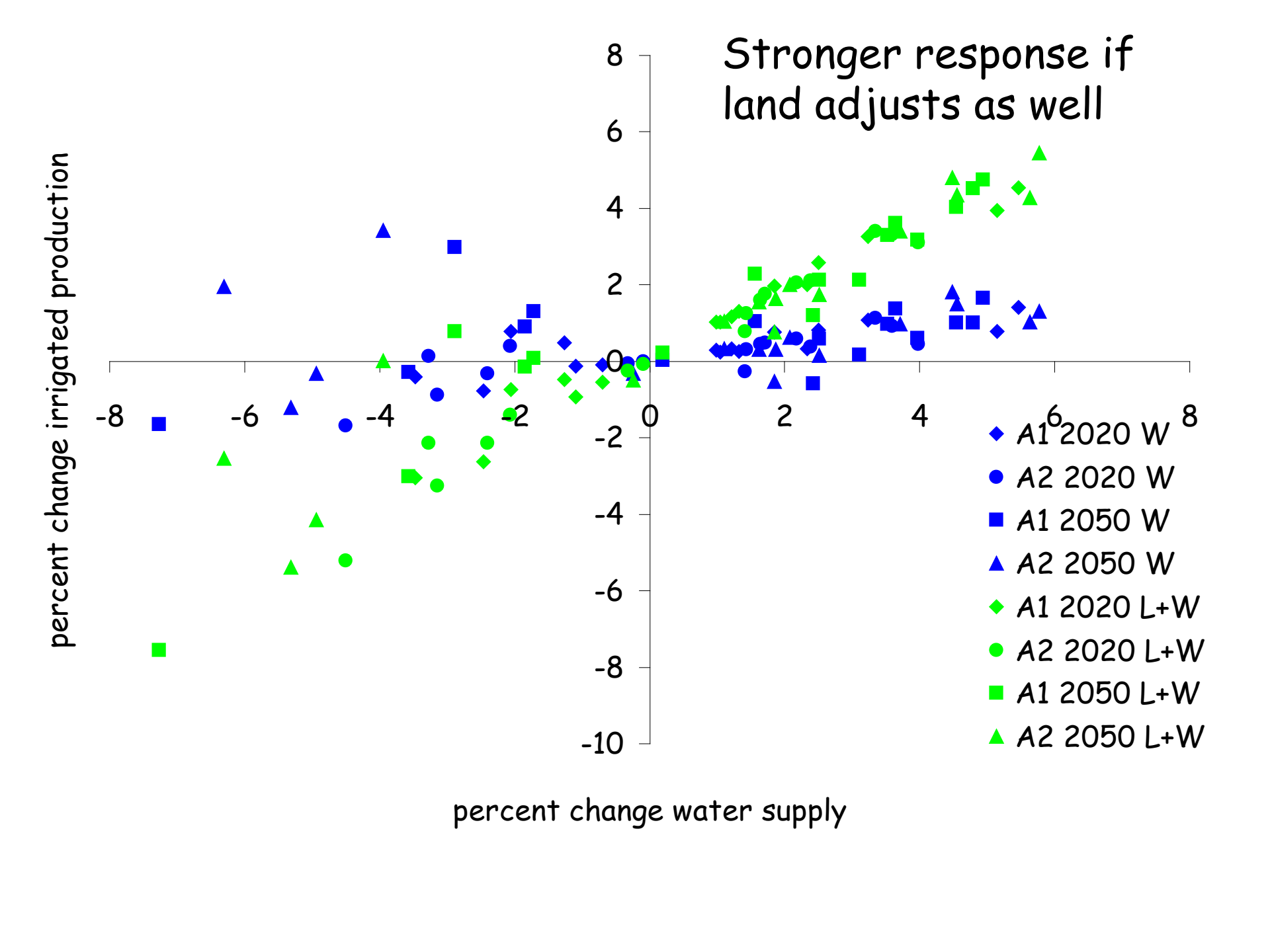

Change in water supply and precipitation
Rivers moderate!
20
15
10
5
0
-5
-10
-15
-20
-10
-5
0
5
10
percent change precipitation
percent change water supply
A1 2020
A2 2020
A1 2050
A2 2050

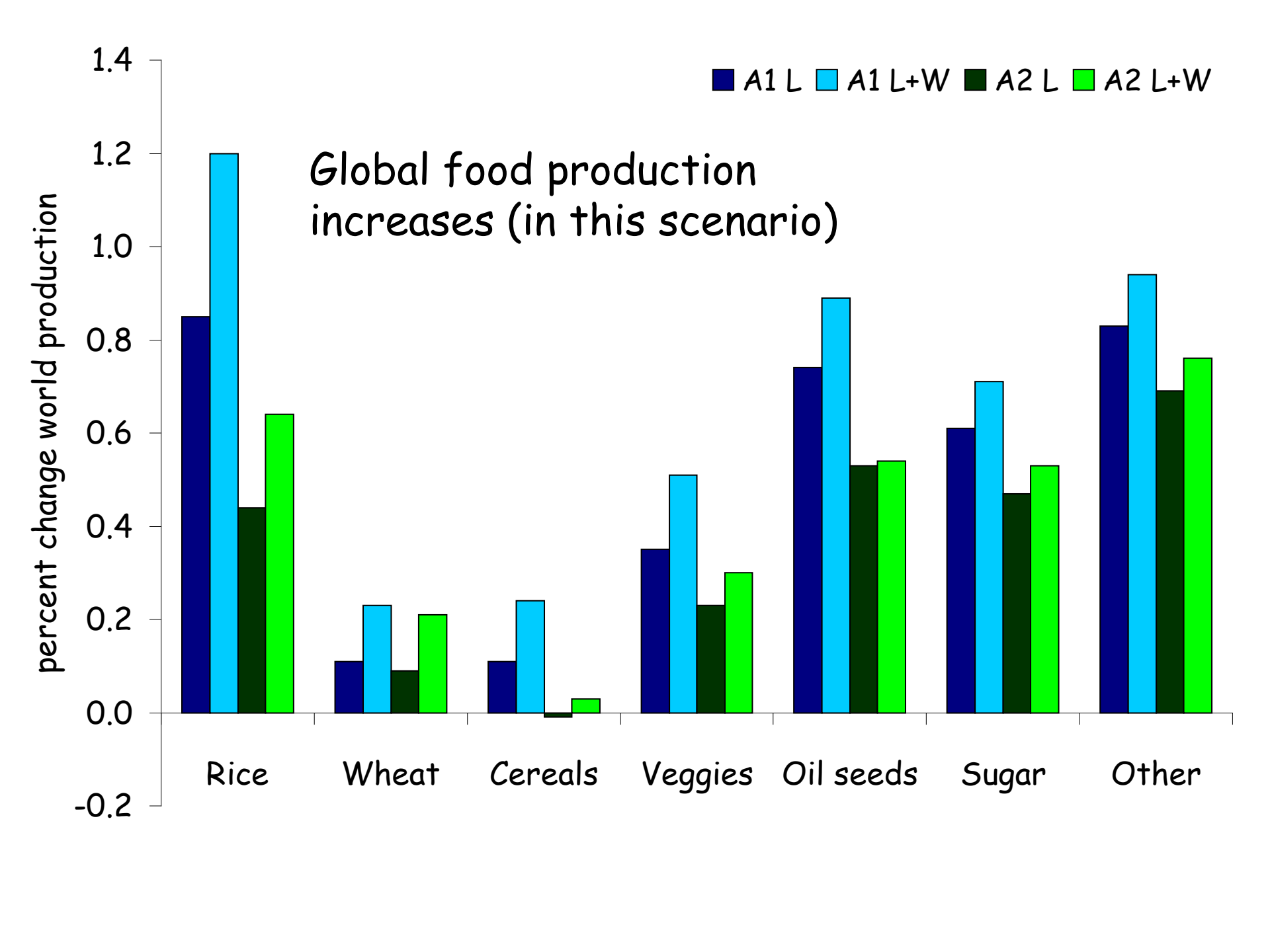
Change in water use is less than change in water availability

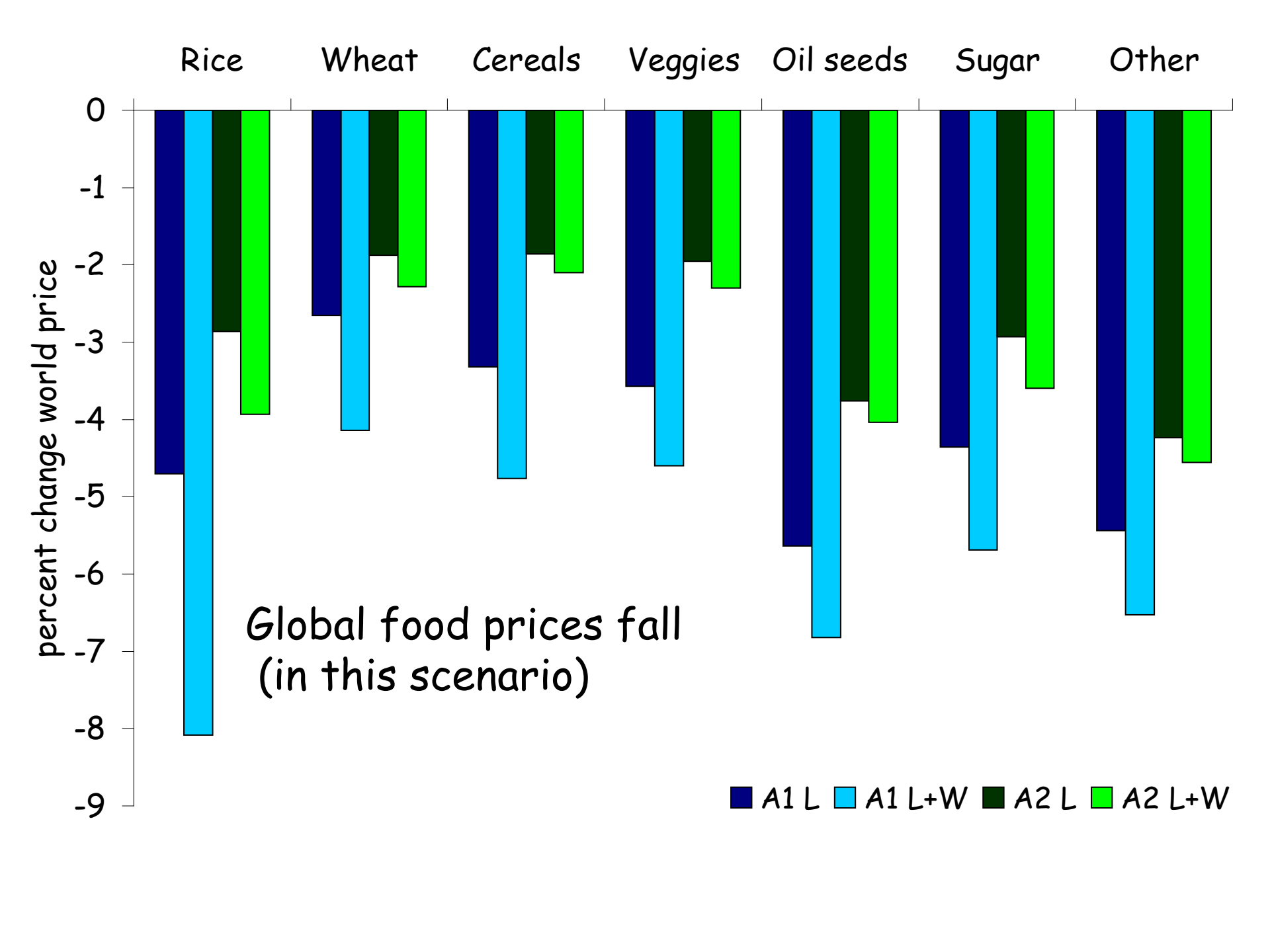


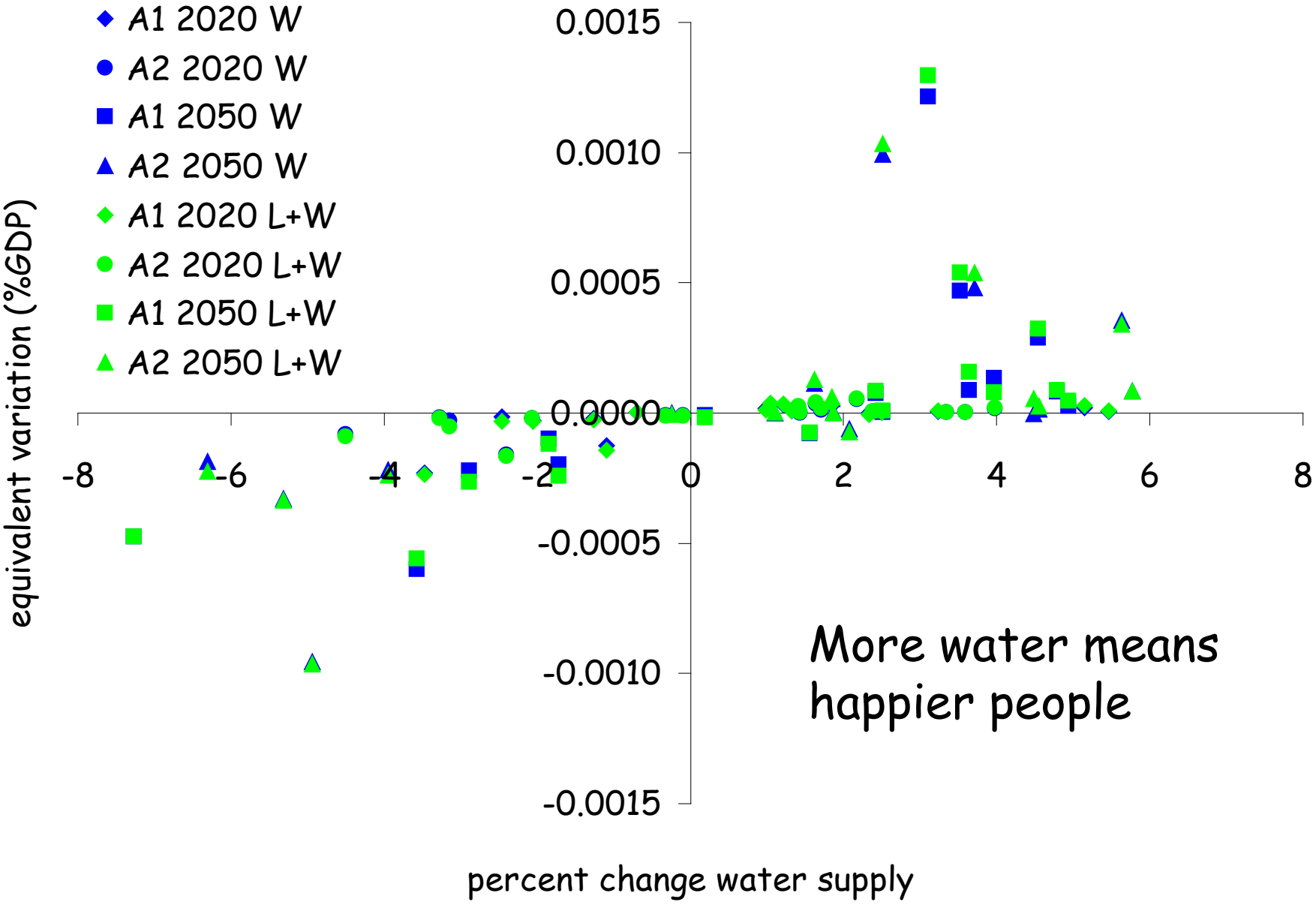

Less rain, less production
percent change rainfed production
percent change rainfall
10
5
0
-5
-10
-15
-20
-25
-30
-20
-15
-10
-5
0
5
10
15
A1 2020
A2 2020
A1 2050
A2 2050


Irrigated production
makes up for losses
in rainfed agriculture
percent change irrigated production
percent change water supply
4
3
2
1
0
-1
-2
-8
-6
-4
-2
0
2
4
6
8
A1 2020
A2 2020
A1 2050
A2 2050


Stronger response if land adjusts as well
percent change irrigated production
percent change water supply
8
6
4
2
0
-2
-4
-6
-8
-10
-8
-6
-4
-2
0
2
4
6
8
A1 2020 W
A2 2020 W
A1 2050 W
A2 2050 W
A1 2020 L+W
A2 2020 L+W
A1 2050 L+W
A2 2050 L+W


A1 L
A1 L+W
A2 L
A2 L+W
Global food production increases (in this scenario)
percent change world production
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
Rice
Wheat
Cereals
Veggies
Oil seeds
Sugar
Other


Rice
Wheat
Cereals
Veggies
Oil seeds
Sugar
Other
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
percent change world price
Global food prices fall
(in this scenario)
A1 L
A1 L+W
A2 L
A2 L+W


A1 2020 W
A2 2020 W
A1 2050 W
A2 2050 W
A1 2020 L+W
A2 2020 L+W
A1 2050 L+W
A2 2050 L+W
0.0015
0.0010
0.0005
0.0000
-0.0005
-0.0010
-0.0015
-8
-6
-4
-2
0
2
4
6
8
equivalent variation (%GDP)
percent change water supply
More water means happier people

Findings

- Lots of adaptation
  - rivers moderate
  - Δ water use < Δ water availability
  - change in land use
  - substitution between irrigated and rainfed agriculture
  - shift in trade patterns
- Overall welfare impacts small and positive
  - 2050 only
  - Increase in water availability