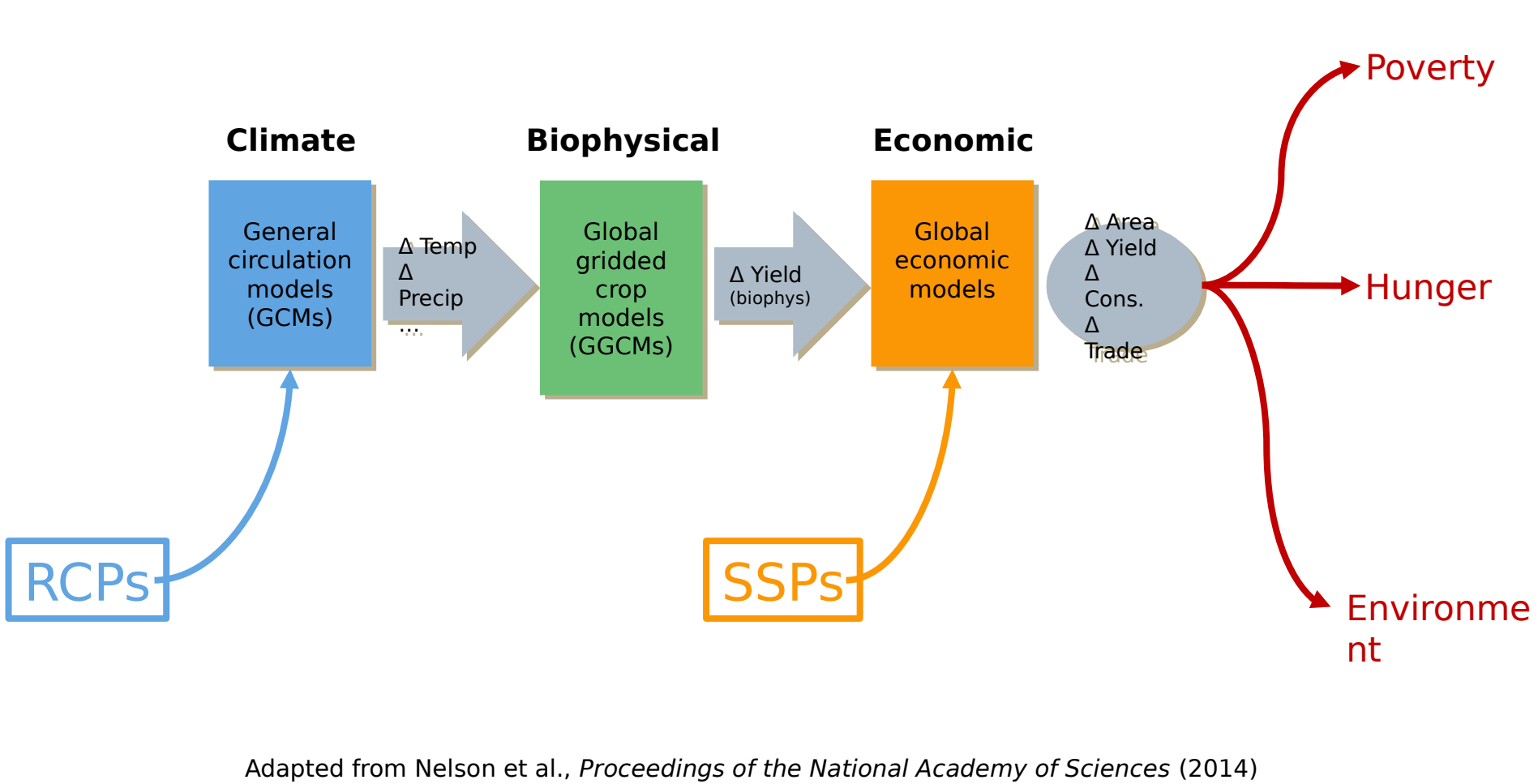
Tradeoffs in achieving food and nutrition security at global and regional scales

Keith Wiebe
Senior Research Fellow
International Food Policy Research Institute
With Global Futures & Strategic Foresight colleagues from AfricaRice, Bioversity, CIAT, CIFOR, CIMMYT, CIP, ICARDA, ICRAF, ICRISAT, IFPRI, IITA, ILRI, IRRI, IWMI, WorldFish, and other partners

Impacts World 2017
Potsdam, Germany
12 October 2017

Modeling alternative futures for agriculture:

biophysical and socioeconomic drivers and effects

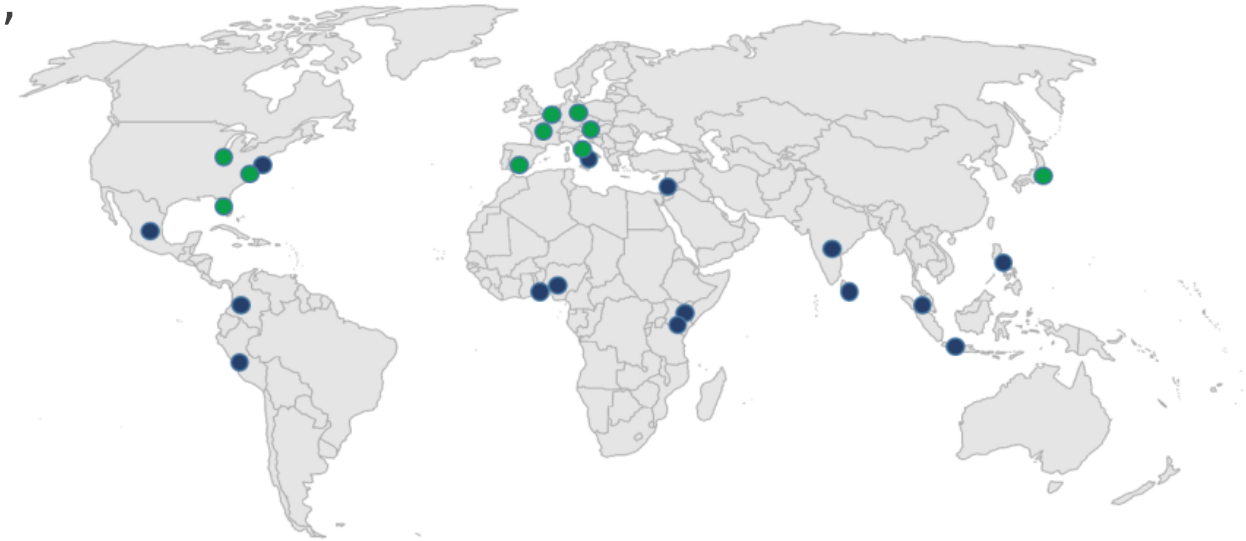


Adapted from Nelson et al., *Proceedings of the National Academy of Sciences* (2014)

Partners in Global Foresight modeling

- AgMIP Global Economics
  - IFPRI, PIK, GTAP, Wageningen, EC/JRC, USDA/ERS, IIASA, FAO, OECD, UFL, NIES, …
- Global Futures & Strategic Foresight – 15 CGIAR centers
  - AfricaRice, Bioversity, CIAT, CIFOR, CIMMYT, CIP, ICARDA, ICRAF, ICRISAT, IFPRI, IITA, ILRI, IRRI, IWMI, WorldFish

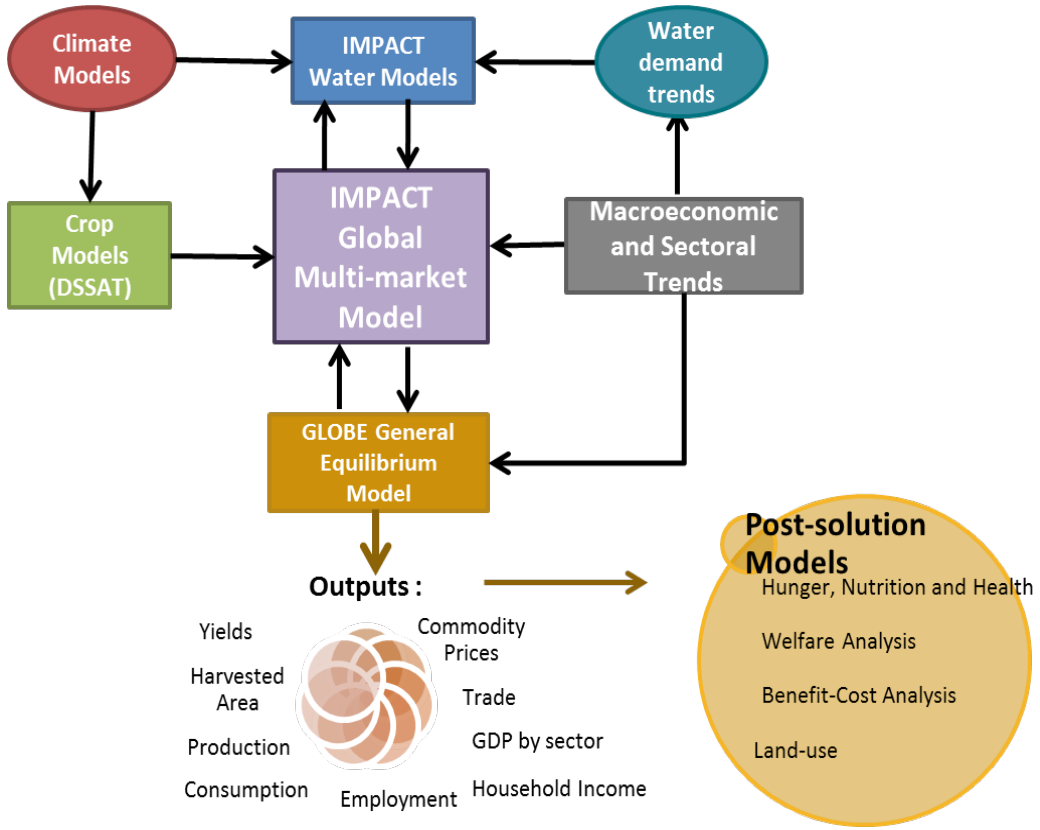
AgMIP The Agricultural Model Intercomparison and Improvement Project

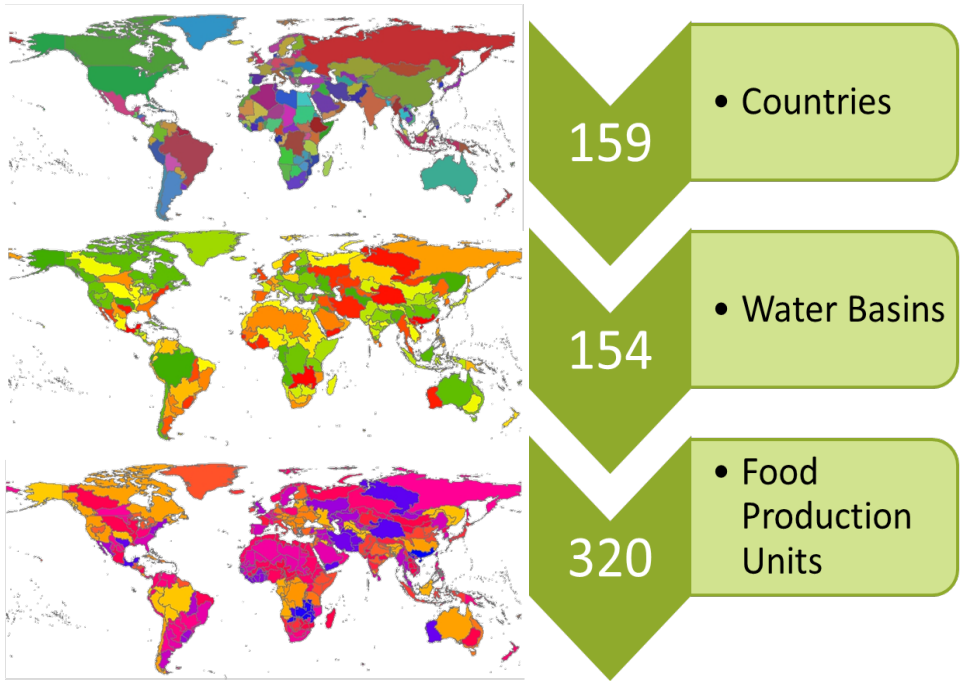


GLOBAL FUTURES & Strategic Foresight
a CGIAR initiative led by IFPRI

IFPRI's IMPACT system of models

Exploring alternative climate and investment futures

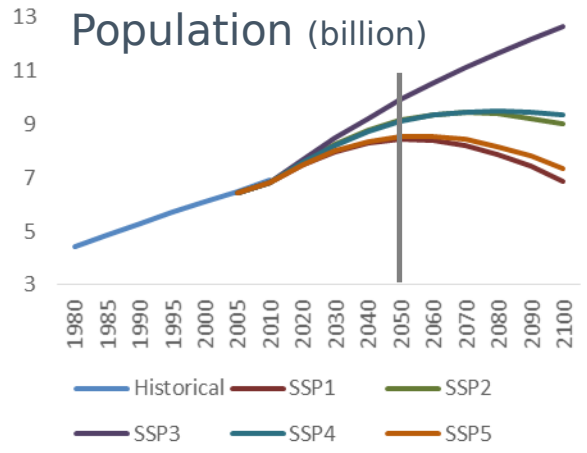


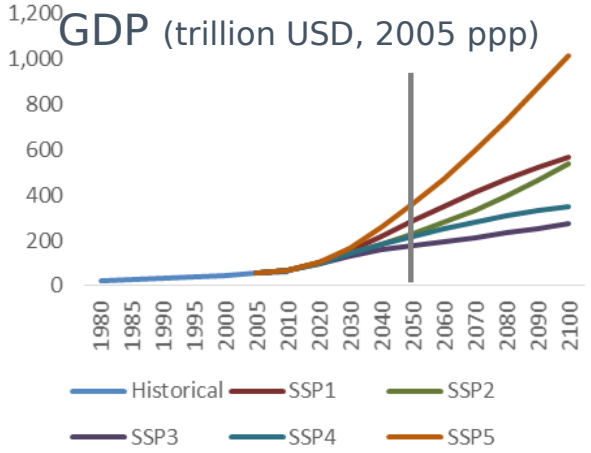


Source: Robinson et al. (2015) "The International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT); Model description for version 3". IFPRI Discussion Paper. International Food Policy Research Institute: Washington, DC.

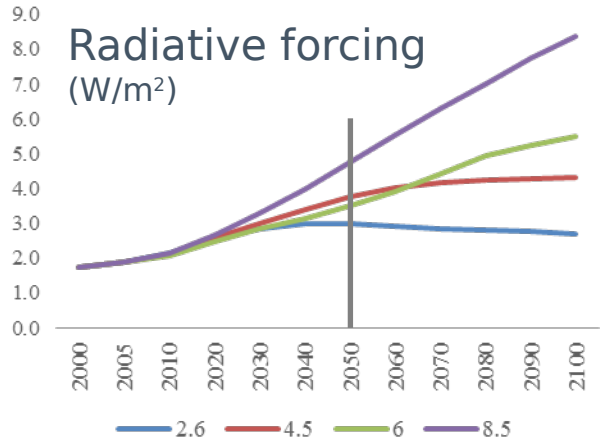
Reference socioeconomic and climate drivers

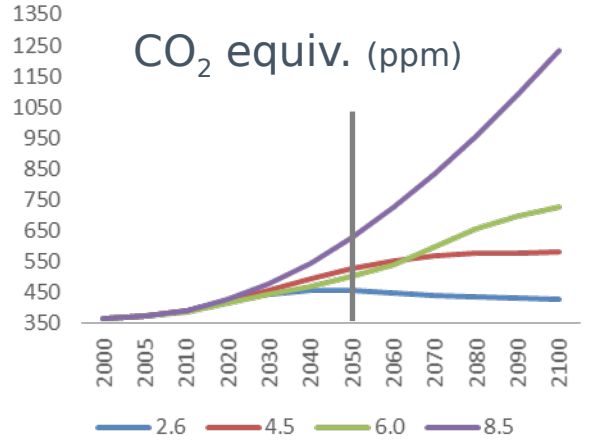
Shared Socioeconomic Pathways (SSPs)





Representative Concentration Pathways (RCPs)





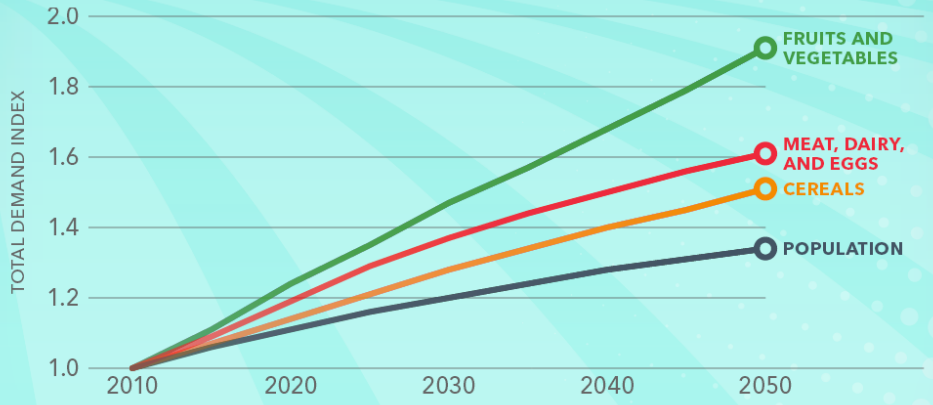
This work uses "middle-of-the-road" **SSP2** and rapid climate change **RCP 8.5** as the reference case.

Source: Downloaded from the RCP Database version 2.0.5 (2015). RCP 2.6: van Vuuren et al. 2006; van Vuuren et al. 2007. RCP 4.5: Clark et al. 2007; Smith and Wigley 2006; Wise et al 2009. RCP 6.0: Fujino et al 2006; Hijioka et al 2008. RCP 8.5: Riahi and Nakicenovic, 2007.

Changing patterns of demand

GROWING DEMAND *for* NON-STAPLE FOODS

Demand for staple crops rises slightly faster than global population, increasing about 50% globally by 2050. As more people move out of extreme poverty and gain access to more diverse diets, however, **demand for meat, dairy, and eggs is expected to grow more than 60% and demand for fruits and vegetables will grow even more.**



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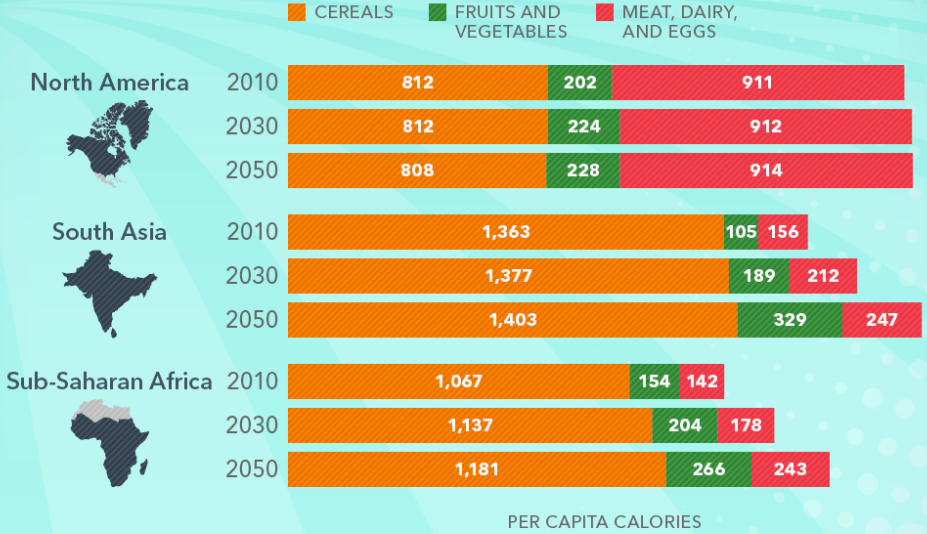
NOTES: Other food groups have been omitted. Numbers do not reflect climate change impacts, which would lower these projections. For more info please visit https://gfpr.ifpri.info/.

SOURCE: IFPRI (International Food Policy Research Institute). "International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT)." *2017 Global Food Policy Report* (2017): 110–118.

DEVELOPMENT SPURS CHANGING DIETS

The main driver in global shifts in food demand is economic development and the changing dietary preferences that come with it. While diets in high-income regions like North America will hardly change at all, **per capita demand for fruit and vegetables in South Asia is expected to more than triple by 2050 and demand for meat, dairy, and eggs in Africa south of the Sahara is expected to grow more than 70%.** Demand for cereals in all regions, however, is unlikely to change much.



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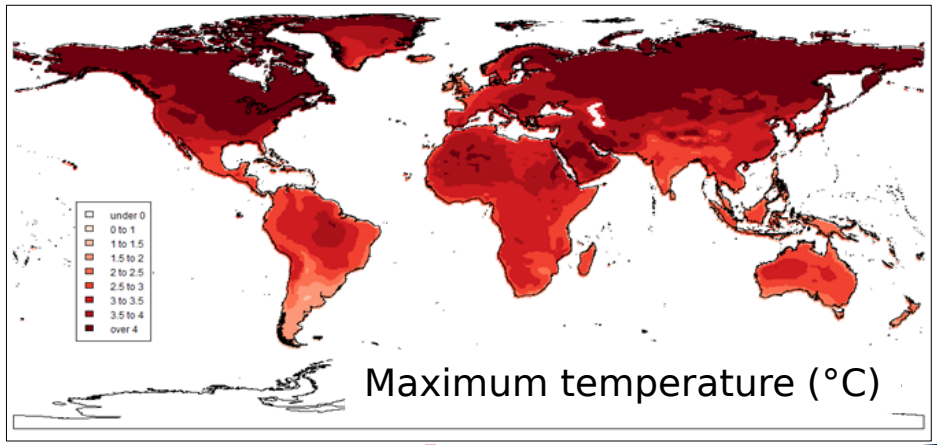
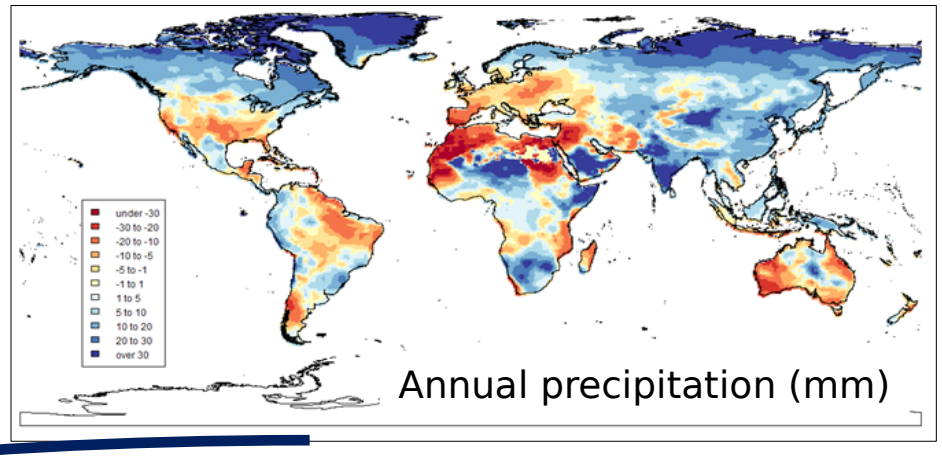
NOTES: Other food groups have been omitted. Numbers do not reflect climate change impacts, which would lower these projections. For more info please visit https://gfpr.ifpri.info/.

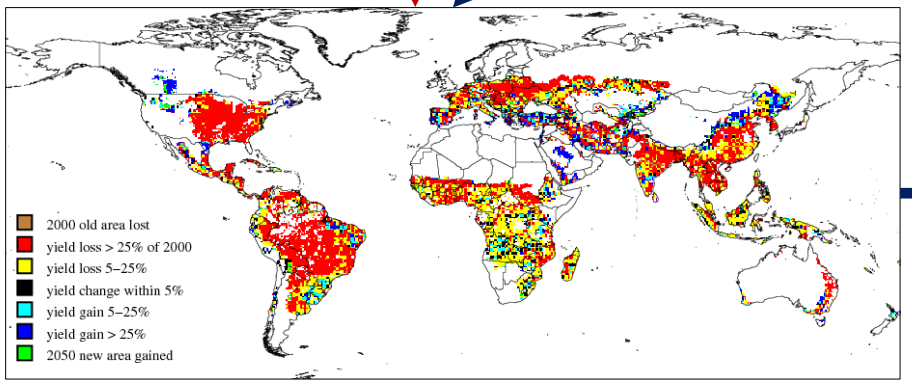
SOURCE: IFPRI (International Food Policy Research Institute). "International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT)." *2017 Global Food Policy Report* (2017): 110–118.

Estimating climate change impacts in 2050

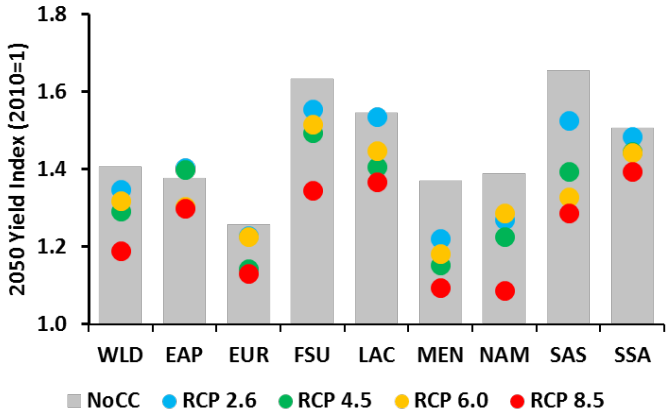
The example of maize yields using HadGEM (RCP8.5), DSSAT, and IMPACT (SSP2)







Change in rainfed maize yields before economic adjustments

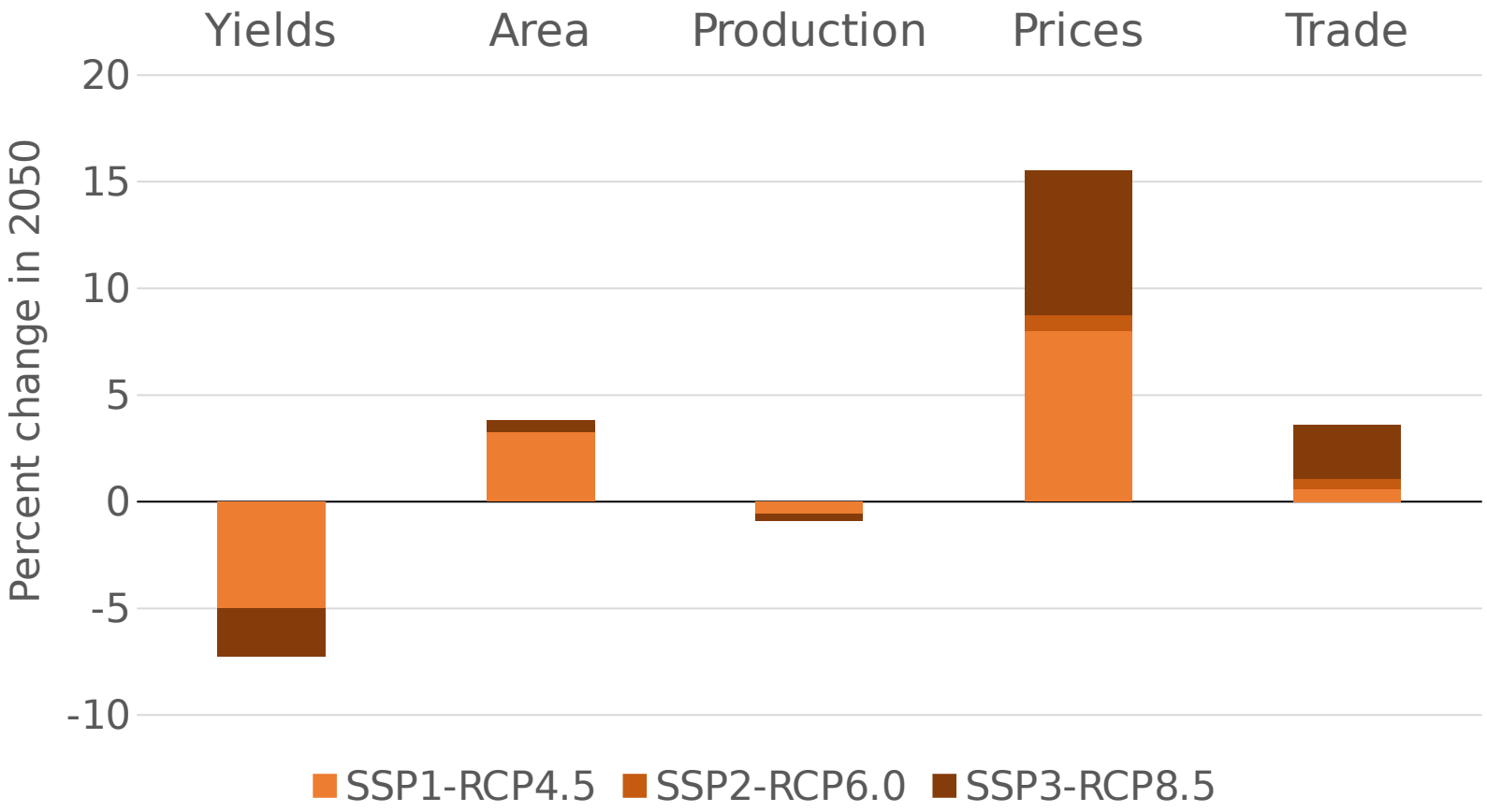


Change in rainfed maize yields after economic adjustments

Source: IFPRI, IMPACT version 3.2, November 2015

Climate change impacts in 2050

Average of 5 global economic models for coarse grains, rice, wheat, oilseeds & sugar



AgMIP The Agricultural Model Intercomparison and Improvement Project

Source: Wiebe et al., *Environmental Research Letters* (2015)

Reference and alternative scenarios

Scenario Grouping	Scenario	Scenario Description
Reference	REF_HGEM	Reference scenario with RCP 8.5 future climate using HadGEM GCM
	REF_IPSL	Alternative reference with RCP 8.5 future climate using IPSL GCM
	REF_NoCC	Alternate reference with no climate change (constant 2005 climate)
Productivity Enhancement	MED	Medium increase in R&D investment across the CGIAR portfolio
	HIGH	High increase in R&D investment across the CGIAR portfolio
	HIGH+NARS	High increase in R&D investment across the CGIAR portfolio plus complementary NARS investments
	HIGH+RE	High increase in R&D investment across the CGIAR portfolio plus increased research efficiency
	REGION	Regionally-focused high increase in CGIAR R&D investments Targets the highest increases to South Asia and Sub-Saharan Africa with medium levels of increase in Latin America and East Asia
Improved Water Resource Management	IX	Investments to expand irrigation in the developing world
	IX+WUE	Irrigation expansion plus increased water use efficiency
	ISW	Investments to increase soil water holding capacity
Improved Infrastructure	RMM	Infrastructure improvements to improve market efficiency through the reduction of transportation costs and marketing margins
Comprehensive Investment	COMP	This comprehensive scenario is a combination of 4 scenarios: HIGH+RE; IX+WUE; ISW; and RMM

Source: Rosegrant et al. 2017

Tradeoffs and synergies under alternative scenarios

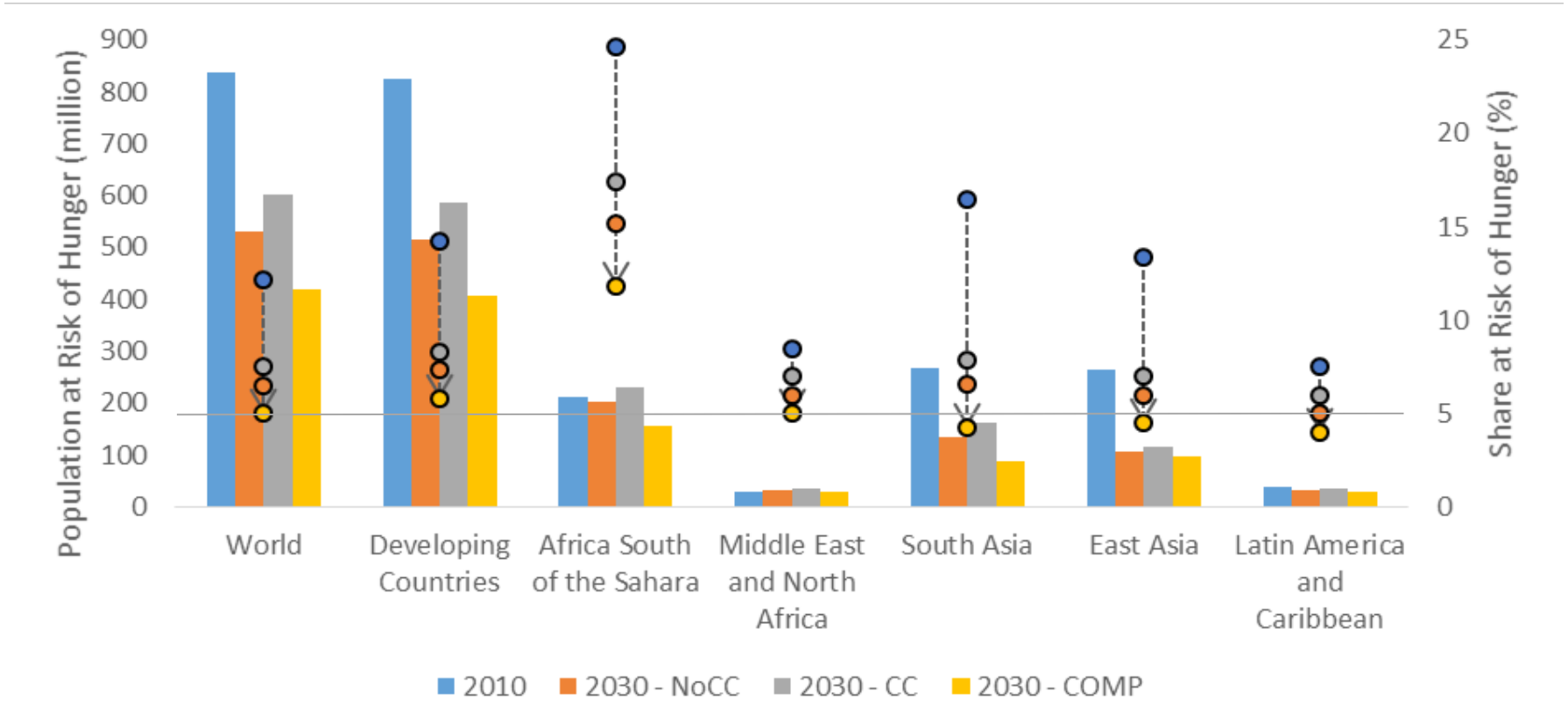
(percentage change relative to baseline in 2030 and 2050)

Scenario	Avg. Annual Cost	2030						2050					
		SLO 1	SLO2		SLO3			SLO1	SLO2		SLO3		
		GDP	Ag Supply	Hunger	Water Use	GHG	Forest	GDP	Ag Supply	Hunger	Water Use	GHG	Forest
MED R&D	1.4	0.7	1.4	-6.5	0.0	-5.5	0.03	1.9	2.7	-9.3	-0.2	-15.4	0.13
HIGH R&D	2.0	1.3	2.8	-12.4	-0.1	-7.5	0.04	3.4	5.7	-16.6	-0.4	-24.3	0.20
HIGH+NARS	3.0	1.6	3.7	-15.8	-0.1	-8.9	0.04	4.3	7.7	-20.2	-0.4	-26.5	0.22
HIGH+RE	2.0	2.6	6.4	-24.4	-0.2	-12.7	0.06	4.2	7.5	-20.0	-0.4	-26.9	0.22
REGION	2.5	1.1	2.4	-10.9	-0.1	-6.5	0.03	3.1	5.1	-15.4	-0.3	-22.6	0.18
Irrig Exp	3.5	0.1	0.1	-1.3	2.6	-1.8	0.01	0.2	0.2	-1.1	2.9	0.7	-0.01
IX+WUE	8.1	0.4	0.9	-4.5	-7.2	-1.9	0.01	0.5	0.9	-2.7	-7.5	-0.2	-0.01
ISWM	4.6	0.2	0.5	-2.1	-1.5	-0.5	0.00	0.5	0.9	-3.0	-2.9	-1.1	0.01
RMM	10.8	1.0	1.6	-5.8	0.1	6.4	-0.02	0.8	1.5	-4.2	0.0	8.9	-0.08
COMP	25.5	4.1	9.8	-30.6	-9.0	-11.5	0.07	5.7	11.5	-24.4	-11.0	-25.4	0.22

Hunger in 2030

by climate and investment scenario

(Bars showing numbers on the left axis, dots showing shares on the right axis)



Note: 2030-NoCC assumes a constant 2005 climate; 2030-CC reflects climate change using RCP 8.5 and the Hadley Climate Model, and 2030-COMP assumes climate change plus increased investment in developing country agriculture.

Source: IFPRI, IMPACT model version 3.3 (Rosegrant et al. 2017).

Diet, nutrition, and health: Progress relative to WHO targets

(*baseline with climate change*)

Region	2010				2050			
	Fruits and Vegetables (g/person/day)[1]	Fat Share of Calories[2]	Sugar Share of Calories[3]	Total Calories[4]	Fruits and Vegetables (g/person/day)	Fat Share of Calories	Sugar Share of Calories	Total Calories
East Asia	819	22%	9%	2,873	971	28%	11%	3,326
South Asia	313	17%	11%	2,360	970	19%	17%	2,826
Former Soviet Union	502	22%	14%	3,090	642	23%	17%	3,339
Middle East and North Africa	775	20%	15%	3,126	813	21%	17%	3,280
Africa South of the Sahara	290	16%	8%	2,356	430	18%	10%	2,703
Latin America and Caribbean	469	25%	18%	2,876	573	27%	20%	3,080

Note: 2050 results reflect climate change impacts simulated using RCP 8.5 and the Hadley Climate Model.
Source: IFPRI, IMPACT model version 3.3 (Rosegrant et al. 2017).

Key findings

- Population and income growth will drive growth in demand
- Food security is projected to improve
- Climate change will slow this progress
- Important implications for nutrients, diets, and health

Thank you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