How climate change may affect global food demand and supply in the long-term?

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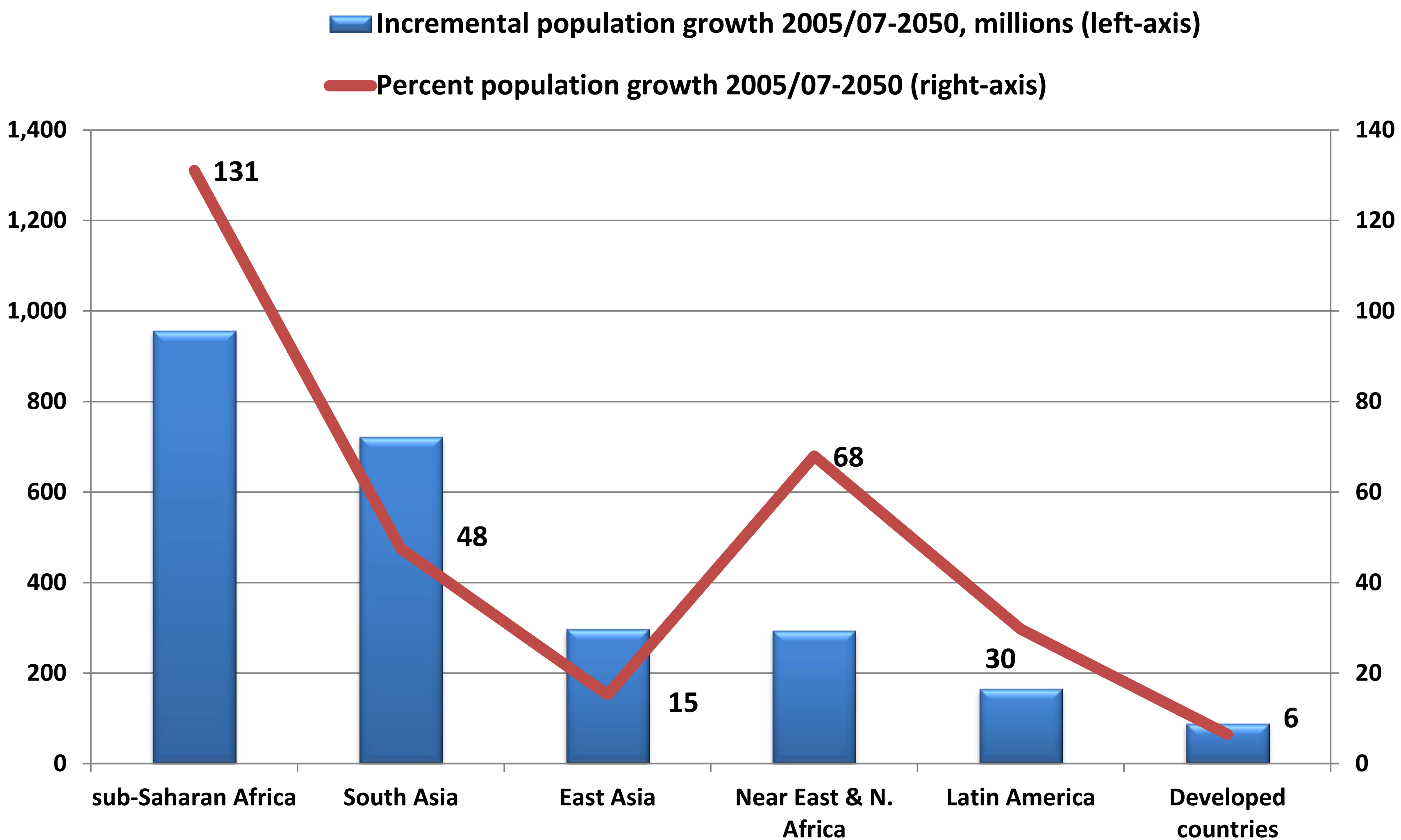
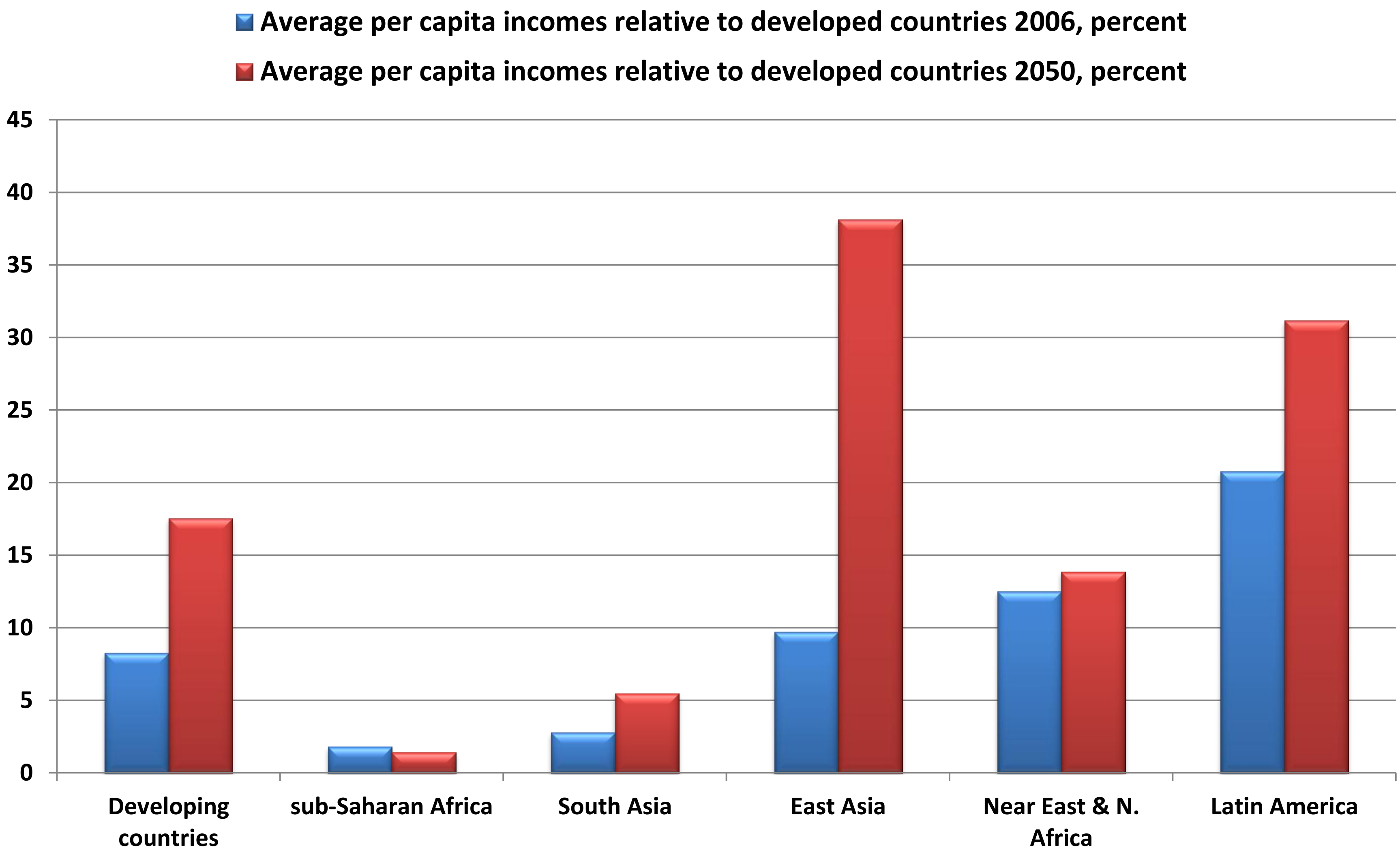
Challenges to ensure sustainable food security in the future

An additional 2.5 billion persons—to 9.1 billion in 2050



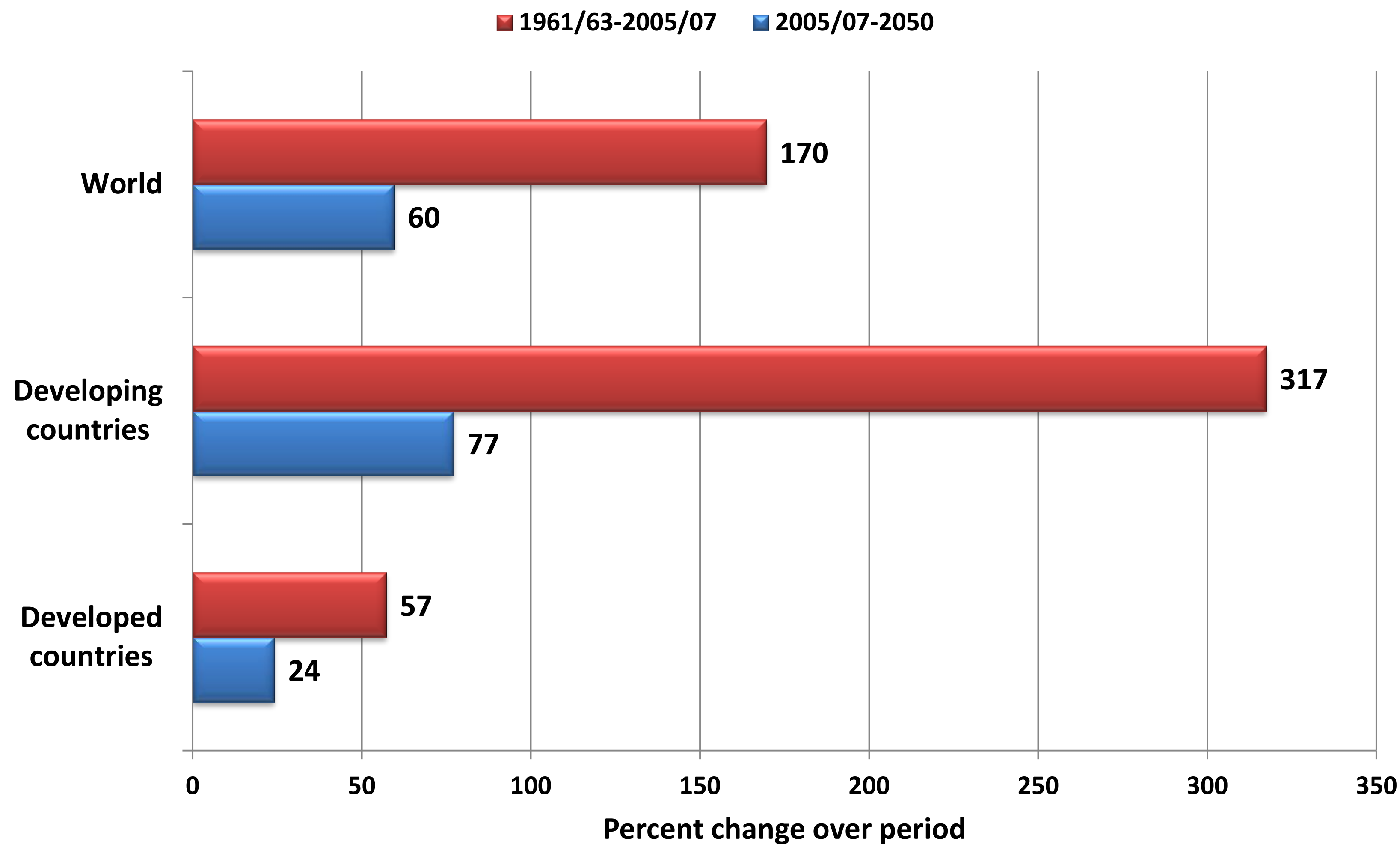
Source: United Nations Population Division (2009).

GDP per capita gaps converge only modestly



Source: Development Prospects Group, The World Bank.

Agricultural production growth slows down

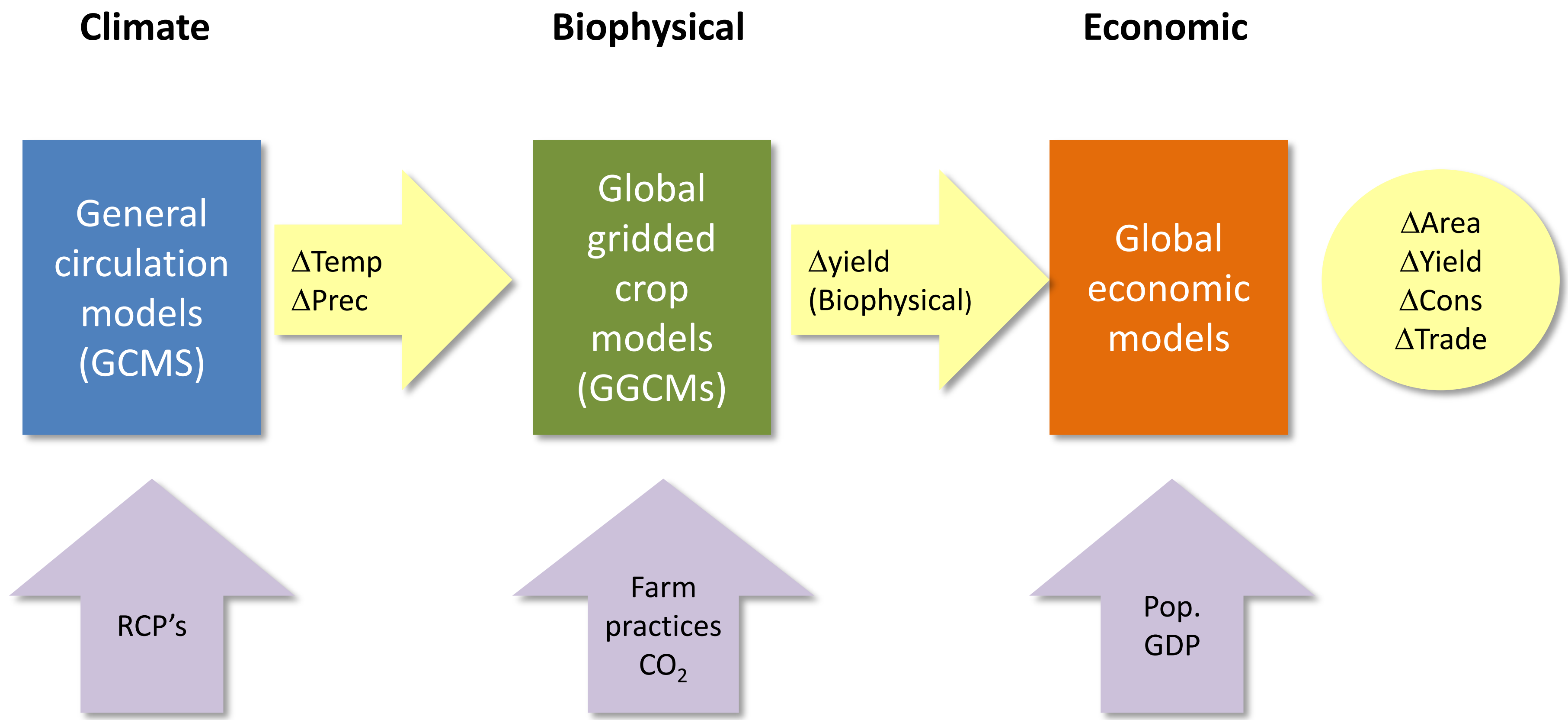


Source: FAO.

Potential impacts of climate change on global food demand and supply

- empirical results based on Agricultural Model Intercomparison and Improvement Project (AgMIP) Phase 1-

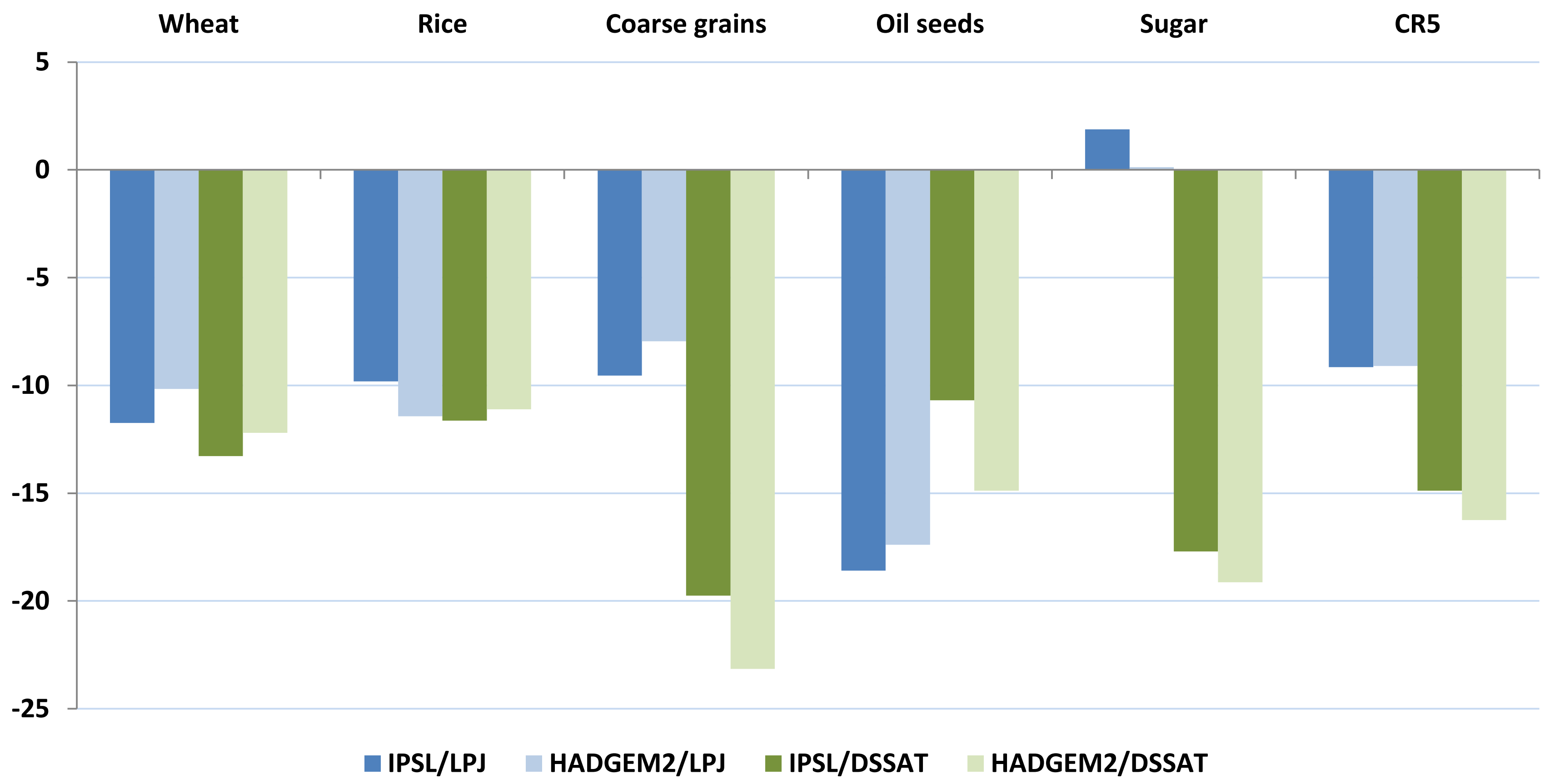
The climate modeling chain in AgMIP: from biophysical to socioeconomic



Reference scenario: SSP2 (no climate change)
Climate scenario: RCP 8.5

Source: Nelson et al., PNAS (2013).

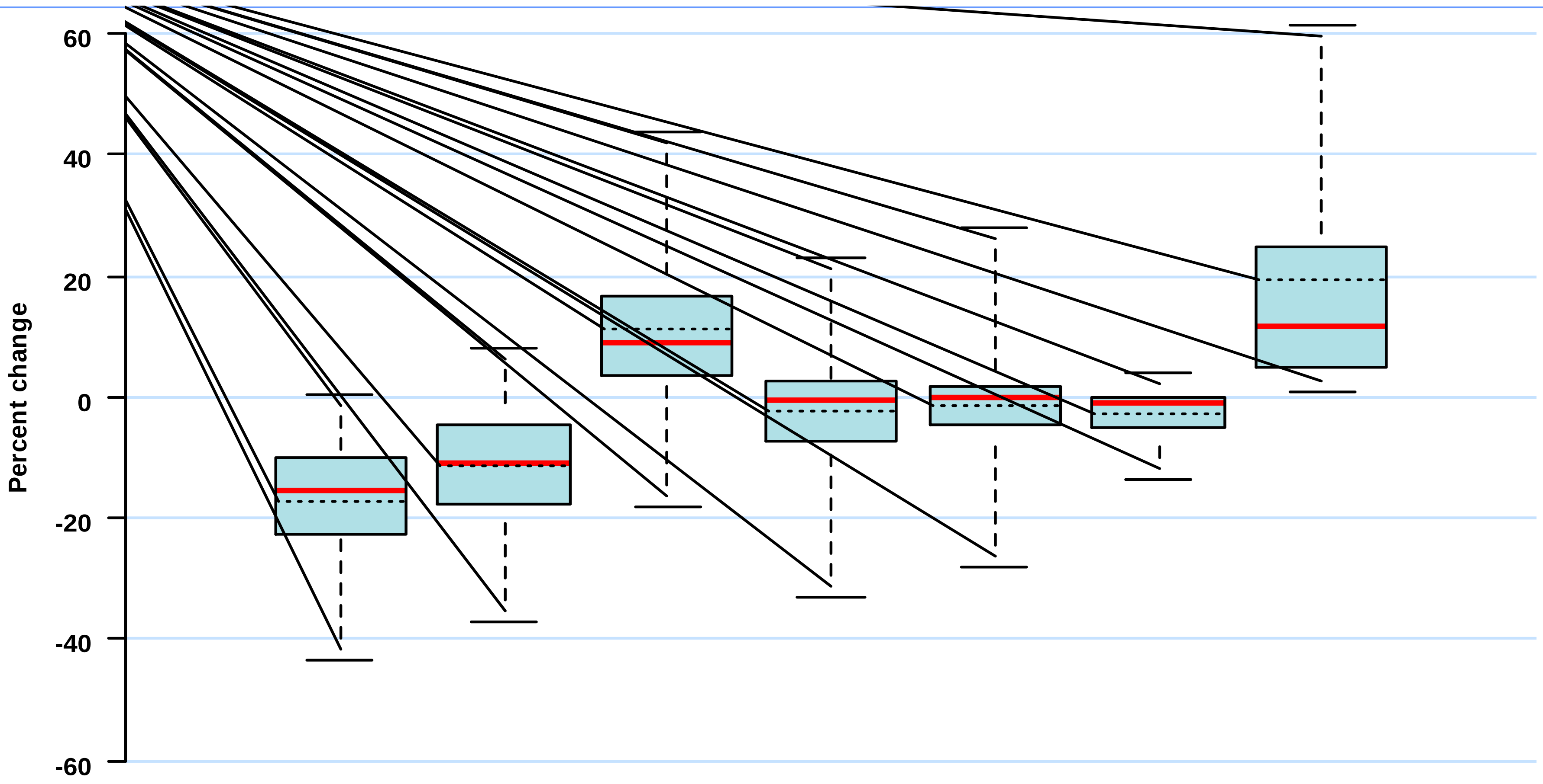
Climate change impacts, percent change in exogenous yields relative to reference in 2050



Source: Nelson et al. (2014).

Note: CR5: average of the five crops

Climate induced changes to global yields, land use, production, trade, consumption and prices relative to reference for CR5 in 2050



	YEXO	YTOT	AREA	PROD	TRSH	CONS	PRICE
n	2891	2891	2891	2891	2891	2891	2891
Mean	-0.17	-0.11	0.11	-0.02	-0.01	-0.03	0.2
SD	(0.131)	(0.166)	(0.249)	(0.25)	(0.264)	(0.063)	(0.242)

Source: Nelson et al. (2014).

Notes: YEXO: exogenous yields,; YTOT: final yields; AREA: crop area; PROD: domestic production; TRSH: net imports relative to production; CONS: consumption; PRICE: average producer prices

Conclusions

Take away messages

- Climate impacts will negatively affect commodity prices, with many of the increases ranging from 5-25%
- Food consumption is expected to drop implying that climate change may well exacerbate food security concerns
- Globally consumption responds less than supply because food demand is not so sensitive to price changes
- Still effects will be felt more in specific regions with already stressed natural resources
- Variability in trade and crop area responses is due to the varying assumptions about trade flexibility and ease of land conversion in the models -> both of which imply different degrees of adaptation to changes in agricultural markets

Further reading

Special issue of Agricultural Economics (2014):
http://onlinelibrary.wiley.com/doi/10.1111/agec.2014.45.issue-1/issuetoc

- **von Lampe, Willenbockel et al.**, "Why do global long-term scenarios for agriculture differ? An overview of the AgMIP Global Economic Model Intercomparison"
- **Robinson, van Meijl, Willenbockel et al.**, "Comparing supply-side specifications in models of global agriculture and the food system"
- **Valin, Sands, van der Mensbrugghe et al.**, "The future of food demand: understanding differences in global economic models"
- **Schmitz, van Meijl et al.**, "Land-use change trajectories up to 2050: insights from a global agro-economic model comparison"
- **Müller and Robertson**, "Projecting future crop productivity for global economic modeling"
- **Nelson, van der Mensbrugghe et al.**, "Agriculture and climate change in global scenarios: why don't the models agree"
- **Lotze-Campen, von Lampe, Kyle et al.**, "Impacts of increased bioenergy demand on global food markets: an AgMIP economic model intercomparison"

Proceedings of the National Academy of Sciences (PNAS) (2014):
http://www.pnas.org/content/111/9/3274.abstract

- **Nelson, Valin et al.**, "Climate change effects on agriculture: Economic responses to biophysical shocks"

Annex

Terminology

- SSPs: Shared Socioeconomic Pathways
- RCPs: Representative Concentration Pathways
- IPR: Intrinsic Productivity Rate
- AgMIP: Agricultural Model Intercomparison Project (http://www.agmip.org/)
- LPJml: Lund-Potsdam-Jena managed Land Dynamic Global Vegetation and Water Balance Model
- DSSAT: Decision Support System for Agricultural Technology
- HadGEM2: Hadley Centre Global Environment Model version 2
- IPSL: climate model of the Institute Pierre Simon Laplace

Reference scenario details

- Based on the SSP2 narrative
- Assumes a middle of the road growth of the economy with intermediate socioeconomic challenges to climate change adaptation and mitigation
- Population and GDP growth path taken over from the SSP database, based in IIASA and OECD projections respectively https://secure.iiasa.ac.at/web-apps/ene/SspDb/dsd?Action=htmlpage&page=about

Climate scenario details

- Radiative forcing of over 8.5 watts per square meter by the end of the century
- Excludes potentially positive effects of increasing CO_2 concentration
- Crop models assume constant management practices (e.g. sowing dates)
- Crop models did not include effects of increased ozone concentration, increased weather variability and greater biotic stress