

Consequence of climate mitigation on risk of hunger

National Institute for Environmental Studies

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K. Takahashi and T. Masui

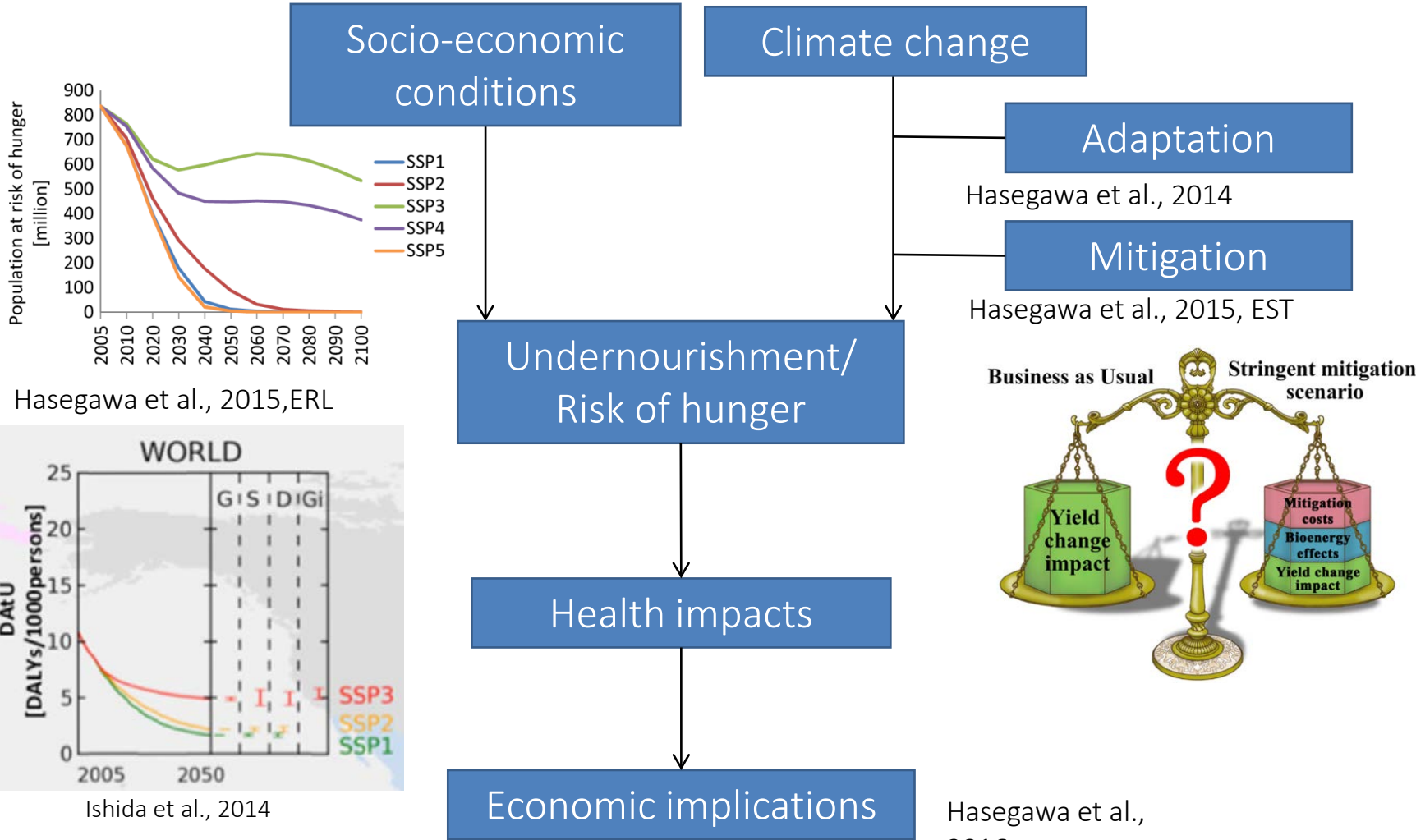
APEC Climate Center, South Korea

S. Yonghee

CESM 2016 Winter Working Group Meetings,

NCAR, February, 8-11, 2016

Our earlier studies

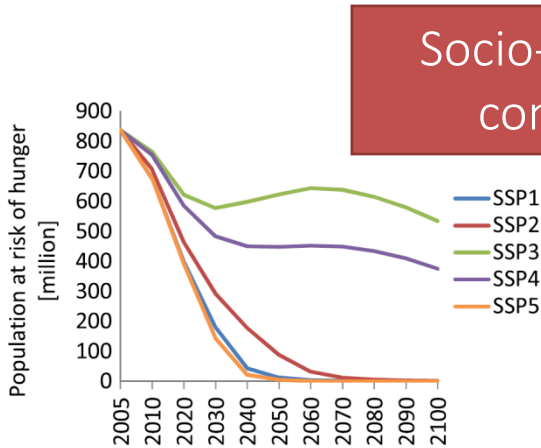


Hasegawa et al., 2015, ERL

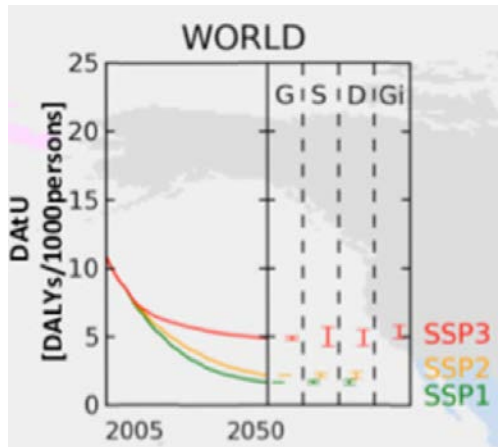
Business as Usual vs Stringent mitigation scenario

Hasegawa et al., 2016

Our earlier studies



Hasegawa et al., 2015, ERL



Ishida et al., 2014

Socio-economic conditions

Climate change

Adaptation

Hasegawa et al., 2014

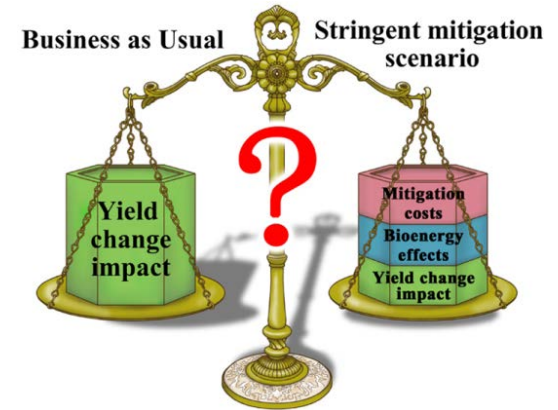
Mitigation

Hasegawa et al., 2015, EST

Undernourishment/
Risk of hunger

Health impacts

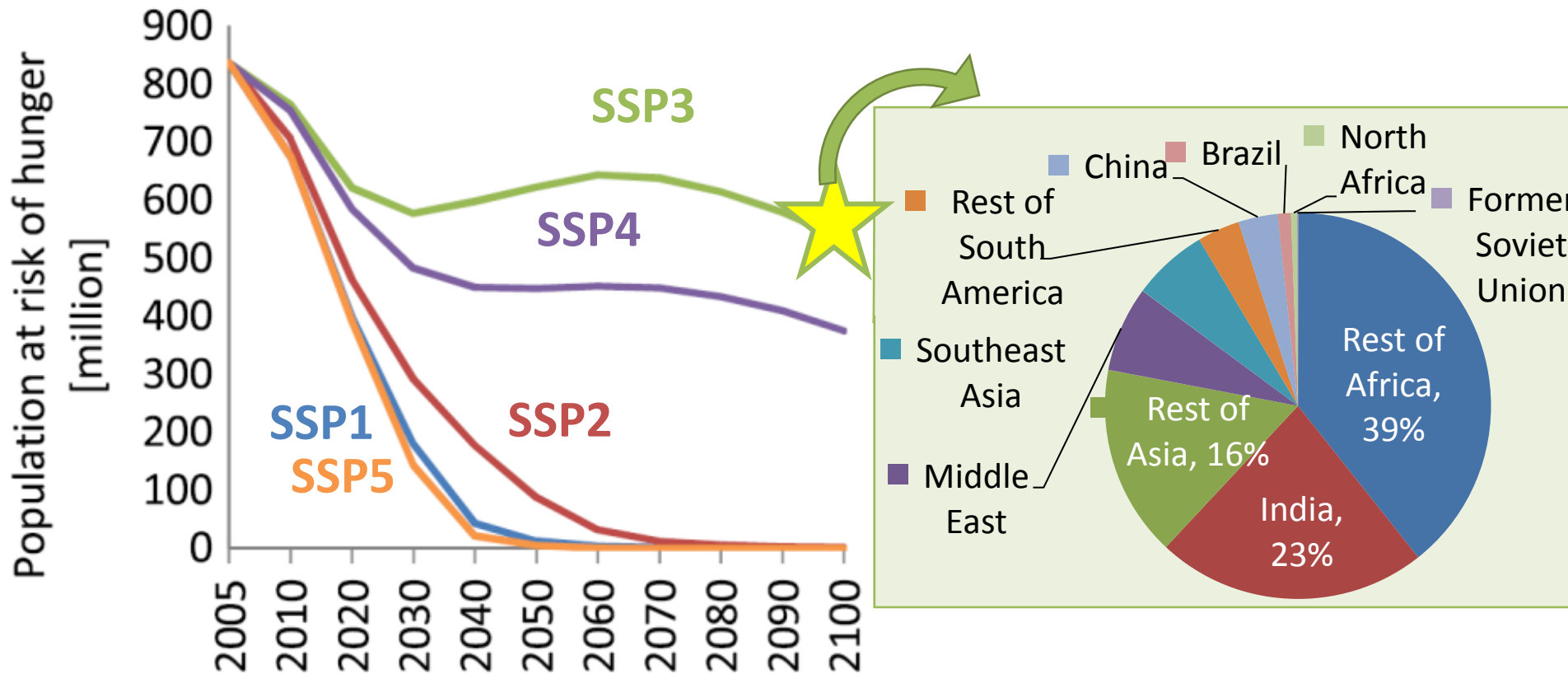
Economic implications



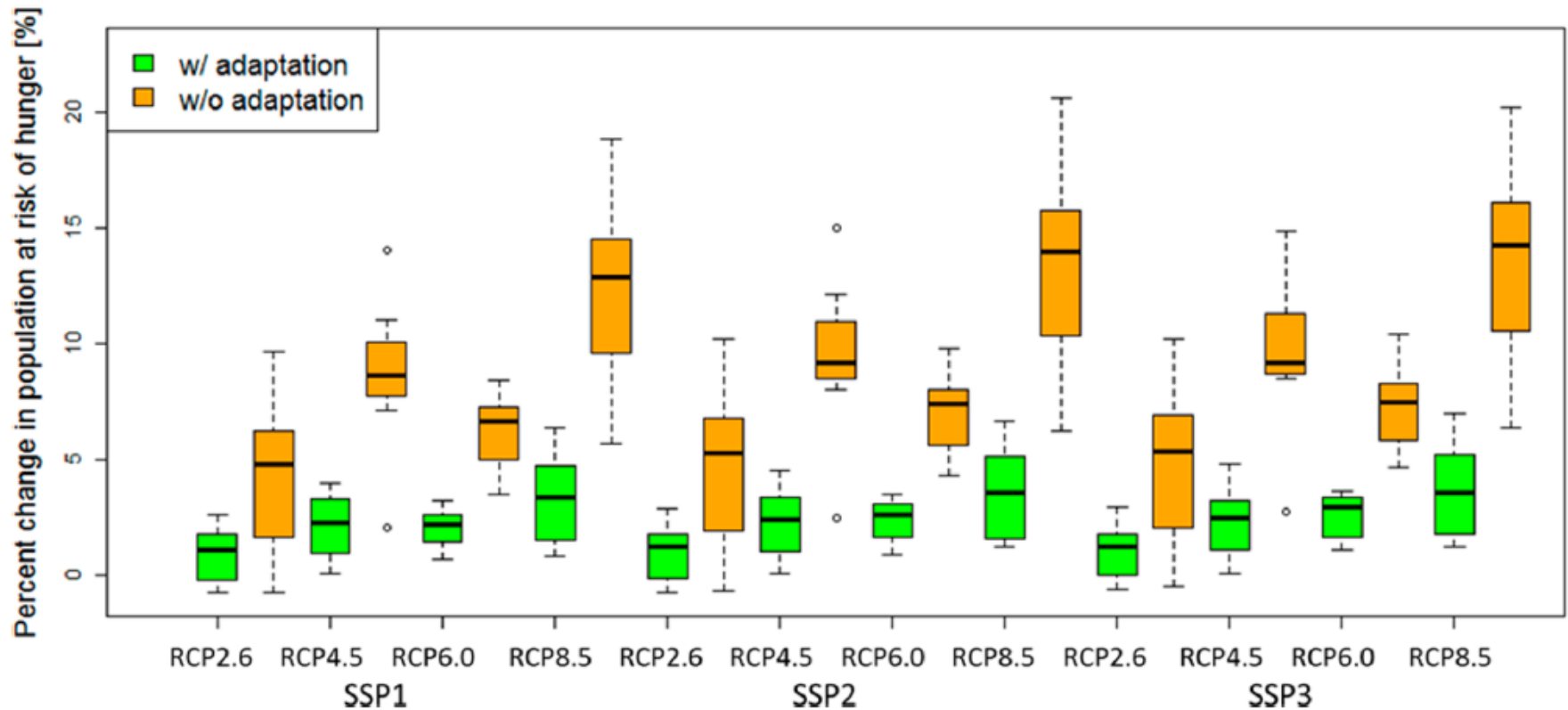
Hasegawa et al., 2016

Risk of hunger in the 21st century

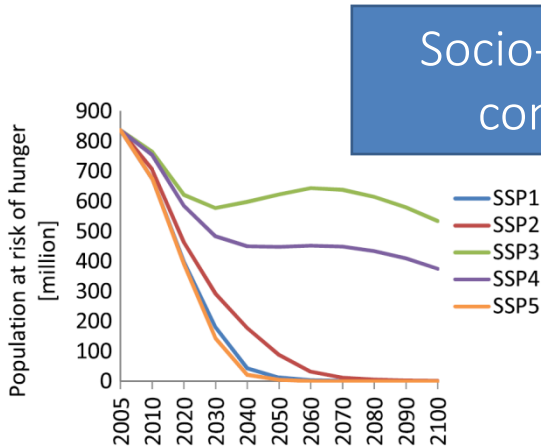
The 21st-century risk of hunger strongly differs among different socioeconomic conditions.



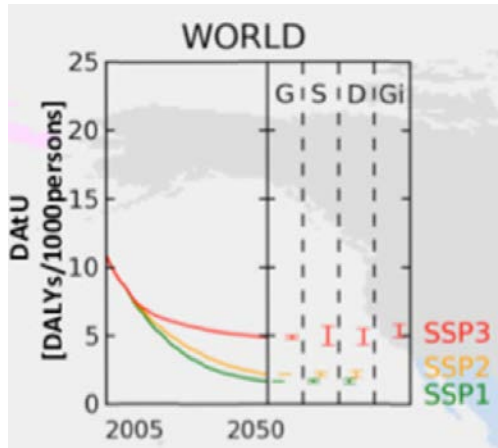
Adaptation effects on hunger risk



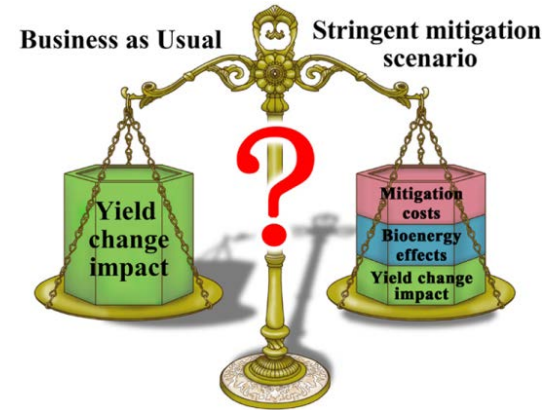
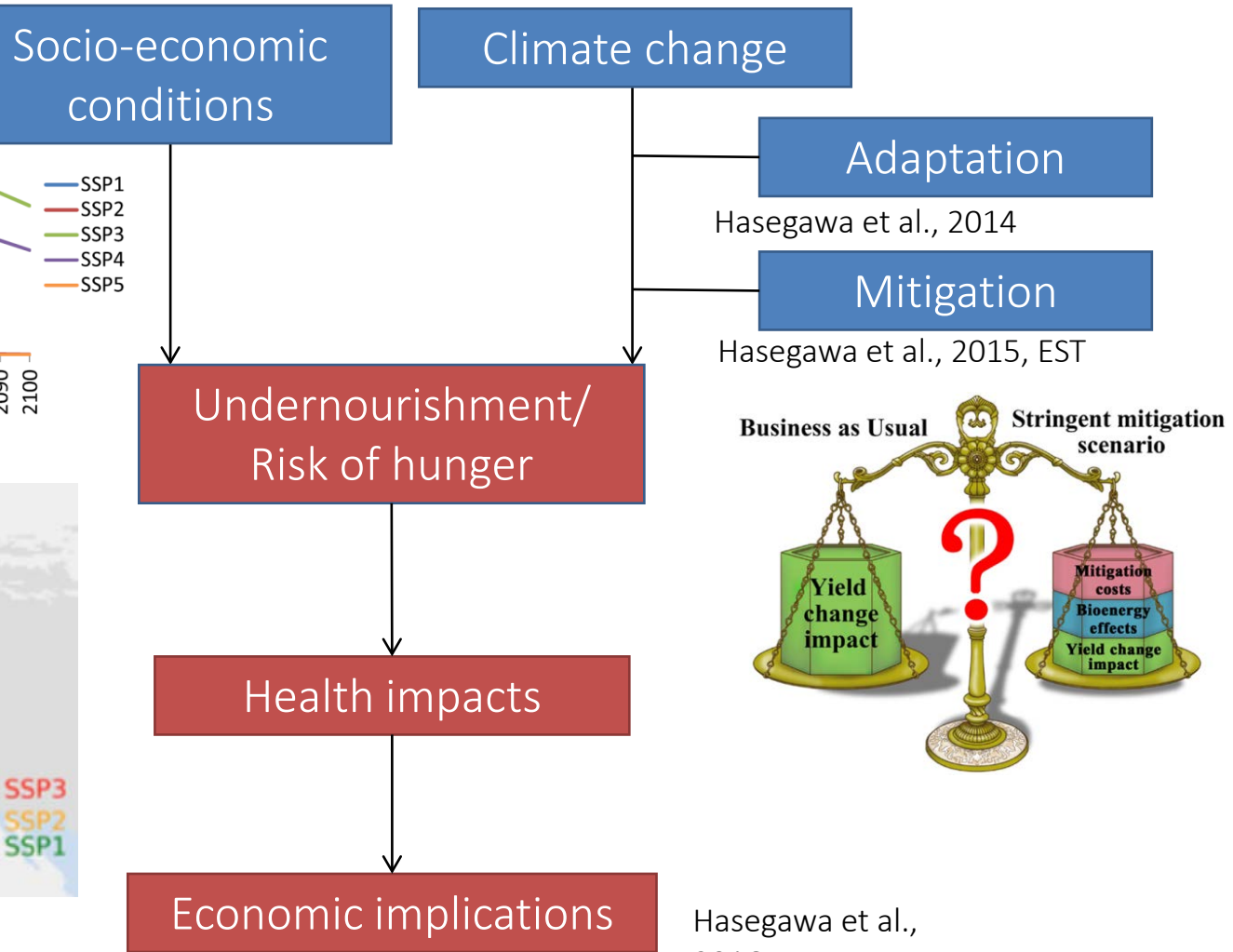
Our earlier studies



Hasegawa et al., 2015, ERL

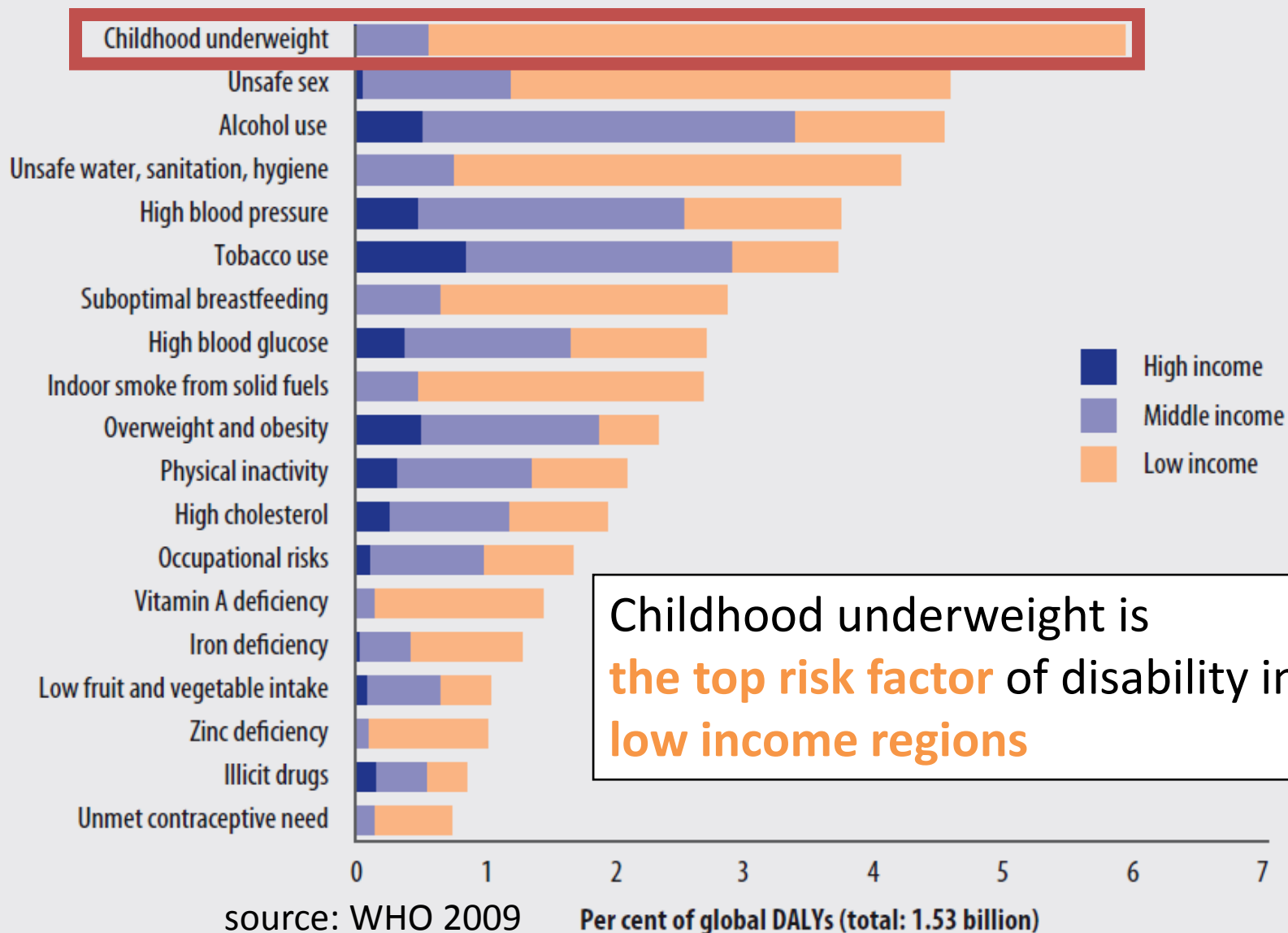


Ishida et al., 2014



Hasegawa et al., 2016

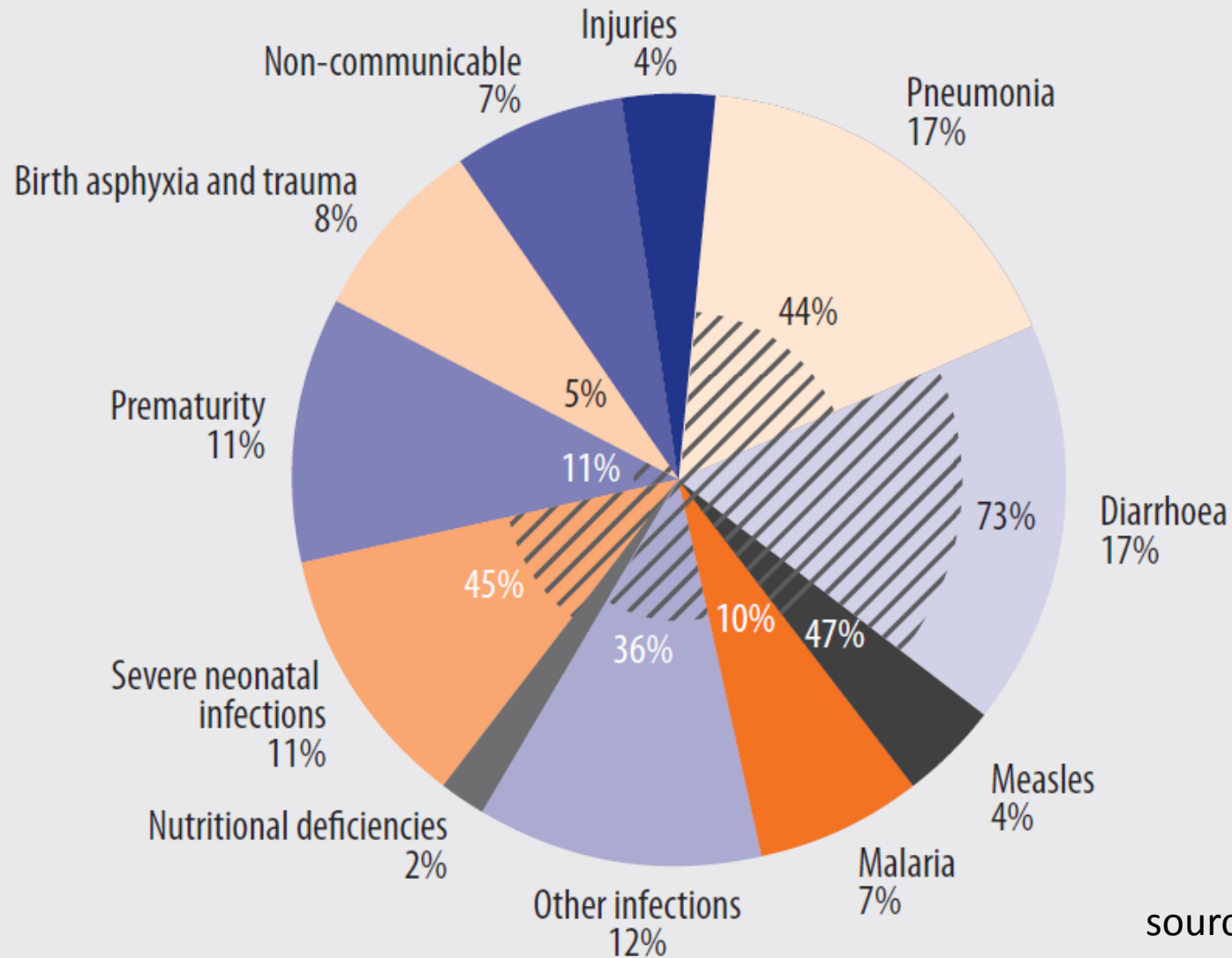
Figure 7: Percentage of disability-adjusted life years (DALYs) attributed to 19 leading risk factors, by country income level, 2004.



Childhood underweight is the top risk factor of disability in low income regions

Major causes of death in children under 5 years old

(Shaded area: contribution of undernutrition to each cause of death)

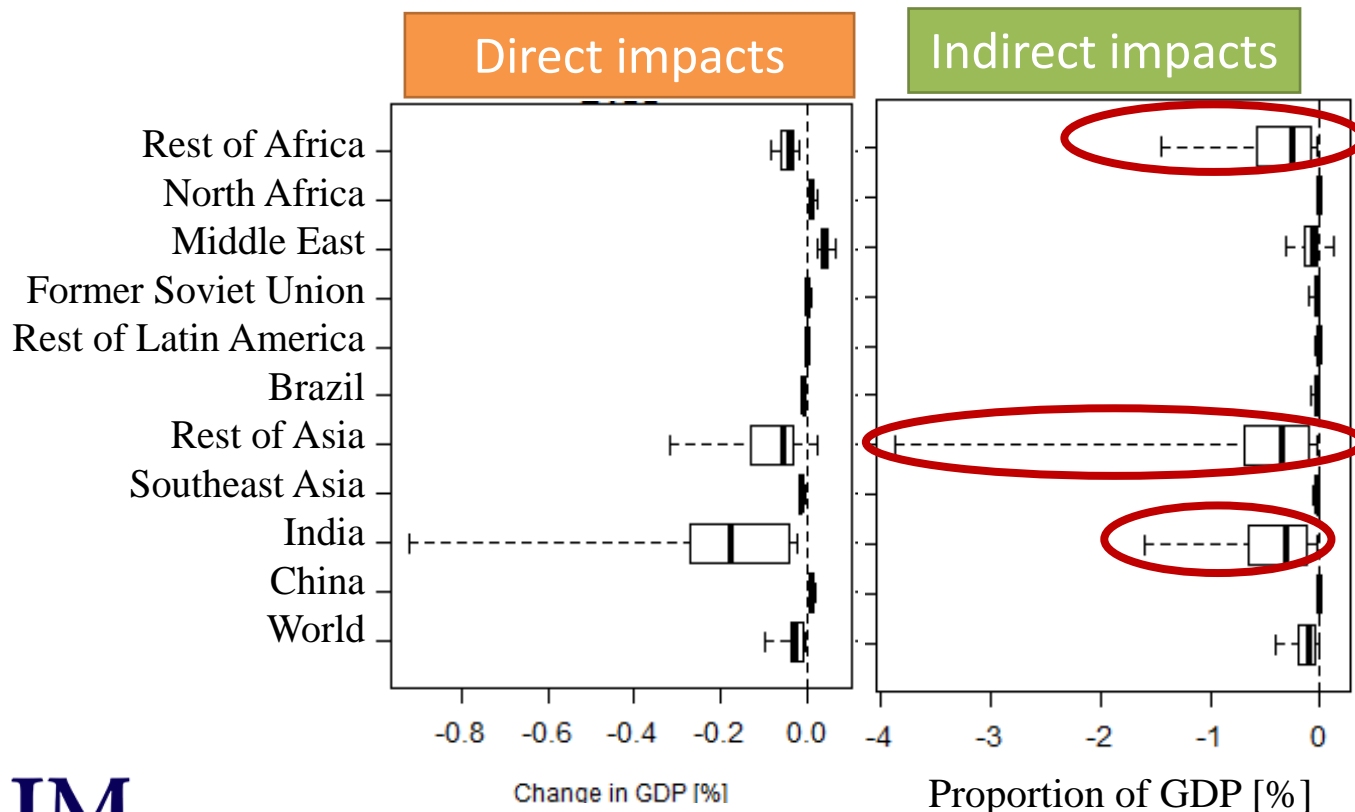


source: WHO 2009

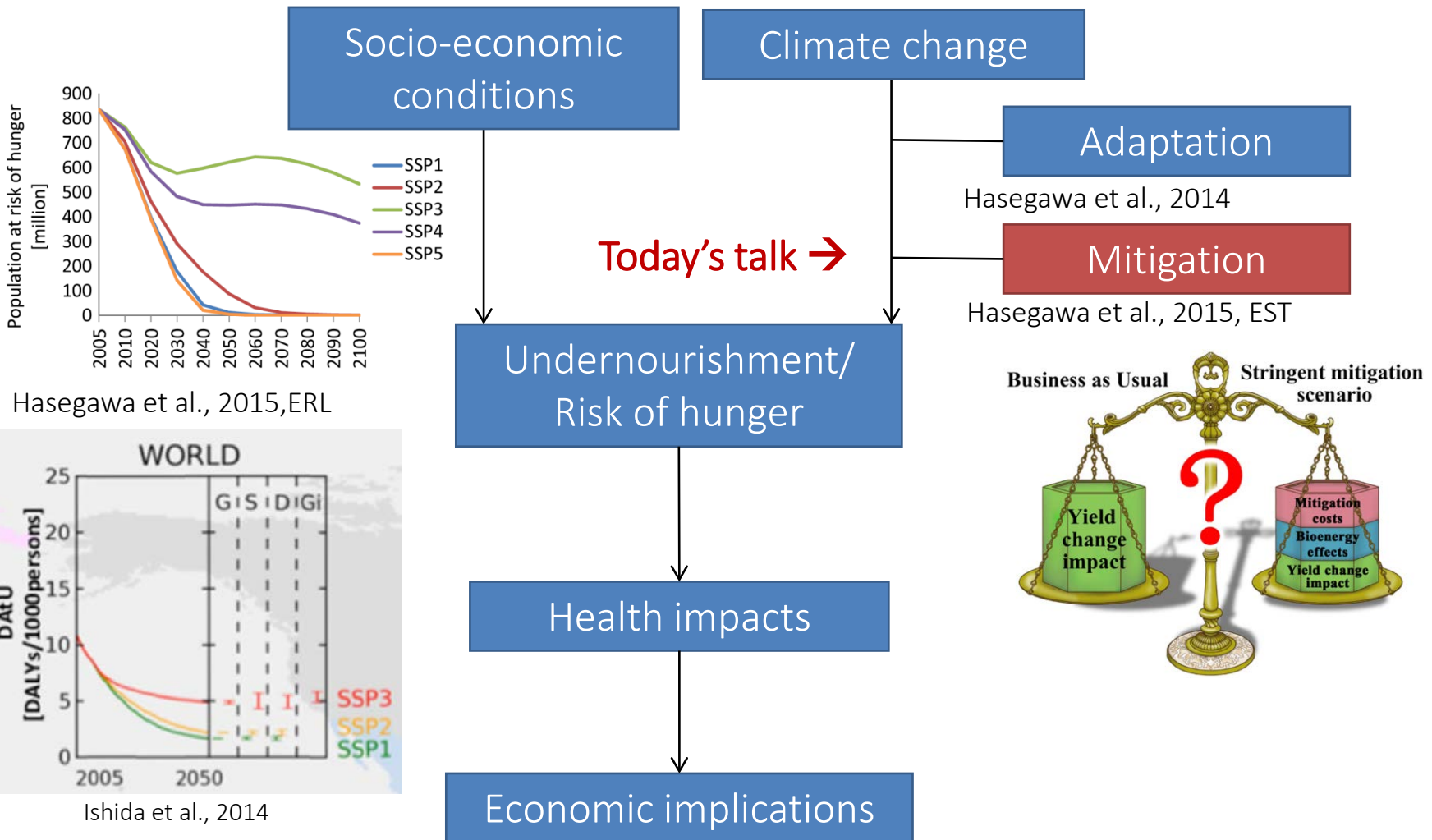
Shaded area indicates contribution of undernutrition to each cause of death

Economic implications of health impacts through undernourishment: SSP3-RCP8.5 in 2100

- **Direct impacts (changes in labor force & healthcare costs):** -0.1–0.0% of Global GDP
- **Indirect impacts (value of lives lost):** -0.4-0.0% of Global GDP; -4.0% at most in regional levels



Our earlier studies



Hasegawa et al., 2015, ERL

Ishida et al., 2014

Consequence of climate mitigation on risk of hunger

Hasegawa T., Fujimori S., Tanaka, A. Shin Y., Takahashi K., Masui T., Consequence of climate mitigation on risk of hunger, Environmental Science & Technology, 2015.

Trade-off between climate change and mitigation measures in food security

Climate change

Yield change impact

Climate change will affect food consumption through change in crop yields.

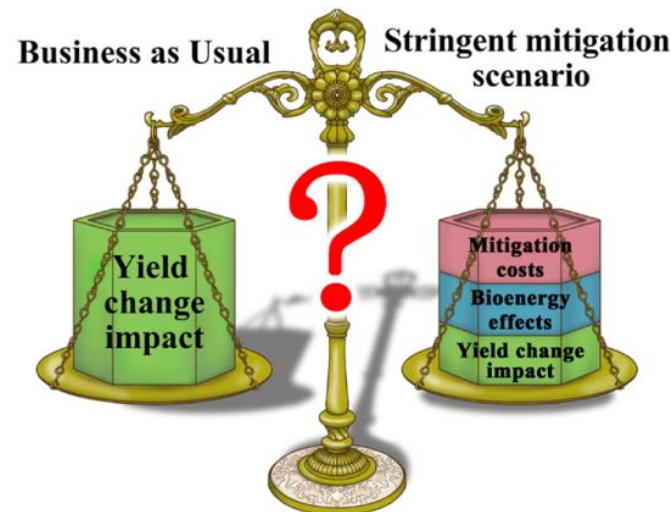
Mitigation measures

Bioenergy impact

Heavy bioenergy implementation would cause land competition between food and energy crops owing to limited land and water resources.

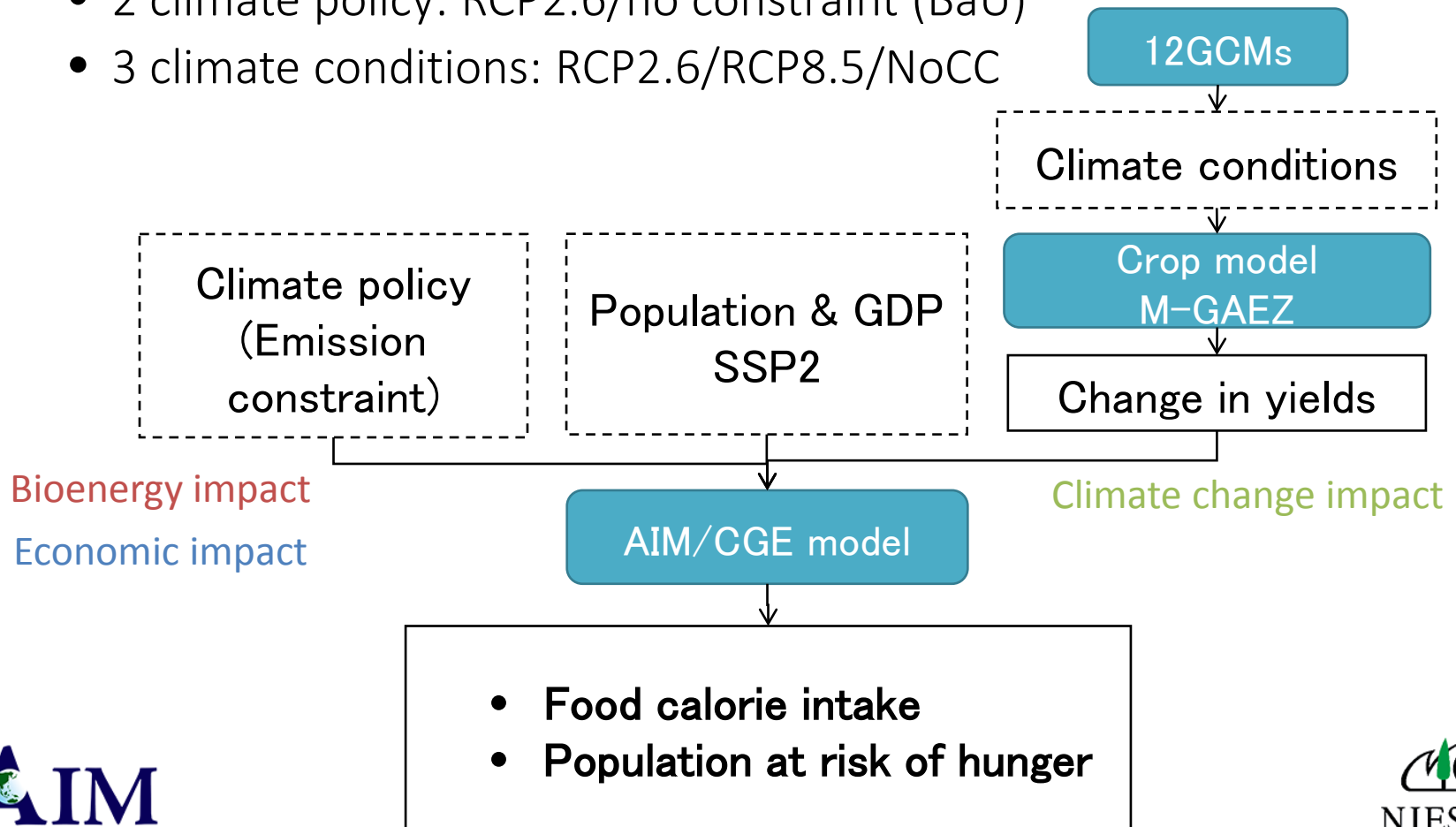
Macroeconomic impact

Stringent mitigation measures aiming 2°C target would cause GDP loss and income loss.



Modeling framework

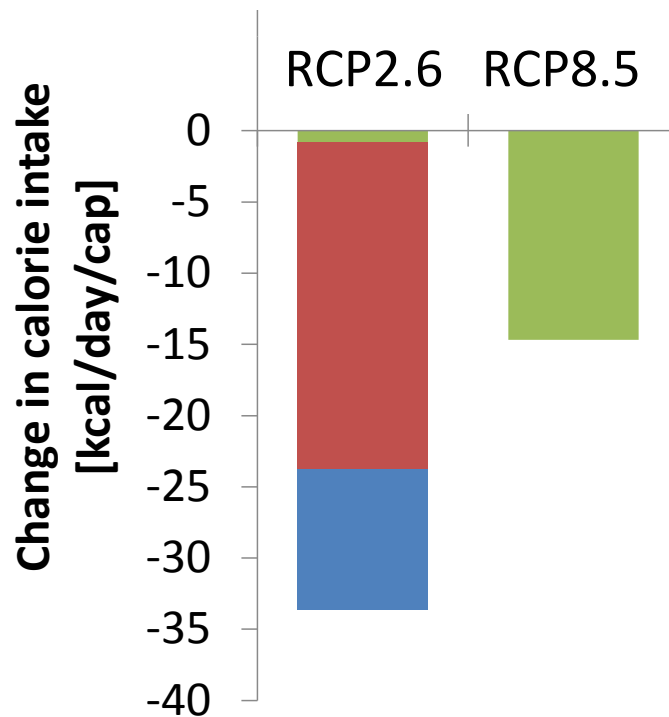
- Models
 - Crop model M-GAEZ & AIM/CGE
- Scenarios
 - 2 climate policy: RCP2.6/no constraint (BaU)
 - 3 climate conditions: RCP2.6/RCP8.5/NoCC



Global impacts on risk of hunger in 2050: RCP2.6 vs. RCP8.5 (median among 12 GCMs)

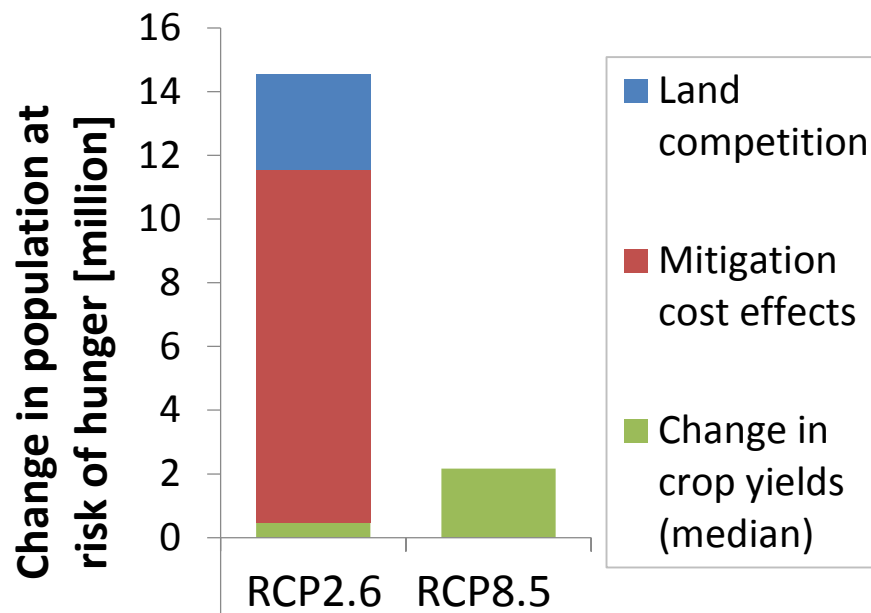


Mean food calorie intake



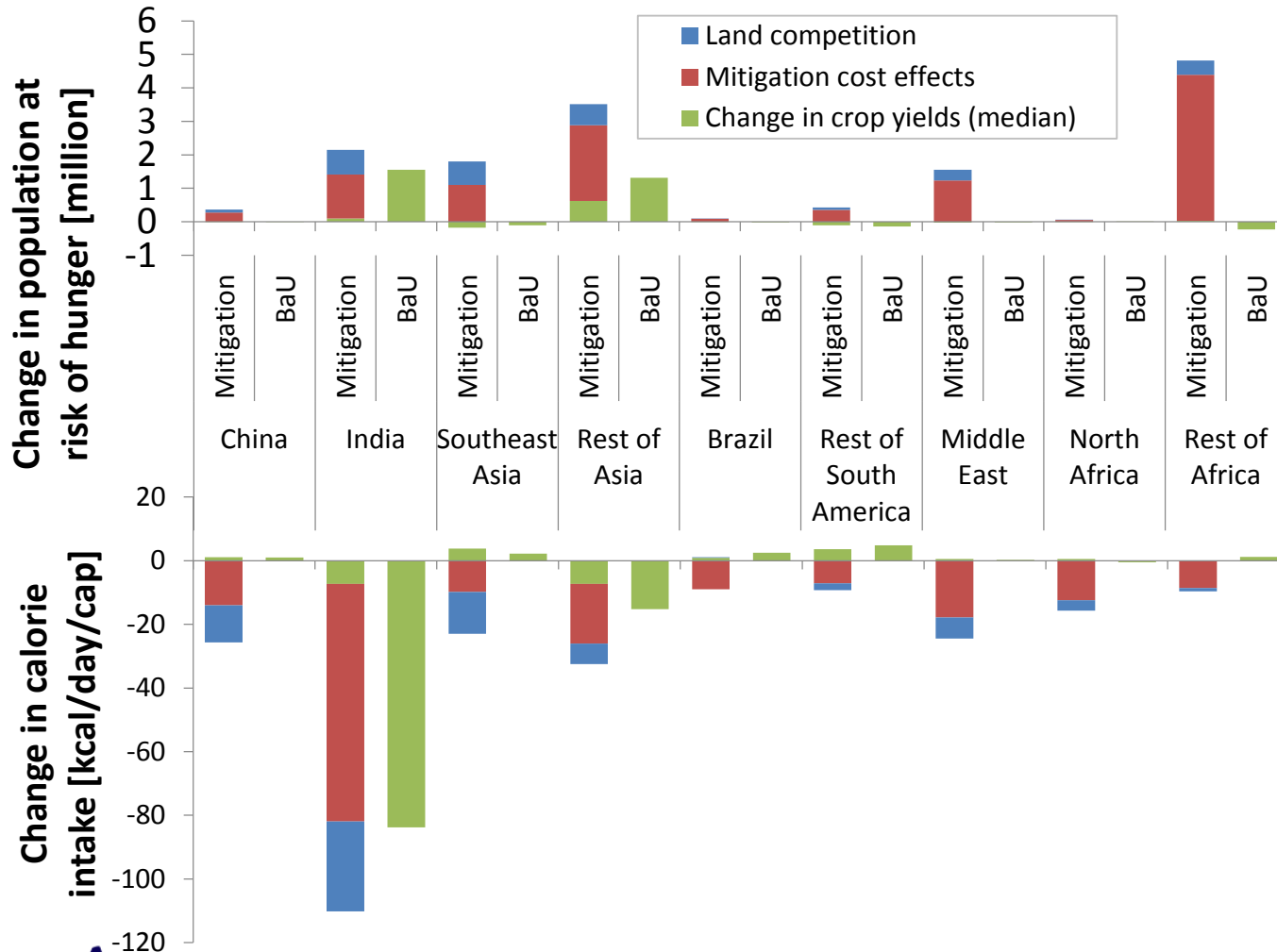
2050 with NoCC: 2950 kcal/cap/day
2005: 2680 kcal/cap/day

Global population at risk of hunger



2050 with NoCC: 90 mil.
2005: 830 mil.

Regional impacts on risk of hunger in 2050: RCP2.6 vs. RCP8.5 (median among 12 GCMs)

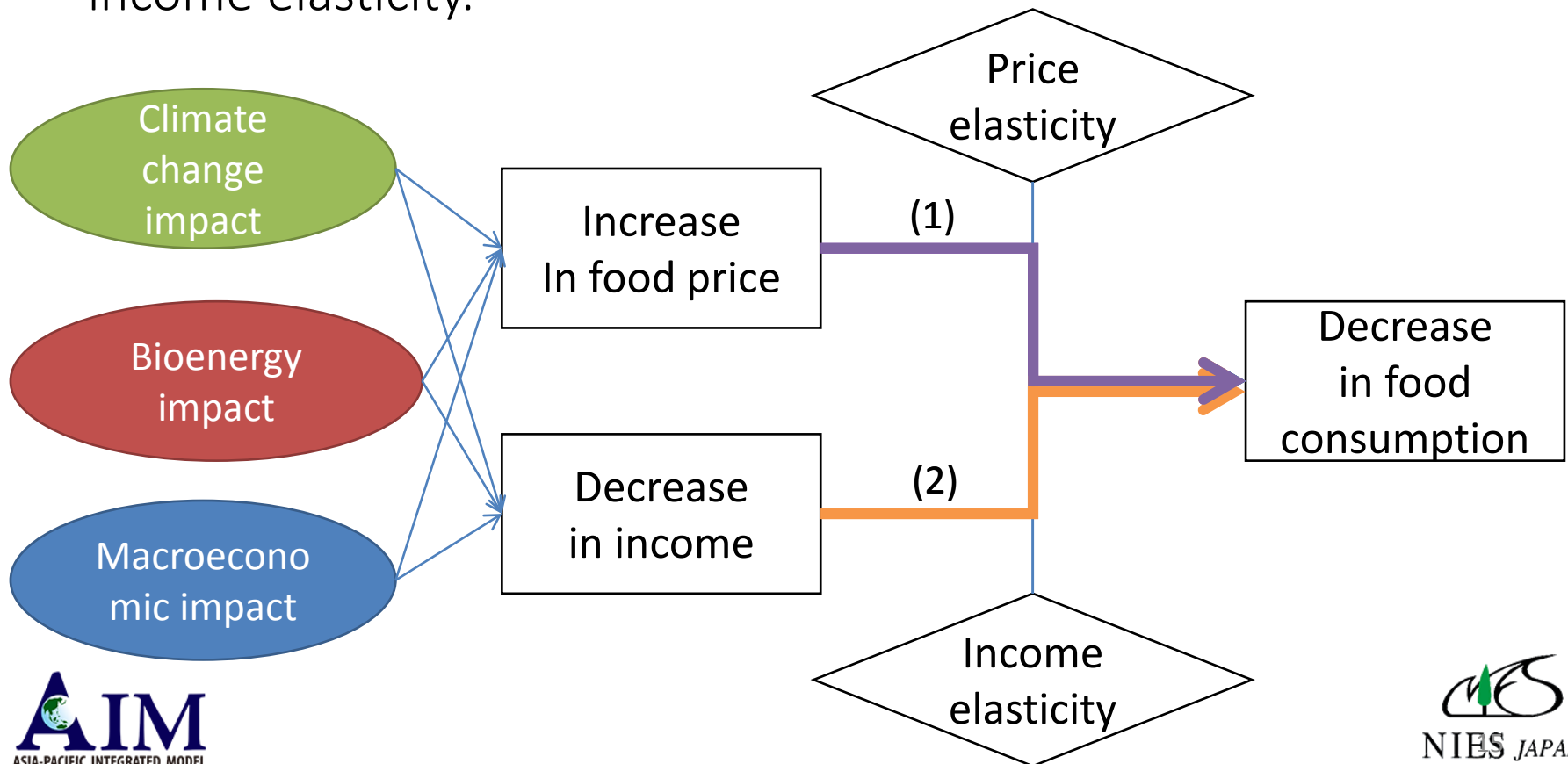


- Regional heterogeneity
- Most impacts are seen in **Asia & Africa**.
- Africa: a small decrease in food consumption will cause a large increase in risk of hunger.
- India: a large bioenergy impact due to limited land availability.

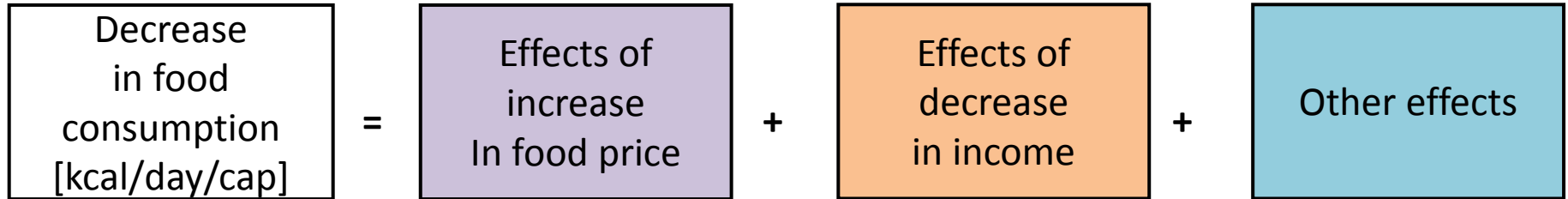
Two factors affect food consumption

(1) Increase in food price reduces food consumption through price elasticity.

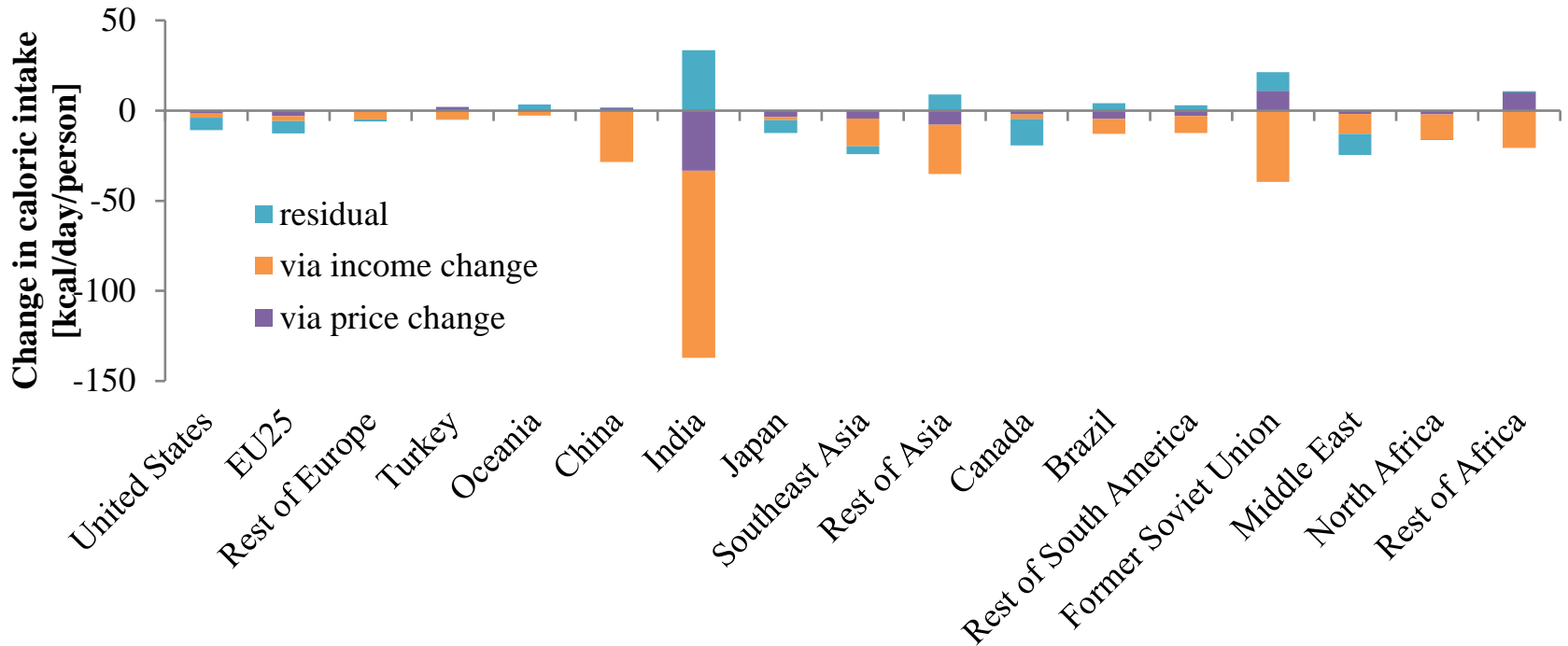
(2) Decrease in income reduces food consumption through income elasticity.



Decomposition analysis of change in food consumption



Income effects >> **Price effects**



Results & Discussion

- We quantified three impacts of climate change and mitigation on food security.
- The strong mitigation measures aim at attaining the 2 ° C target have large negative impacts on the risk of hunger in the low-income countries.
- In a strongly carbon-constrained world, the change in food consumption depends more strongly on the change in incomes than the change in food prices.
- Necessary to take into account the negative impacts of mitigation measures and the remediation cost of the impacts.
- As such, this study provides a new perspective to evaluate future mitigation measures.

Limitations & future challenges

This study does NOT consider...

- ▶ Extreme event (i.e. drought, flood, heat waves)
- ▶ Other climate change impacts such as impact on health, coastal area and sea-level rise etc.
- ▶ Competition between food and energy crops associated with ecosystem damage and water resources
- ▶ Spatial distributions at smaller regional scale.

ご清聴ありがとうございました
Thank you for your attention

Acknowledgments

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Asia-Pacific Integrated Model

<http://www-iam.nies.go.jp/aim/index.html>



NIES JAPAN

Scenario framework

Scenario	Climate conditions	GHG emission constraints	Other conditions	Issues to be analyzed
S0	No CC	BaU	-	-
S1	RCP2.6	RCP2.6	-	B + E + C impacts
S2	RCP2.6	BaU	-	C impact@RCP2.6
S3	No CC	RCP2.6	-	B + E impacts
S4	No CC	RCP2.6	No land input to bio-crop production	E impact
S5	No CC	RCP2.6	Fund transfer	Effects of fund transfer
S6	RCP8.5	BaU	-	C impact@RCP8.5

"NoCC": No Climate Change assuming present climate conditions.

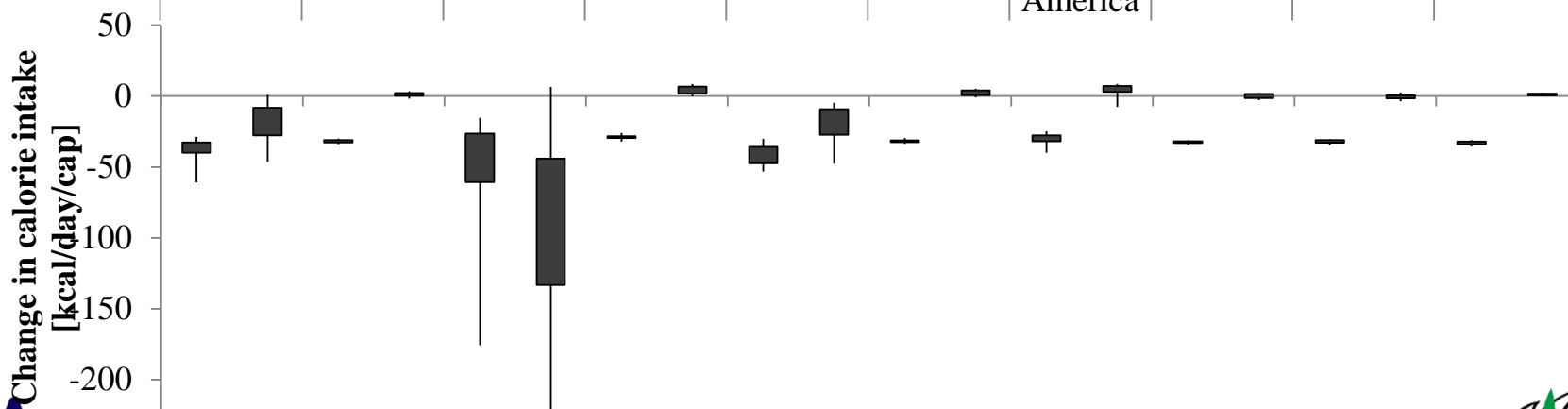
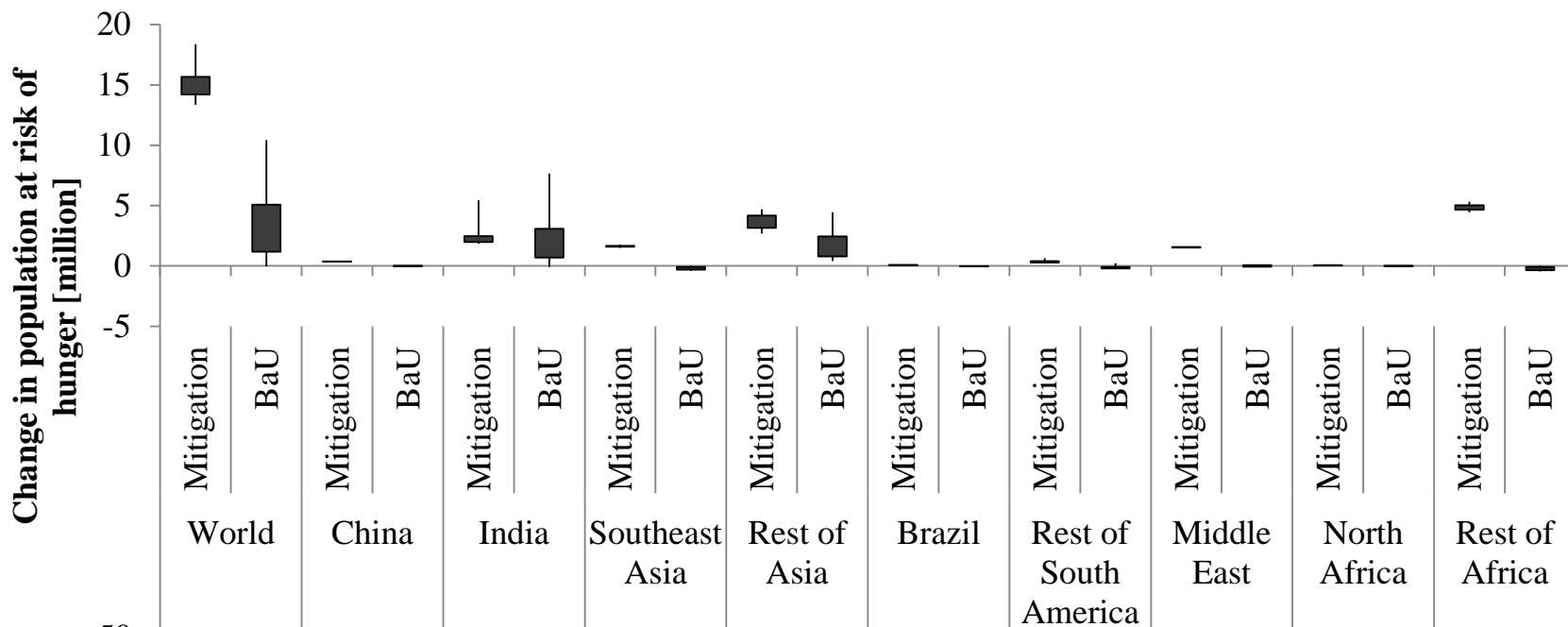
"BaU" represents no emission constraints.

"B": Bioenergy impact

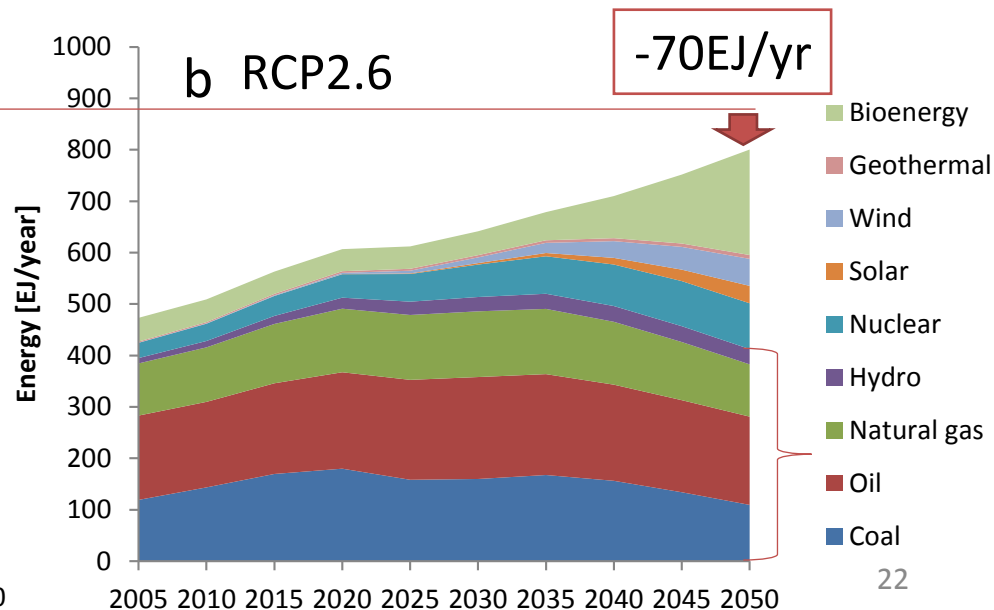
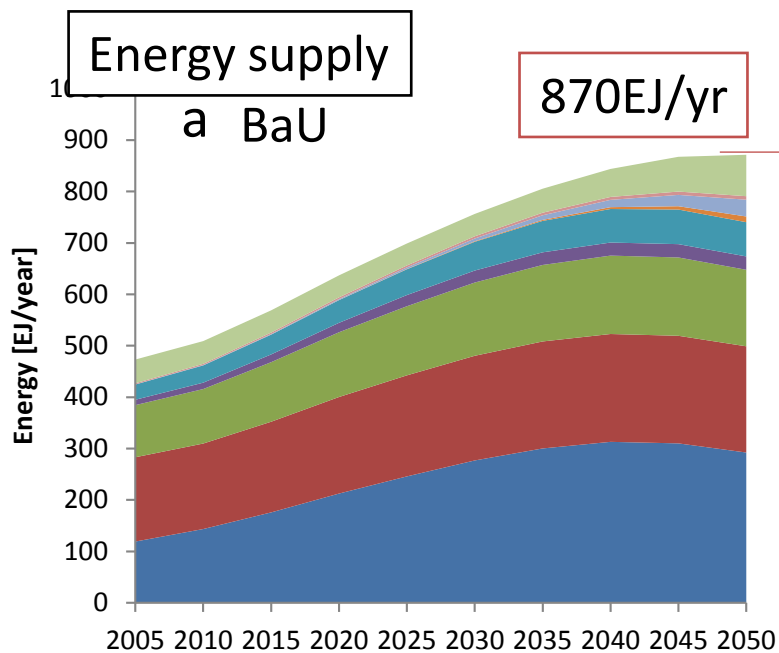
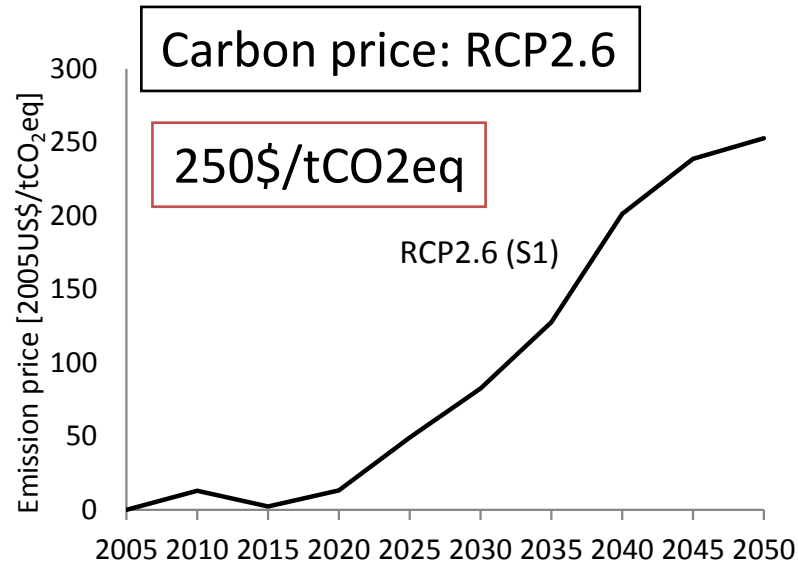
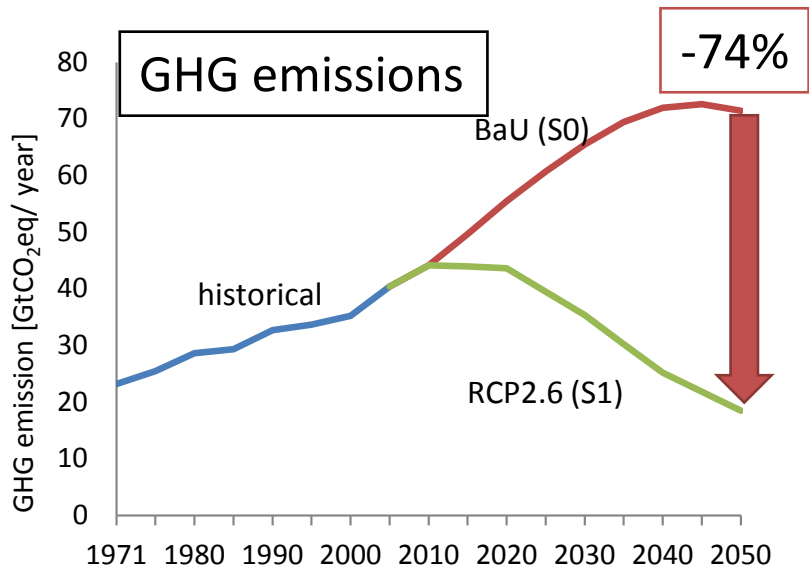
"E": Economic impact

"C": Climate change impact

Regional impacts on food security in 2050: RCP2.6 vs. RCP8.5 with multi-GCMs



The World of RCP2.6



The World of RCP2.6

