

# Scenarios for the Risk of Hunger in the 21st Century using Shared Socioeconomic Pathways

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The 20<sup>th</sup> AIM international workshop,  
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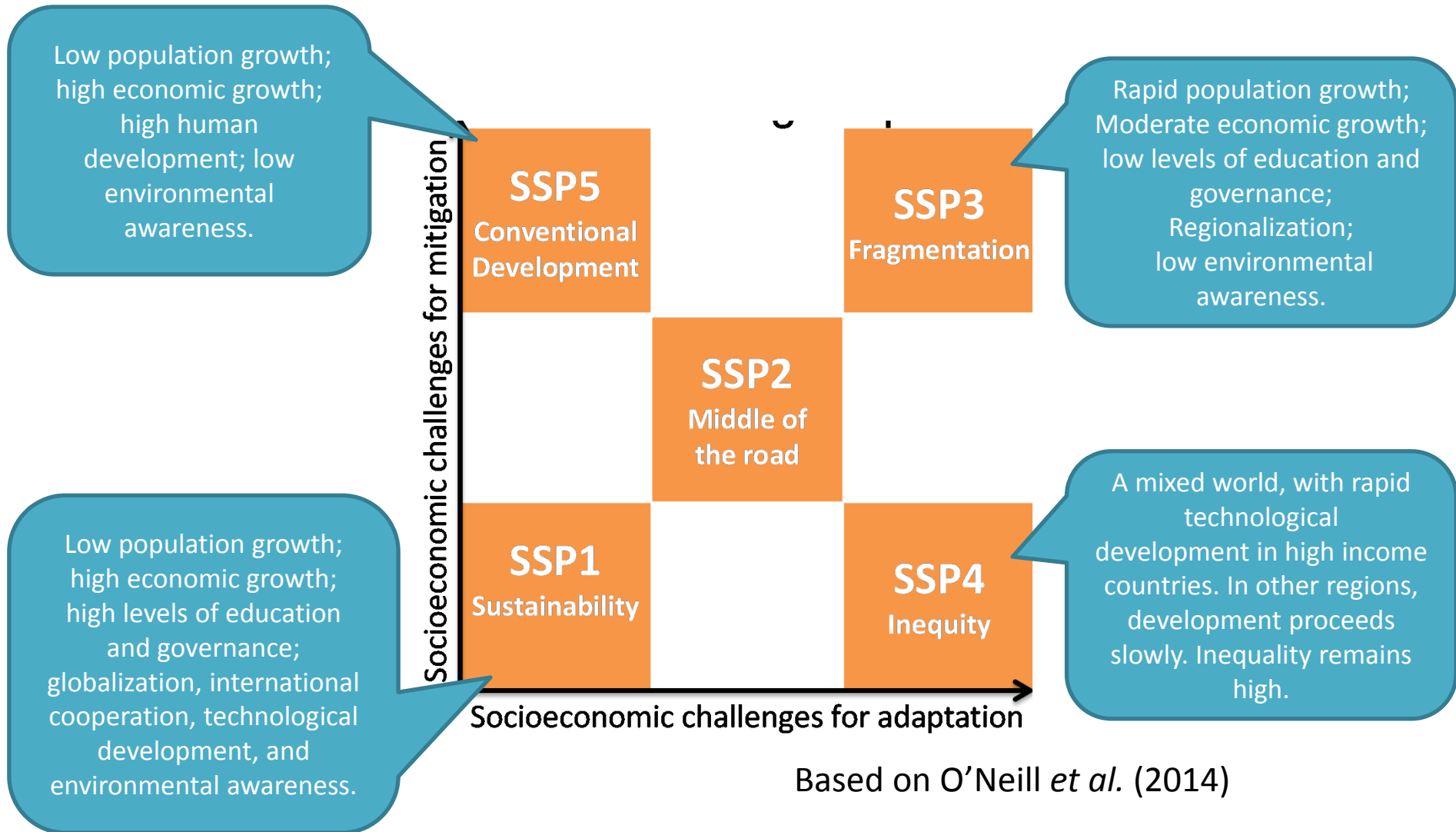
# Background

- Climate change would increase the number of malnourished children.
- The climate impacts strongly depend on population and GDP.
  - Based on the **SRES** and **CMIP3**; Need updated.
  - **Only population and GDP** were considered; other socioeconomic indicators could be considered.
- A new interdisciplinary scenario framework (SSP+RCP) has recently been designed for climate change research.
- Scenarios for various fields (e.g. water use) have been developed based on SSPs.
  - **No scenarios for risk of hunger** consistent with SSPs have been developed.

# Objectives

1. Develop 21<sup>st</sup>-century scenarios for the risk of hunger consistent with SSPs as a baseline of climate impact research on agriculture
  2. Identify the elements strongly affecting future risk of hunger
- 7 socioeconomic indicators were considered:
    - Population, demographic change, GDP, equality of food distribution, crop yields, irrigation area, land productivity of livestock and wood products

# Shared Socioeconomic Pathways



# AIM/CGE (Computable General Equilibrium)

- Economic model
- Fundamental idea:
- supply = demand,
- **balanced by price mechanism**

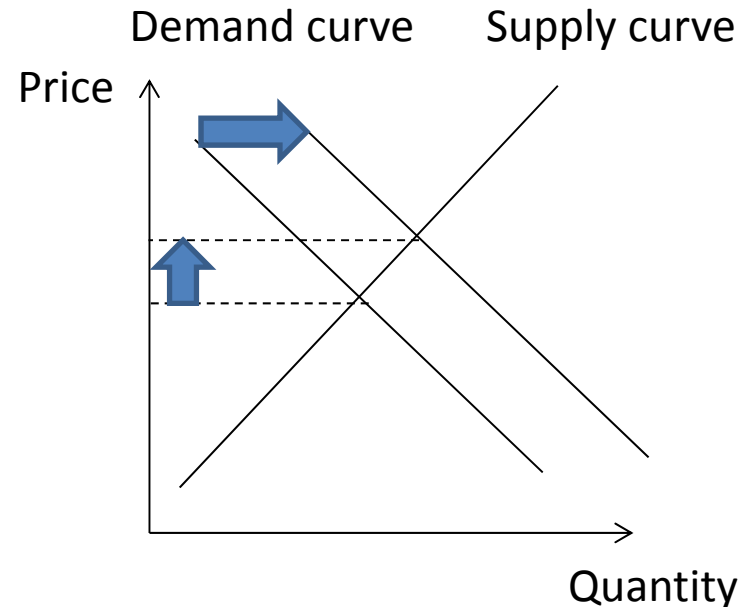
Population & income growth

→ Increase in food demand

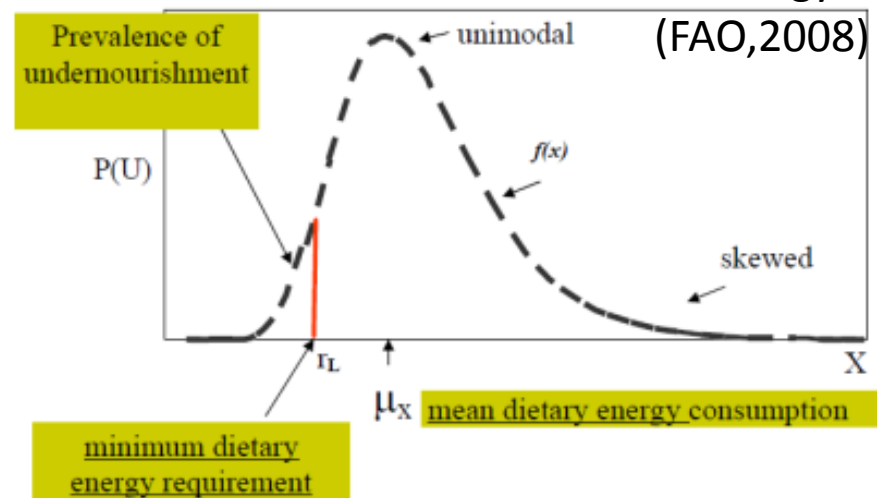
→ Increase in food price

→ Producers: increase in production  
(cropland expansion, yield growth)

→ Consumers: decrease in  
consumption; shift to less expensive  
goods



Domestic distribution of food energy



## Method

# Parameters related to food and hunger

### Parameters:

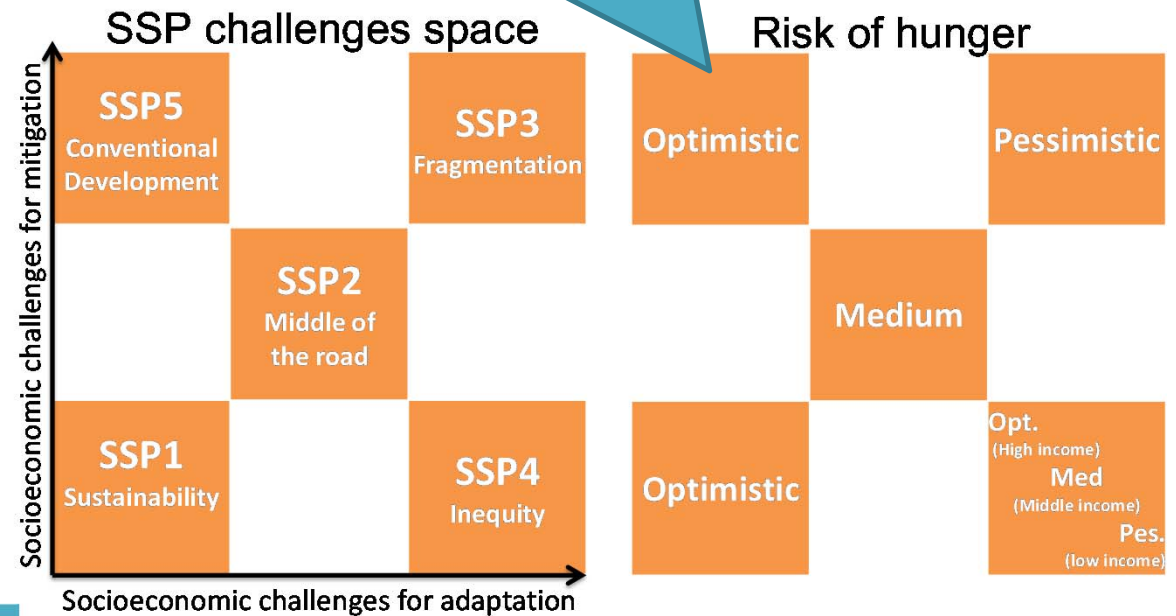
Population, demographic change  
 GDP  
 Equality of food distribution  
 Crop yield  
 Irrigation area  
 Land productivity of livestock and wood products  
 Income elasticity of food demand  
 Price elasticity of land use change  
 Price elasticity of trade

AIM/CGE

### Endogenous variables:

Food consumption  
 Meat consumption  
 Land use (Cropland, pasture, forest)

Each parameters were determined from the adaptation viewpoint



## Method

# Parameters related to food and hunger

### Parameters:

Population, demographic change

GDP

Equality of food distribution

Crop yield

Irrigation area

Land productivity of livestock and wood products

Income elasticity of food demand

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AIM/CGE

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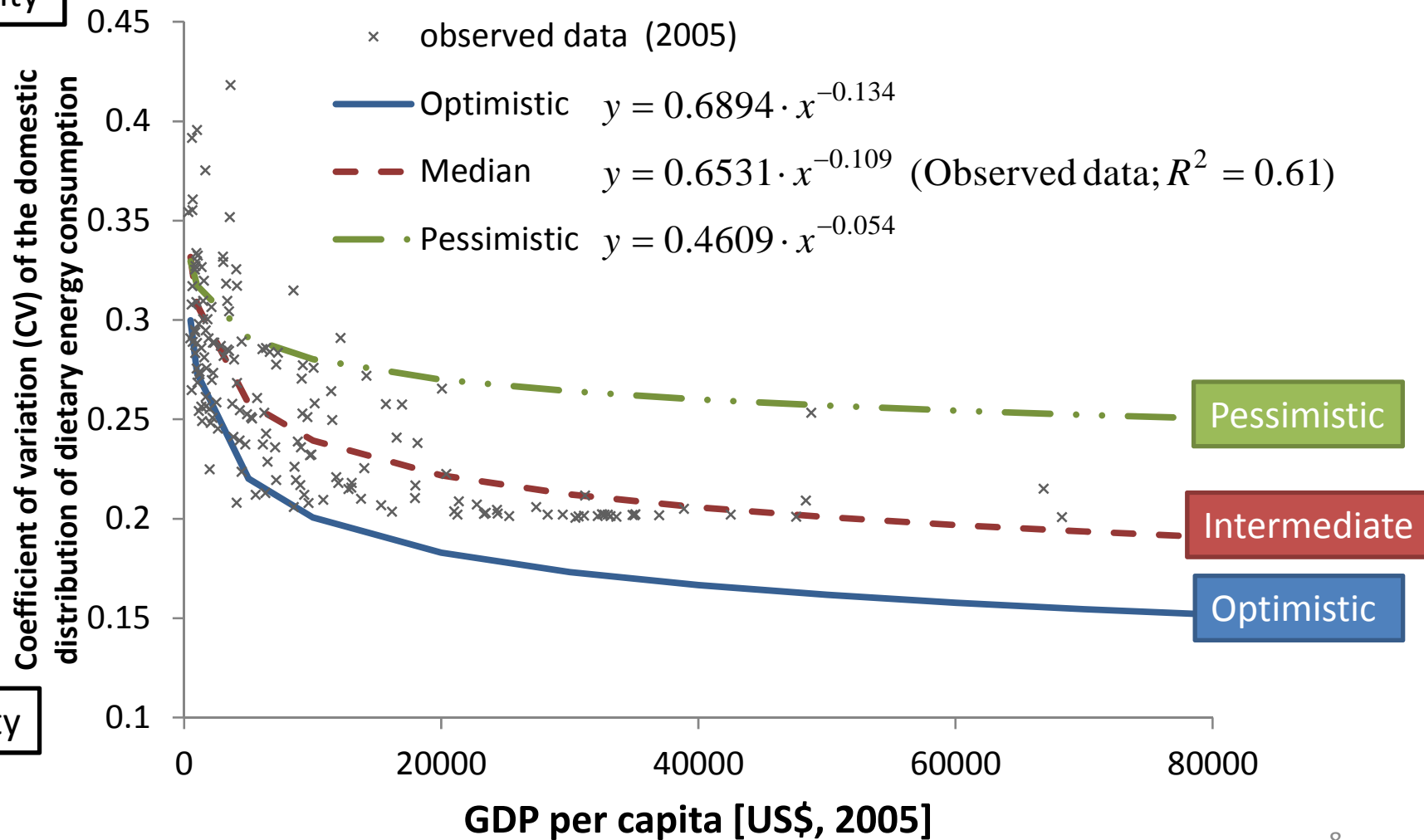
Three approaches for assuming parameters

1. Based on **observed data** (Stylized fact)
2. Based on **existing studies**
3. Assumed in line with SSP storylines if neither were available.

## Method

# Comparison with observed data: the improved equality of food distribution with income growth

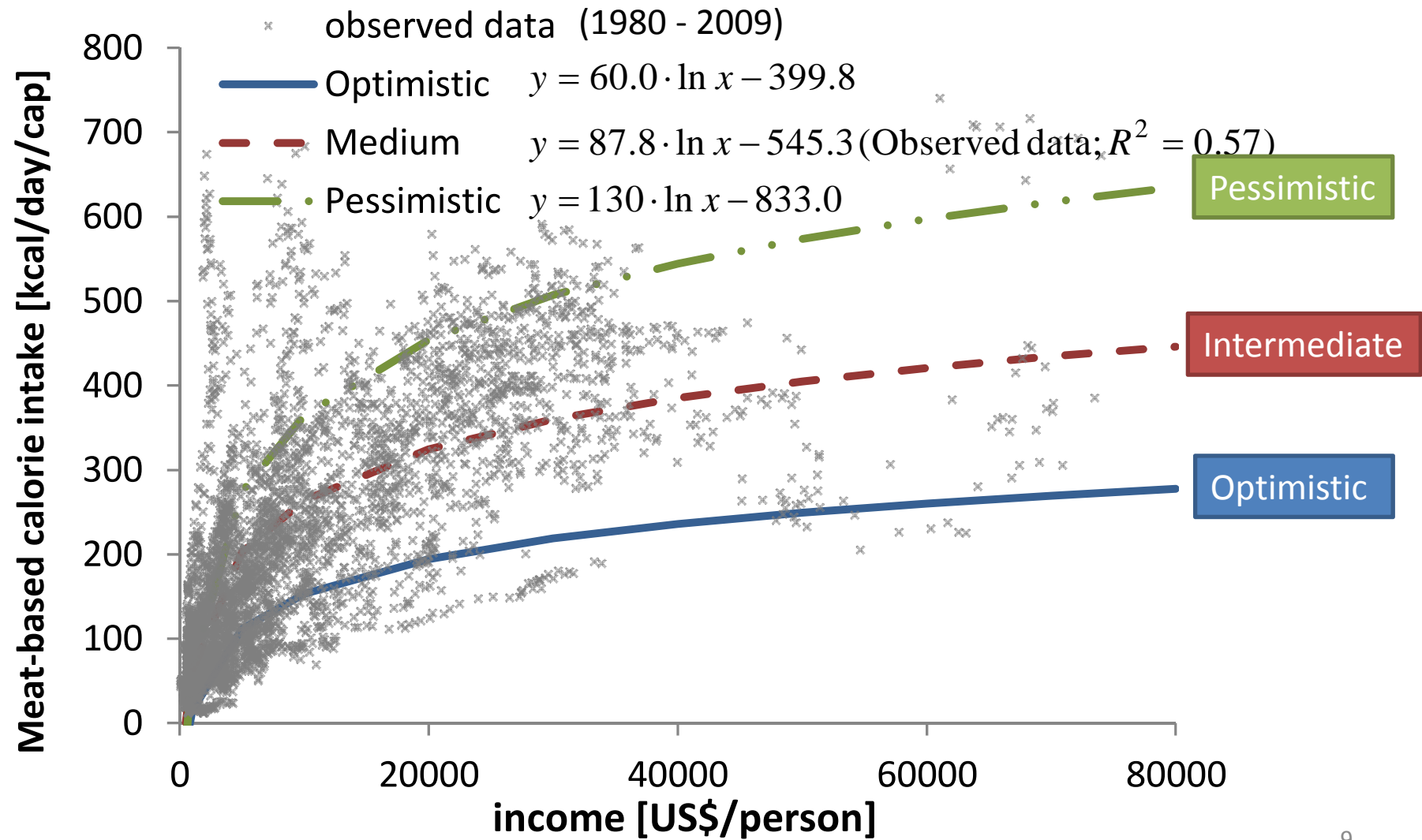
Inequality



Equality

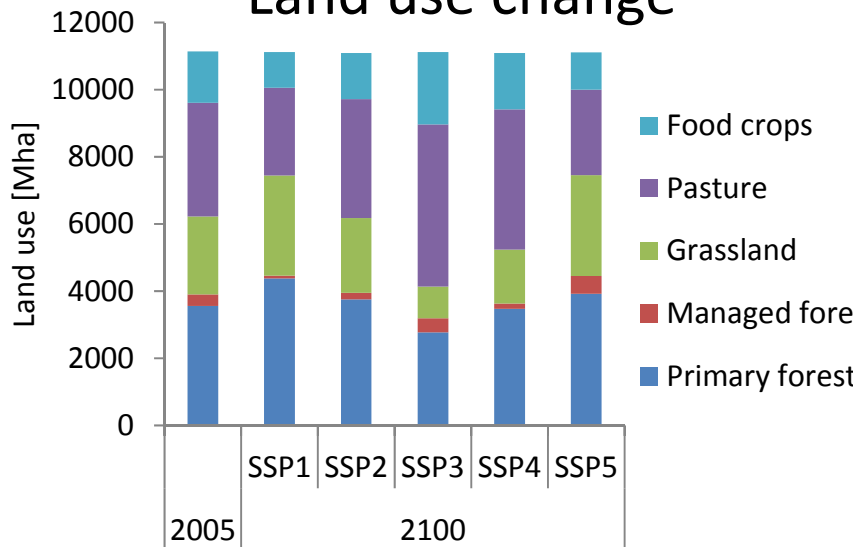


# Comparison with observed data: increased meat consumption with income growth

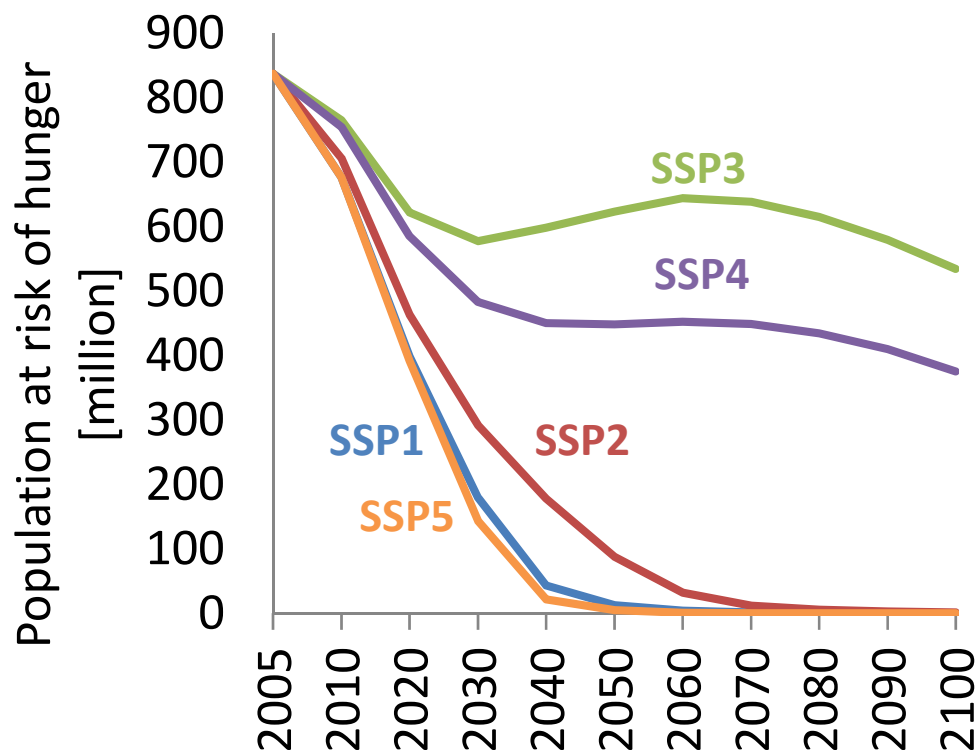


# The 21<sup>st</sup>-century Scenarios of risk of hunger using SSPs

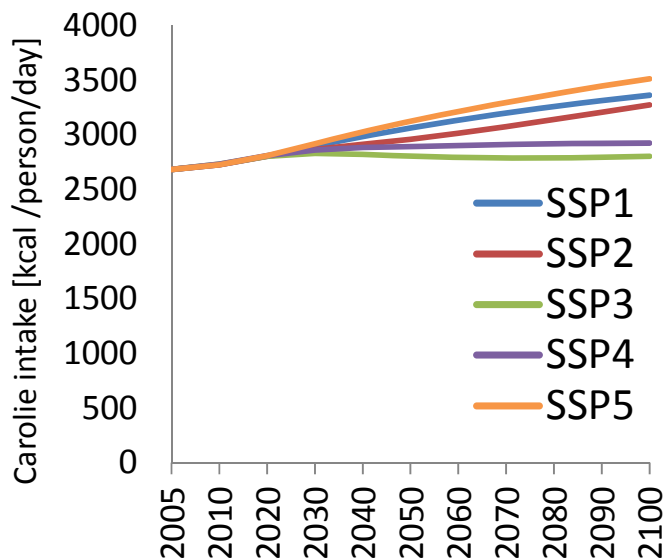
## Land use change



## Population at risk of hunger



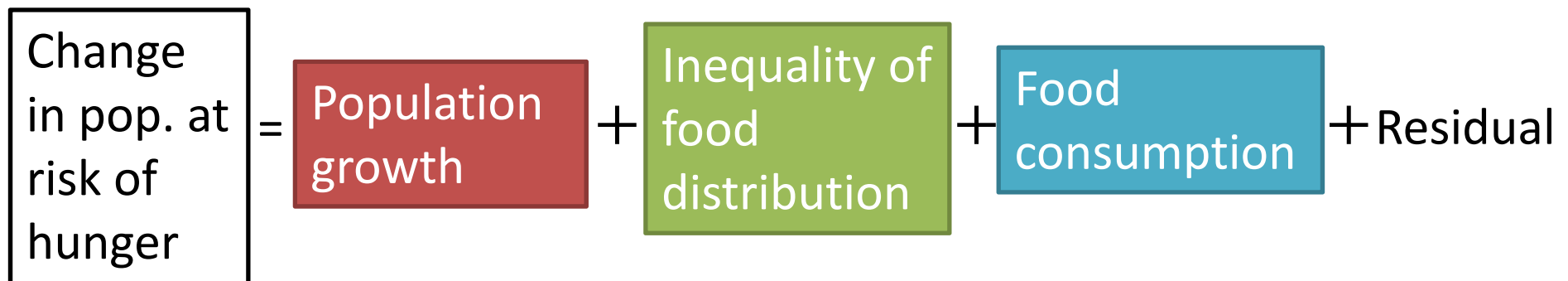
## Food consumption per capita



## Decomposition analysis

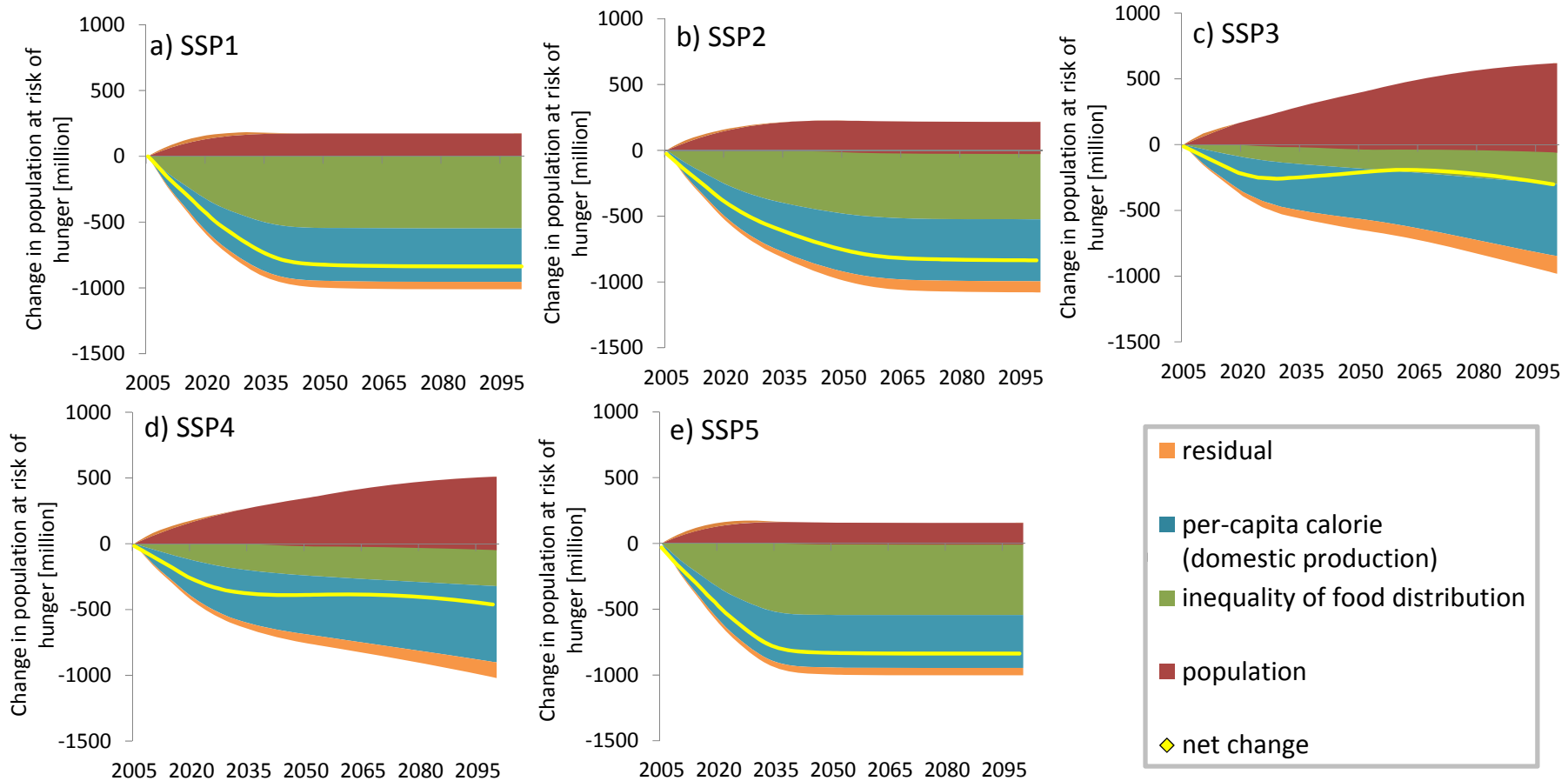
What strongly affects future risk of hunger?

- Change in hunger risk was decomposed into three factors;



\* See discussion paper for more detail @<http://www.nies.go.jp/social/dp/dpindex.html>.

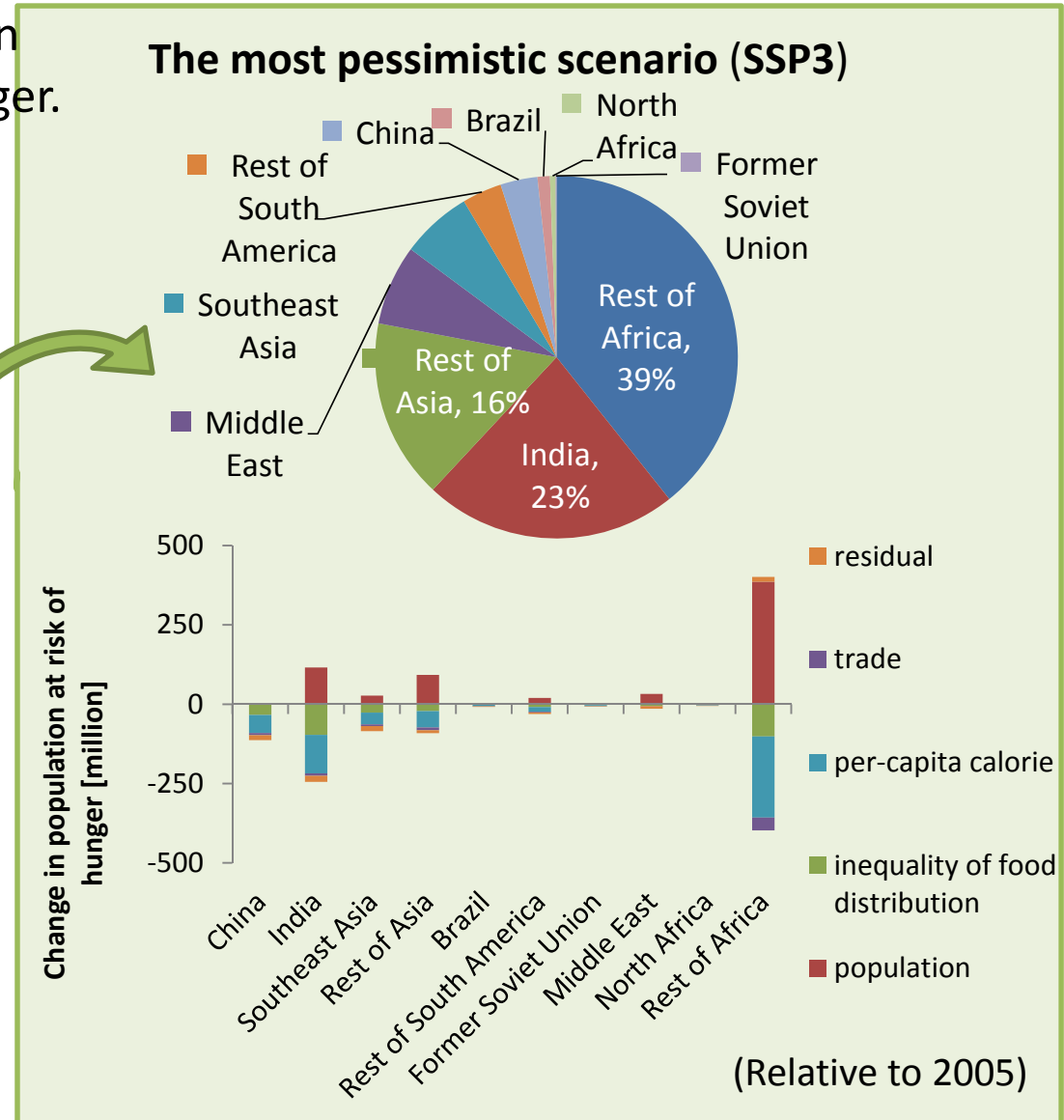
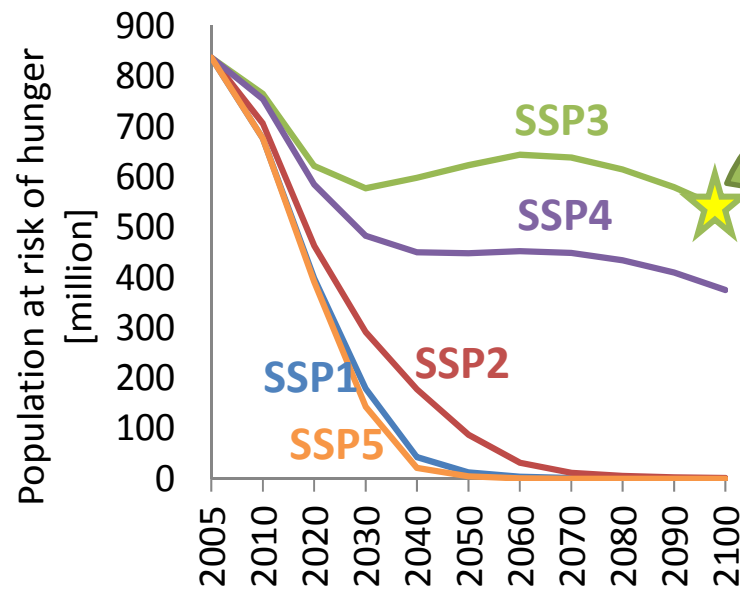
# Factors affecting future hunger risk (global, at 2005 level)



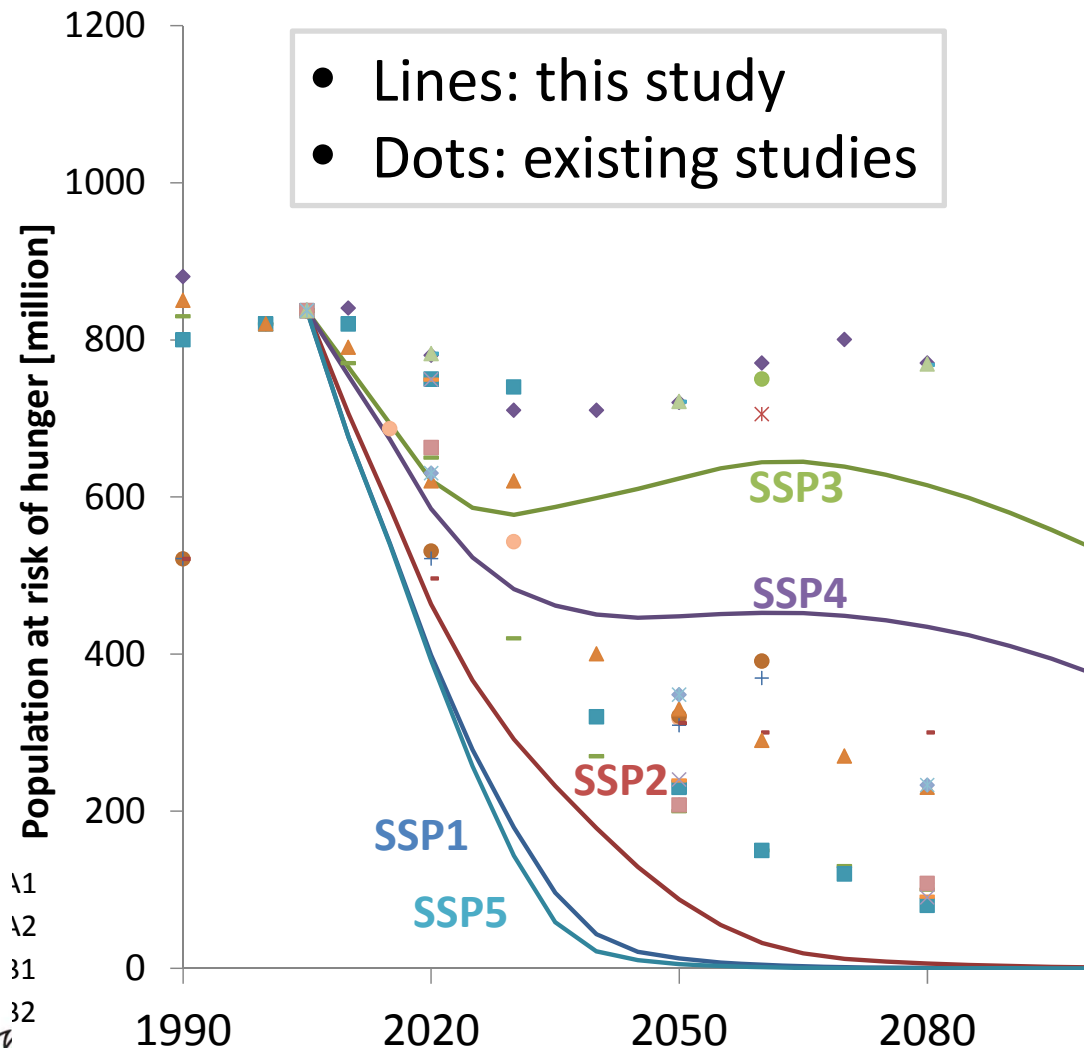
- Population, inequality of food distribution causes large differences in hunger risk among SSPs

# Regional population at risk of hunger and its factors (SSP3, 2100)

- 21st-century risk of hunger differs among SSPs
- Regional distribution depends greatly on population growth, equality in food distribution and increase in food consumption
- Regions with greater population growth face higher risk of hunger.



# Comparison of the population at risk of hunger with existing studies



- Pop. at risk of hunger in this study was lower than in existing studies.
- **Improvements in food distribution equality** was considered in this study whereas it was not for existing studies.
- → **Inequality of food distribution influences long-term assessments of hunger risk.**

# Conclusion

We developed scenarios for hunger risk in the 21<sup>st</sup> century using SSPs.

Factors affecting future hunger risk were investigated.

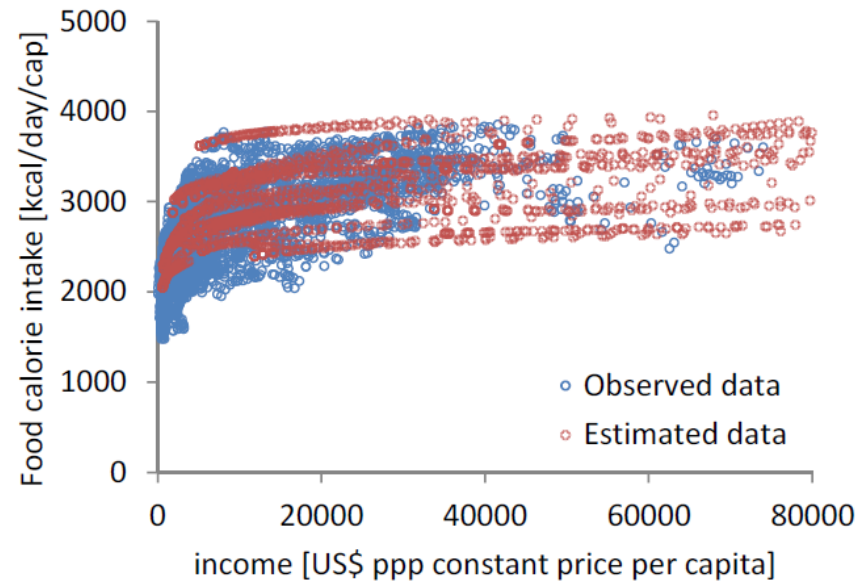
- Risk of hunger without climate change in the 21<sup>st</sup> century differed among SSPs
- Factors influencing the future reduction of hunger risk were population, inequality of food distribution, and per-capita food consumption.
- Inequality of food distribution greatly influences long-term assessments of hunger risk.

# Thank you for your attention!

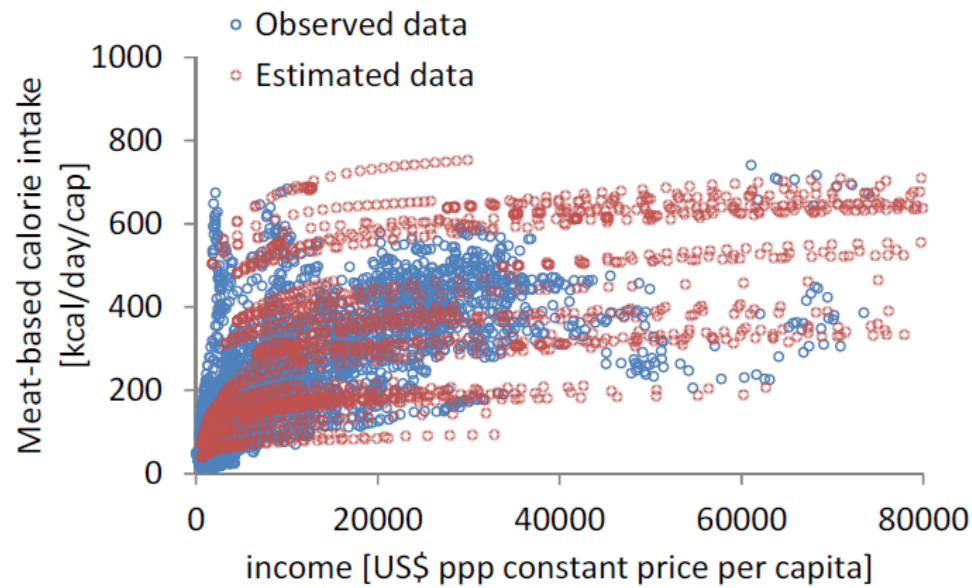
## Acknowledgments

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**Figure S15** Observed and estimated relationships between income and food calorie intake. Blue indicates observations for 1980–2009; red shows the estimates in this study.



**Figure S16** Observed and estimated relationships between income and meat-based calorie intake