What Makes for Food Systems that are Sustainable and Resilient?

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Outline

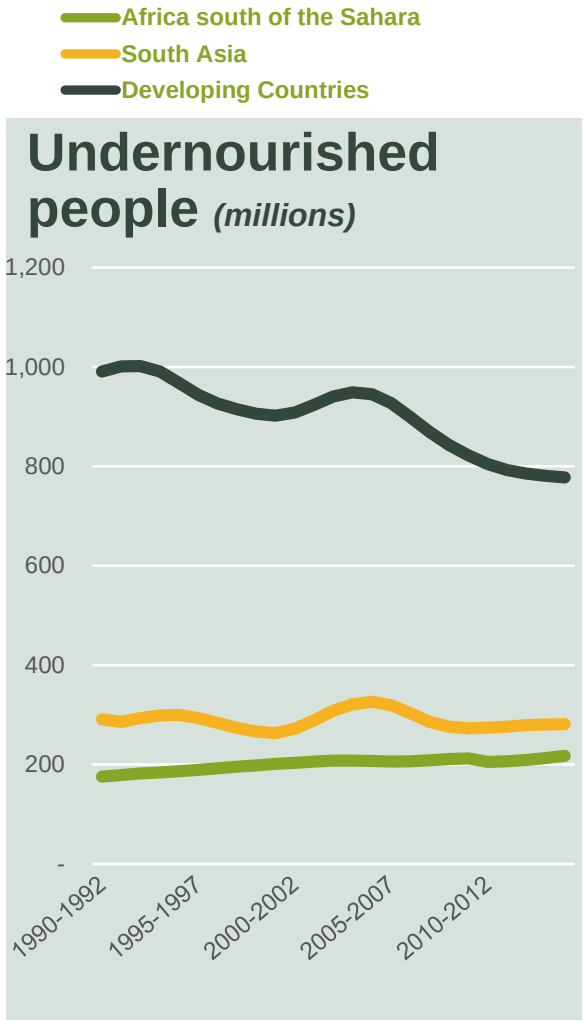
- Definitions and Objective
- Challenges
- Scenarios for More Sustainable and Resilient Food Systems
  - Methods
  - Investment Scenarios
  - Dietary Change Scenarios
- Conclusions

Definitions and Objective

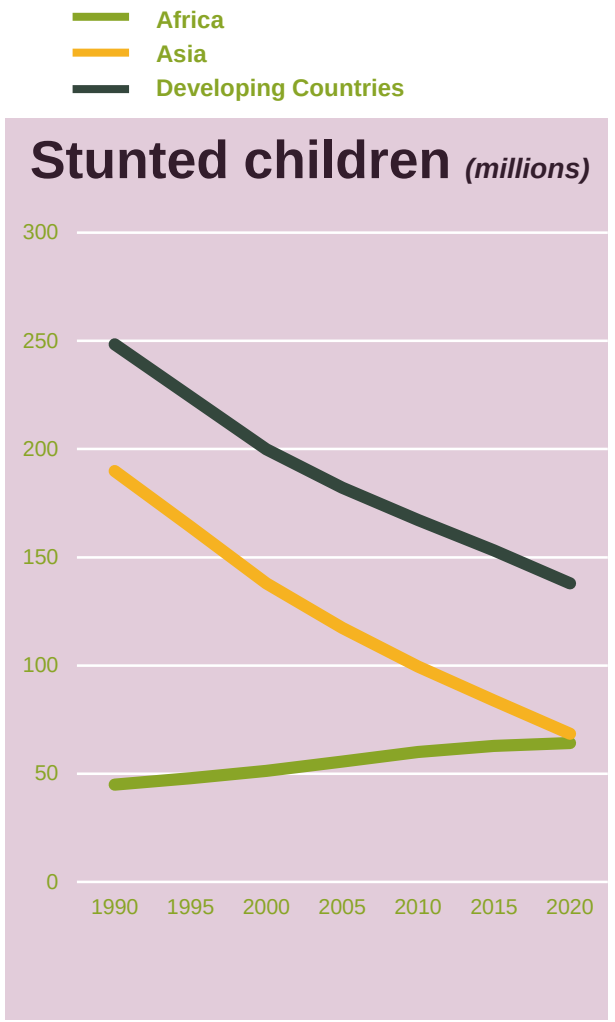
- A ***sustainable food system*** is a ***food system*** that delivers ***food*** and **nutrition** security for all in such a way that the economic, social and environmental bases to generate ***food*** security and ***nutrition*** for future generations are not compromised (United Nations)
- A ***resilient food system*** is a food system that is able to persist, adapt, and transform under conditions of uncertainty (Koch et al. 2010)
- What policies, investments, and behavioral change contribute to improving income, food security, and nutrition while reducing GHG emissions and the use of water and land, and conversion of forests?

CHALLENGES

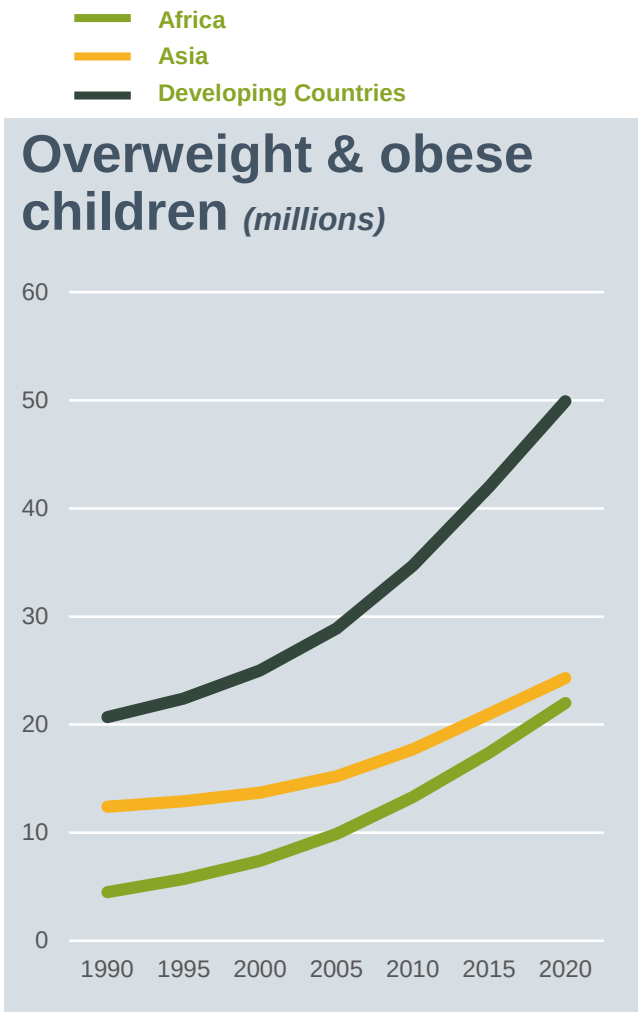
Slow decline in malnourishment. Alarming increase in obesity.



Source: FAOSTAT3 (http://faostat3.fao.org/download/D/FS/E).



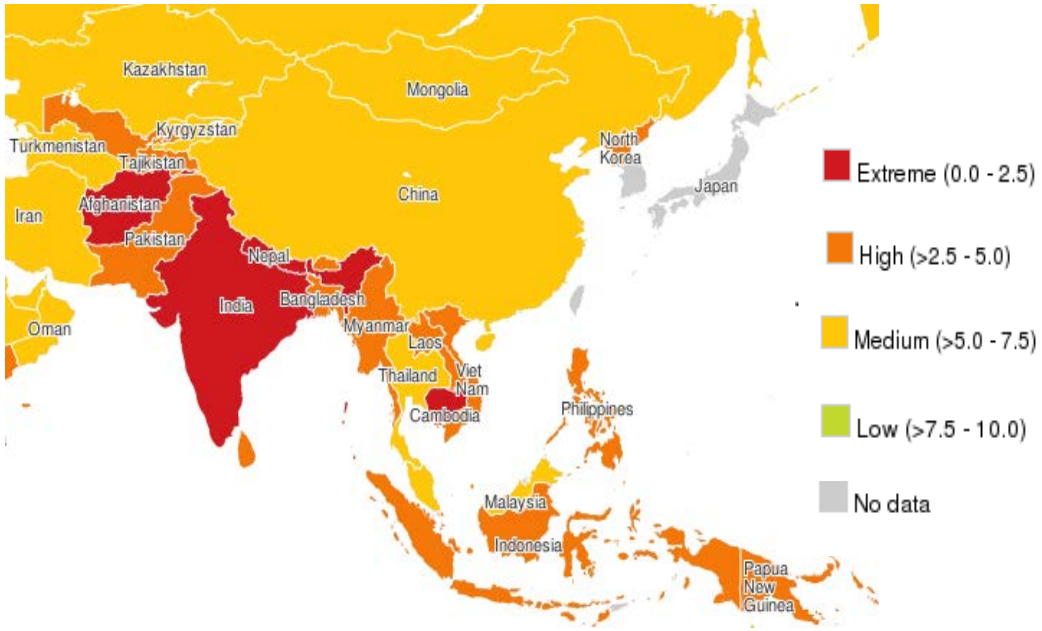
Source: de Onis, M, M. Blössner and E. Borghi. 2011 http://www.who.int/nutgrowthdb/publications/Stunting1990_2011.pdf.



Source: UN in de Onis, M, M. Blössner and E. Borghi. 2010. Global prevalence and trends of overweight and obesity among preschool children. American Journal of Clinical Nutrition 92:1257–64. (http://www.who.int/nutgrowthdb/publications/overweight_obesity/en/).

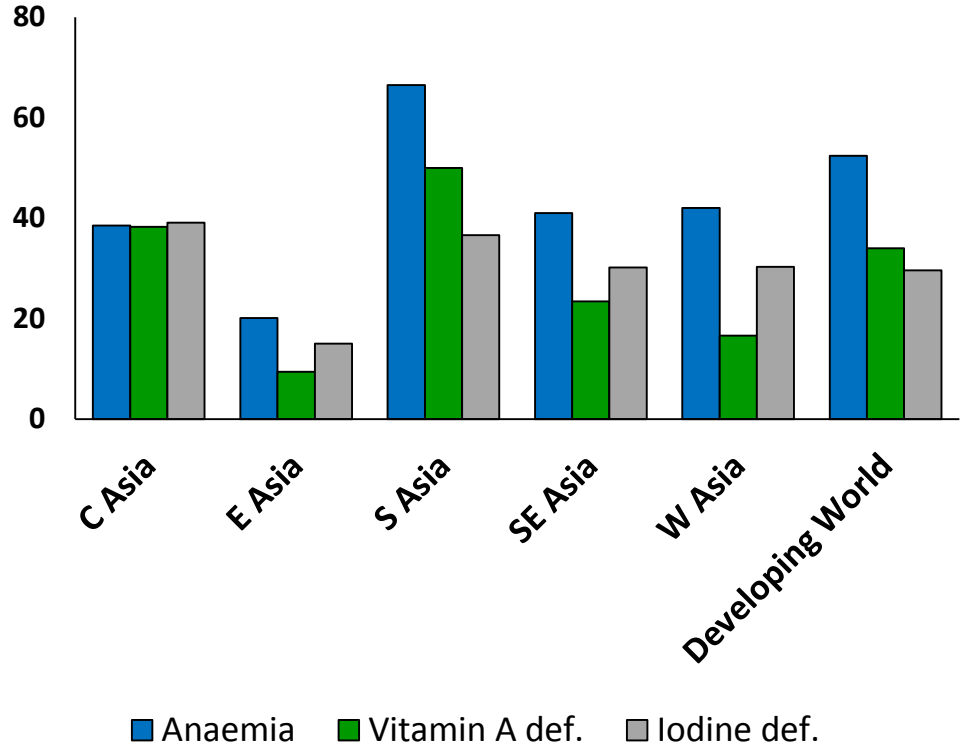
Micronutrient deficiencies are pervasive

Accumulative Mineral and Vitamin Deficiency Index, Asia



Source: Maplecroft 2012

Prevalence of Specific Micronutrient Deficiencies (%)

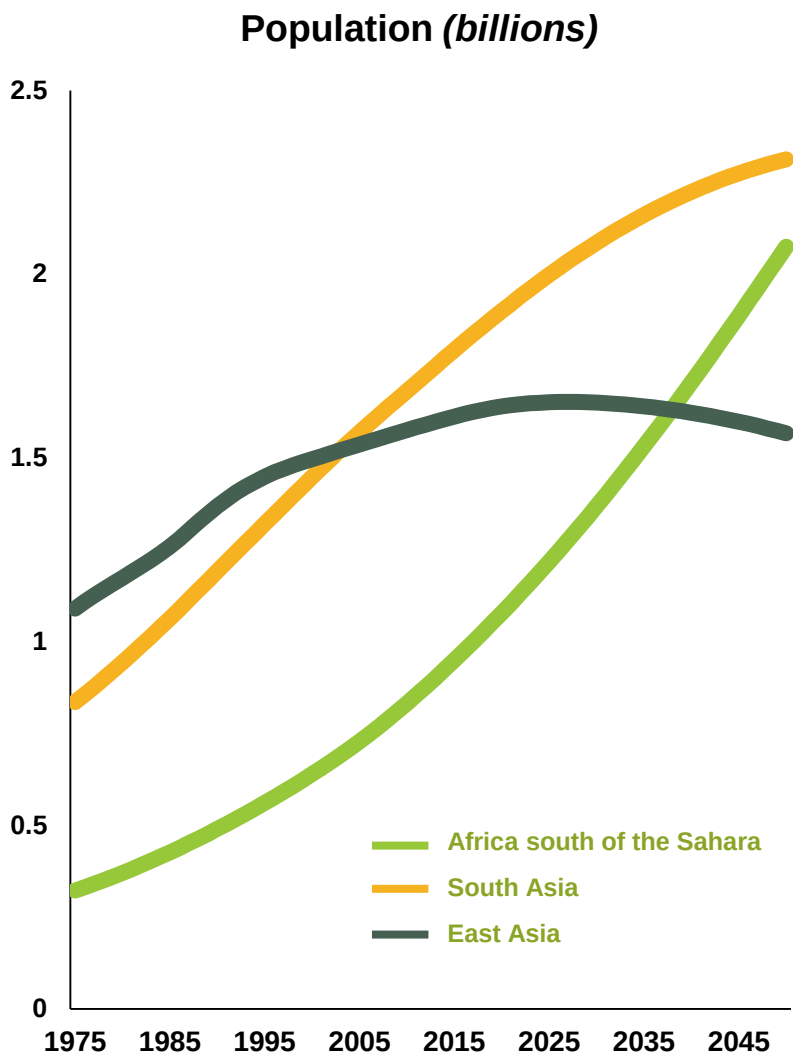


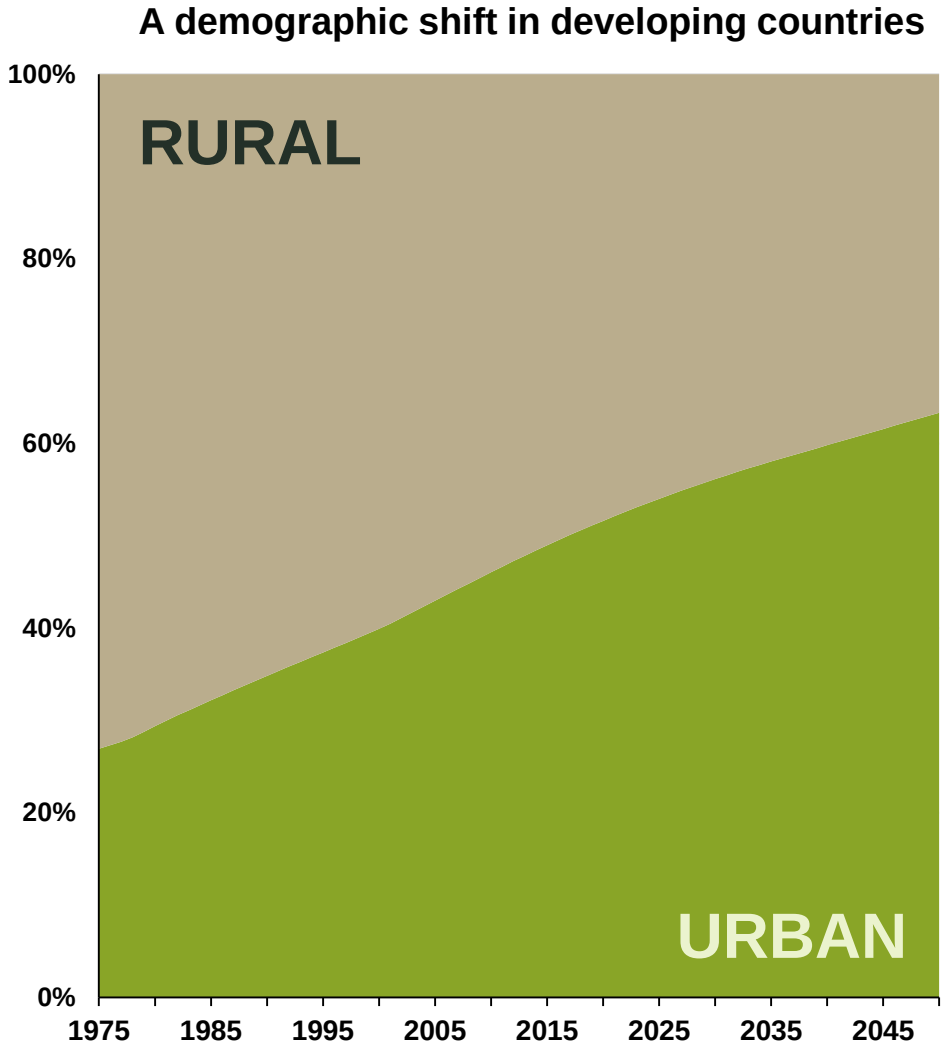
Source: FAO 2013

E.g. Economic cost of micronutrient deficiencies in India = US$17.3 billion (2004 dollars) or 2.5% of GDP

Source: Stein and Qaim 2007

Population: Rapid growth in Africa and South Asia. Developing world urbanizes





Source: United Nations, Department of Economic and Social Affairs, Population Division (2014). World Urbanization Prospects: The 2014 Revision, CD-ROM Edition.

Evolution of Food Demand

- Rapid income growth and urbanization - effects on diets and patterns of agricultural production
  - Change in diets to convenience foods, fast foods
  - Increased consumption of fruits and vegetables
  - Higher food energy, more sugar, fats and oils
  - Rapid growth in meat consumption and demand for grains for feed
  - Half of growth in grain demand will be for livestock
  - Intense pressure on land and water

Water stress risk

36%	population	52%
39%	grain production	49%
22%	global GDP	45%

TODAY

Total population living in water scarce areas

2.5 BILLION PEOPLE

Global GDP generated in water scarce regions

US$9.4 TRILLION

By 2050

Total population living in water scarce areas

4.7 BILLION PEOPLE

90%

Global GDP generated in water scarce regions

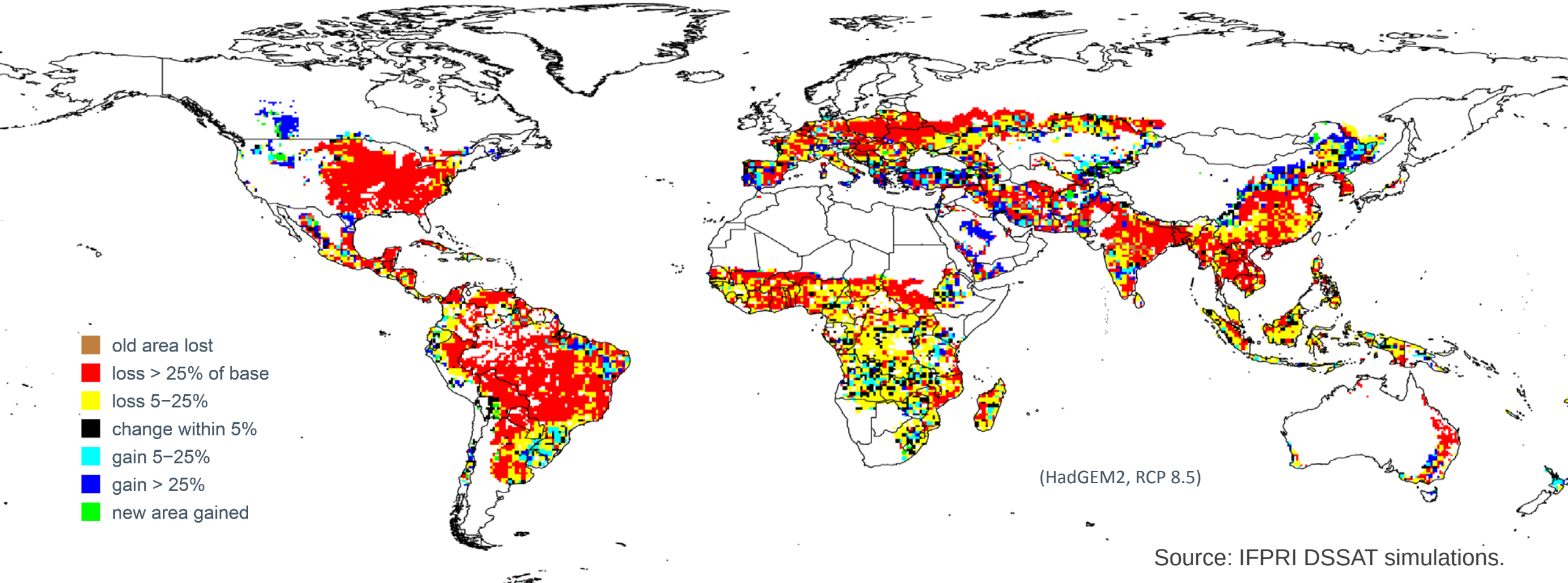
US$63 TRILLION

570%

Source: Veolia Water & IFPRI 2011.

Climate change will reduce crop yields relative to current weather

Without adaption policy global maize yields projected
30% lower in 2050 compared to no climate change



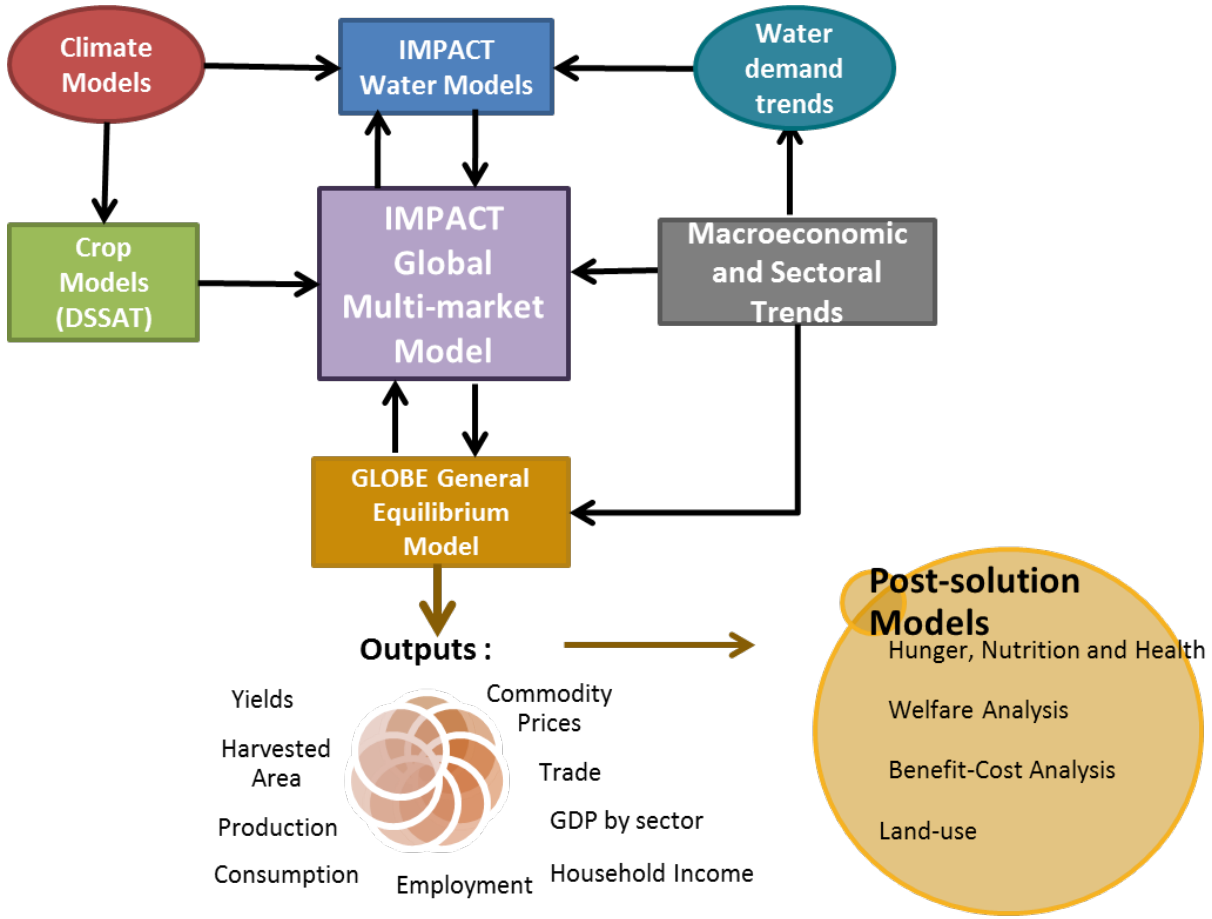
Source: IFPRI DSSAT simulations.

SCENARIOS FOR MORE SUSTAINABLE AND RESILIENT FOOD SYSTEMS

Methods and Results

IFPRI's IMPACT Modeling System

Exploring alternative climate and investment futures



- Linked climate, water, crop and economic models
- Estimates of production, consumption, hunger, and environmental impacts
- High level of disaggregation
  - 159 countries
  - 154 water basins
  - 60 commodities
- Links to other global modeling groups through AgMIP, and to all 15 CGIAR centers

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.

Scenario Description: Agricultural Investment and Food Security

- Three types of scenarios using the IMPACT system of models
  - SSP2 with no climate change
  - SSP2 with climate change Hadley General Circulation Model (HGEM), RCP 8.5
  - SSP2 with climate change and additional investments in agriculture sector

Scenarios

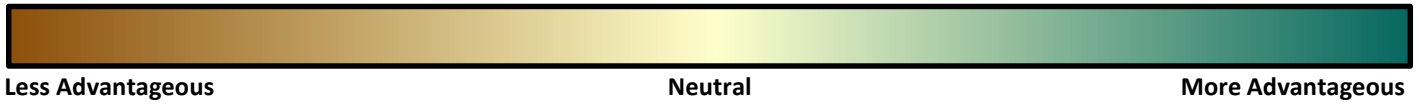
- 2050 with Climate Change (CC) and Comprehensive Investment Portfolio (COMP): $25.5 billion per year above baseline
  - Uses above CC scenario as reference point; overlays scenario that combines additional investments (starting in 2015) targeted at ameliorating major constraints in global food system
  - ***R&D:*** CGIAR system and NARS investments in agricultural R&D to increase agricultural productivity in the developing world
  - ***Water***: Expansion of irrigation systems along with enhancing water use efficiency and soil management (system efficiency, no-till, ISFM, rainwater harvesting)
  - ***Infrastructure***: Investment in transportation and energy sectors to benefit agricultural production and value chains

RESULTS

Summary effects of scenarios on GDP, agricultural production, water use, hunger, forest area, 2050

Note: Costs are in billion USD, while other values are percentage differences in each indicator relative to the REF_HGEM scenario.

Scenario	Avg. Annual Cost	2030						
		Income	Food supply, hunger, and nutrition			Environment		
		GDP/cap	Ag Supply	Hunger	Stunted Children	Water Use	GHG	Forest Cover
MED CGIAR	1.4	1.9	2.7	-9.3	-2.9	-0.2	-15.4	0.13
HI CGIAR	2.0	3.4	5.7	-16.6	-5.0	-0.4	-24.3	0.20
HI_NARS	3.0	4.3	7.7	-20.2	-5.4	-0.4	-26.5	0.22
HI_EFFICIENCY	2.0	4.2	7.5	-20.0	-6.8	-0.4	-26.9	0.22
REGION	2.5	3.1	5.1	-15.4	-6.7	-0.3	-22.6	0.18
HI IRRIG	3.5	0.2	0.2	-1.1	-0.3	2.9	0.7	-0.01
HI IRRIG & WUE	8.1	0.5	0.9	-2.7	-0.8	-7.5	-0.2	-0.01
ISWM	4.6	0.5	0.9	-3.0	-0.9	-2.9	-1.1	0.01
RMM	10.8	0.8	1.5	-4.2	-1.2	0.0	8.9	-0.08
COMP	25.5	5.7	11.5	-24.4	-9.0	-11.0	-25.4	0.22

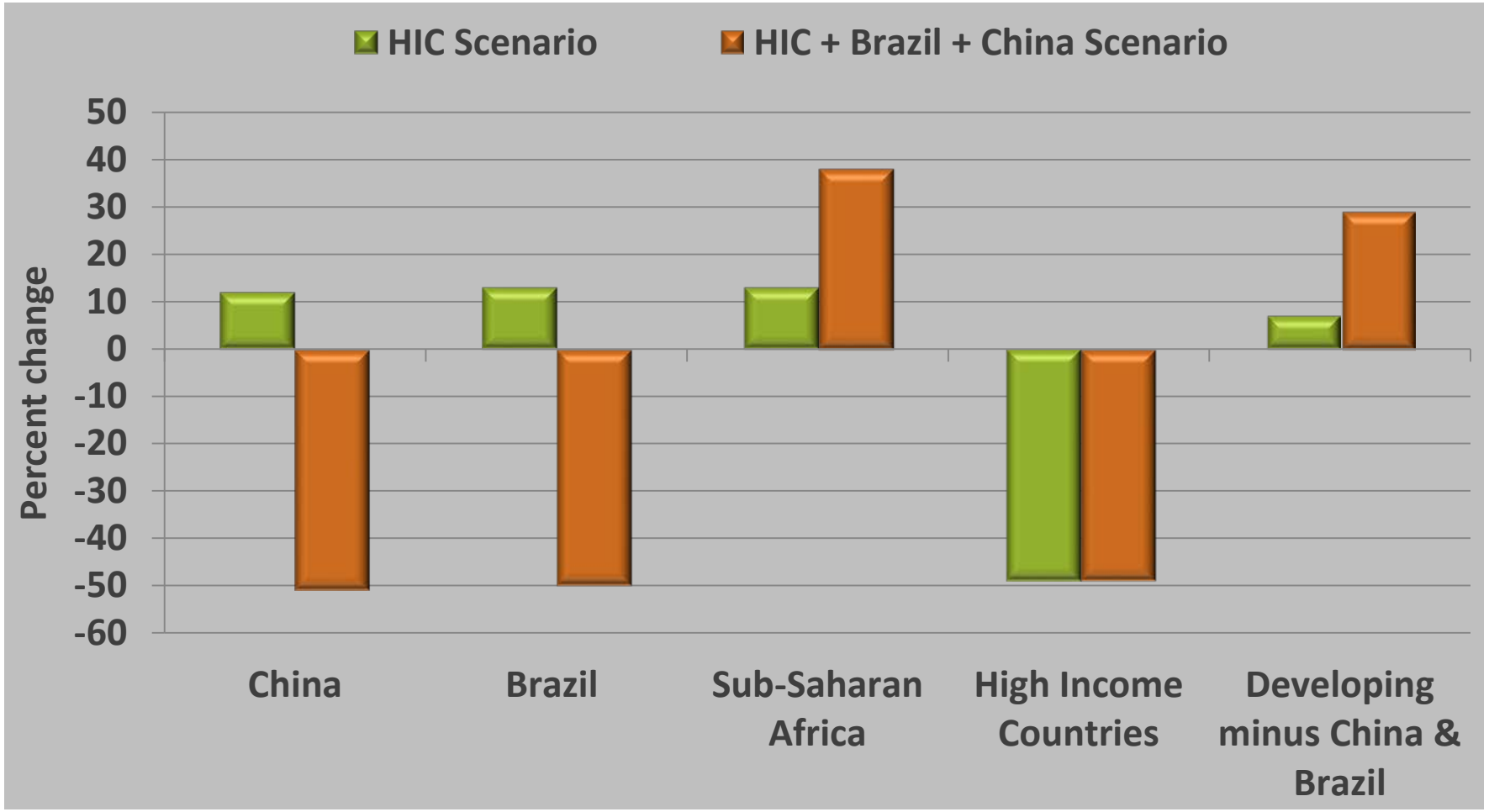


Alternative Scenarios: Reduced Meat Demand and Global Food Security

- HIC Scenario: 50% reduction in per capita meat consumption in high income countries in 2050 compared to baseline
- HIC+Brazil and China: 50% reduction also in Brazil and China

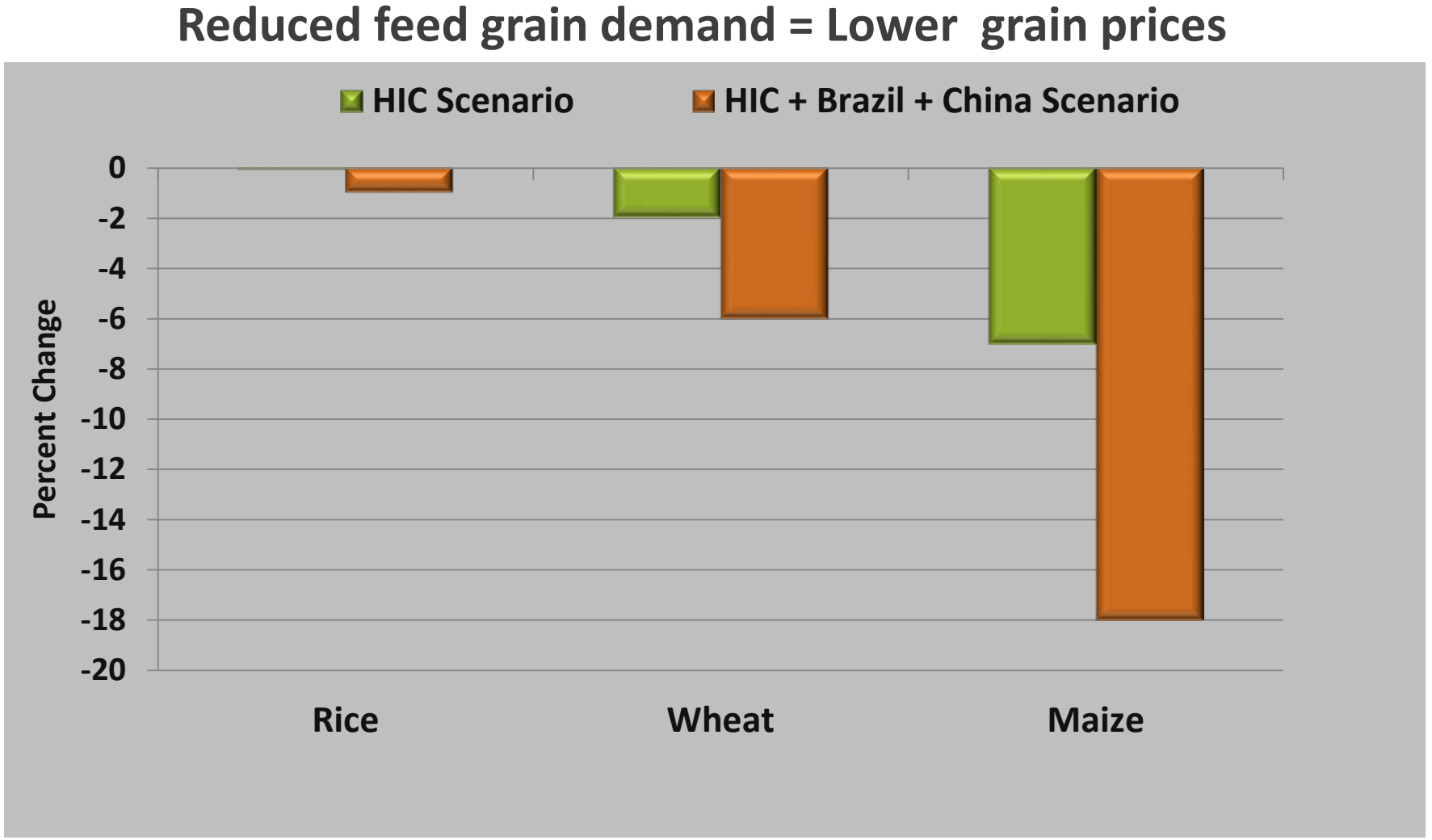
Percent Change in Per Capita Meat Consumption, 2050

Less meat in rich countries = more in developing countries



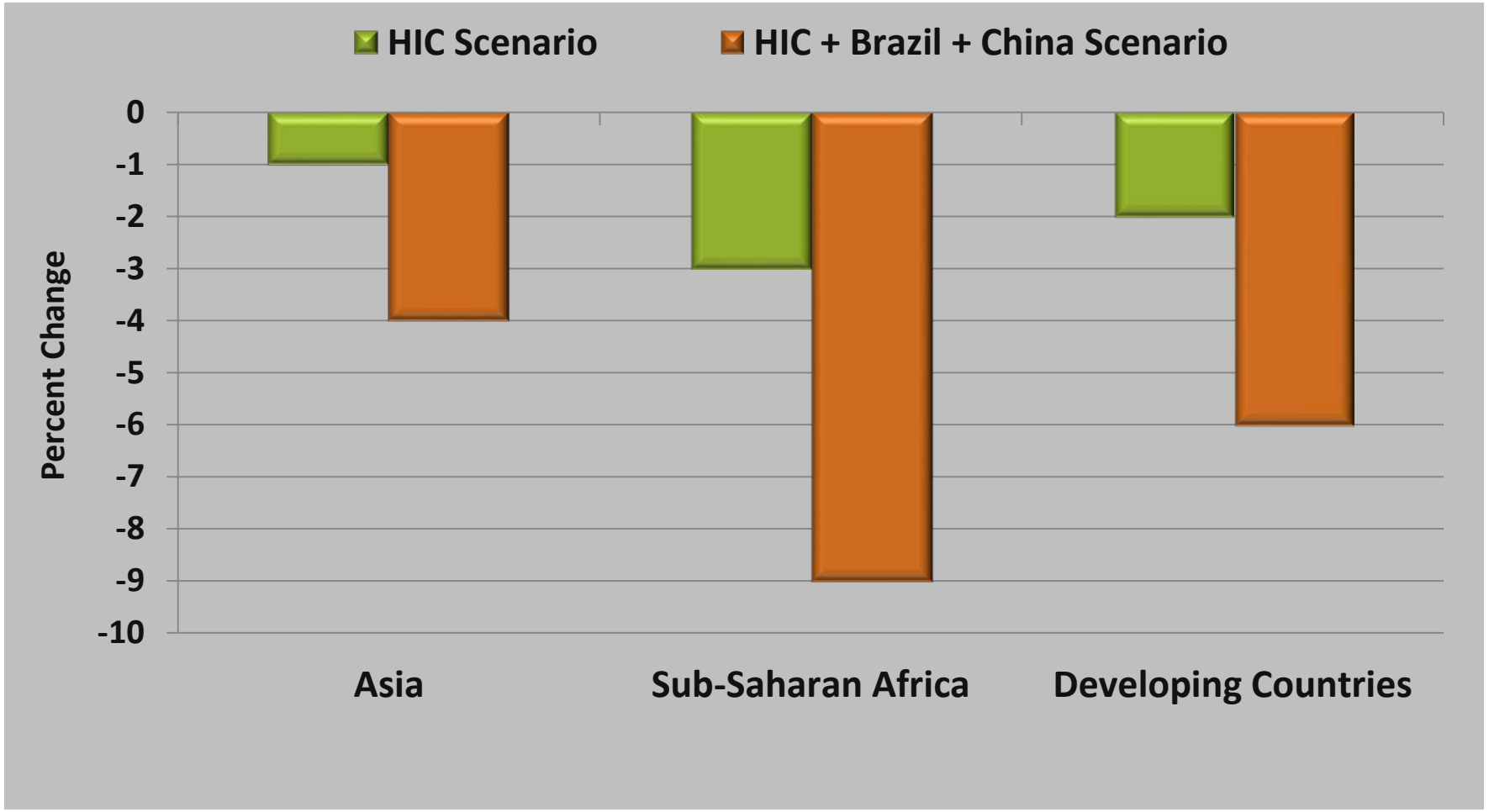
Source: IMPACT Model Projections

Percent Change in World Prices of Grains, 2050



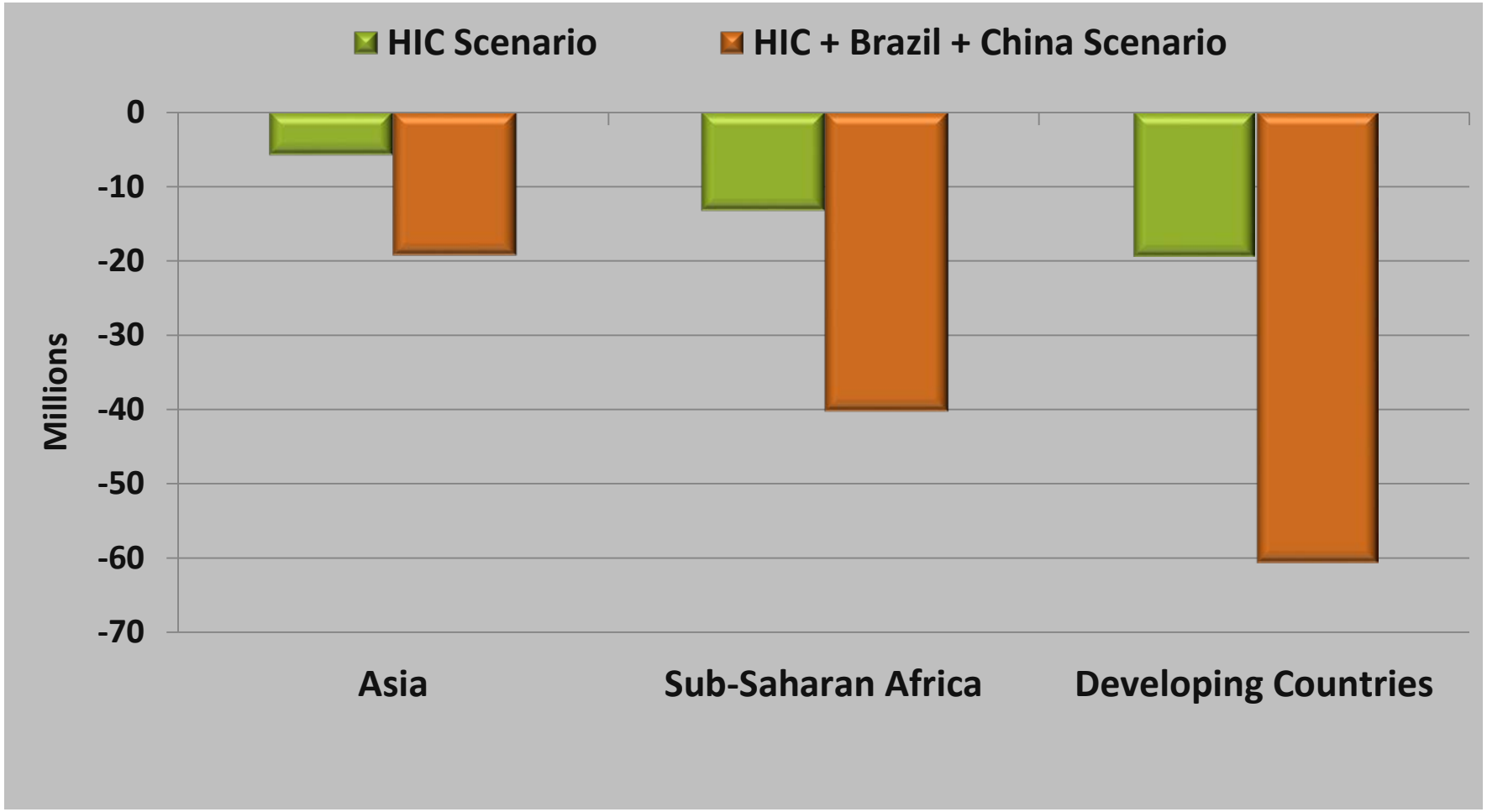
Source: IMPACT Model Projections

Percent Change in Population at Risk of Hunger, 2050



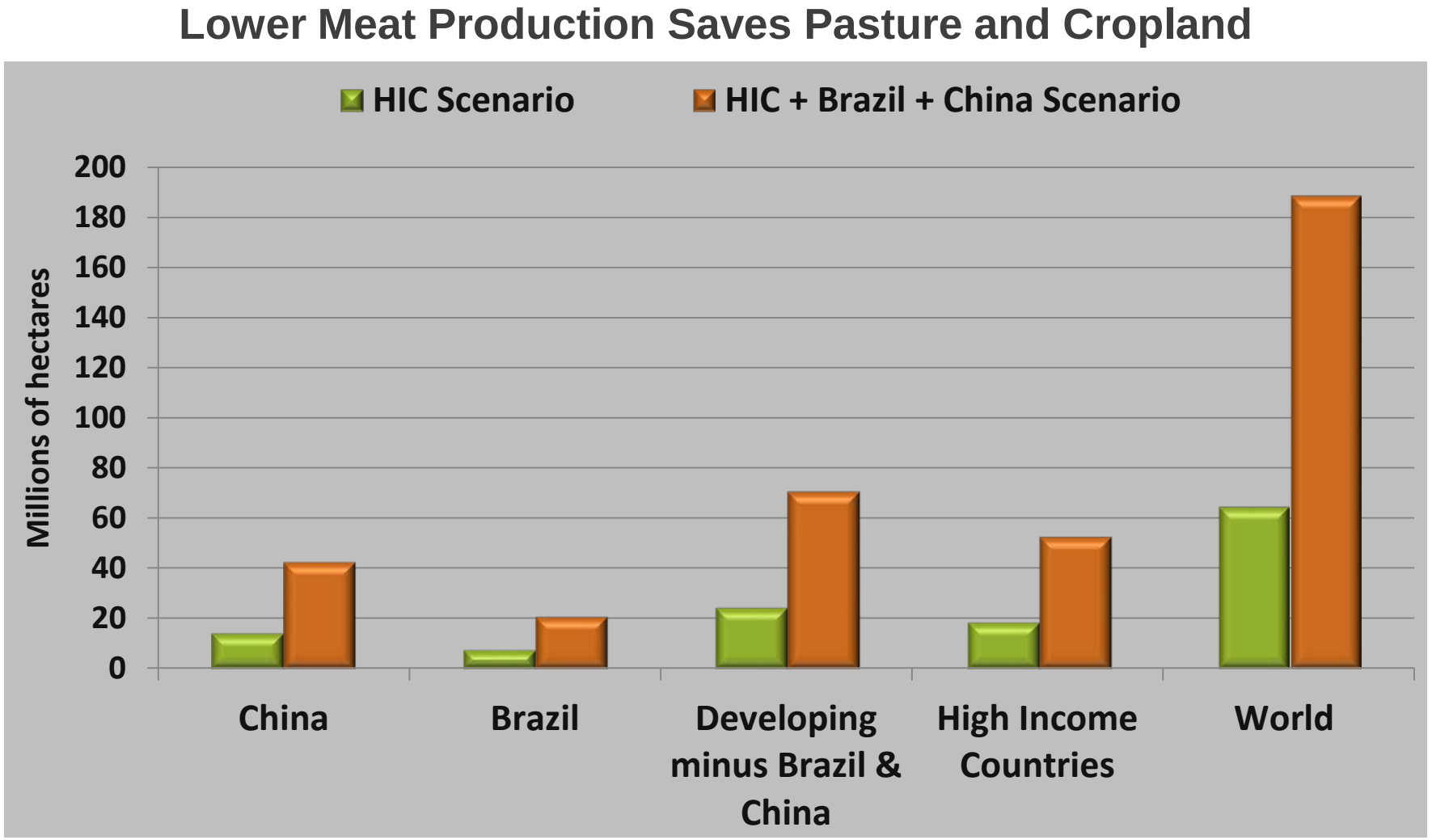
Source: IMPACT Model Projections

Change in Population at Risk of Hunger, 2050



Source: IMPACT Model Projections

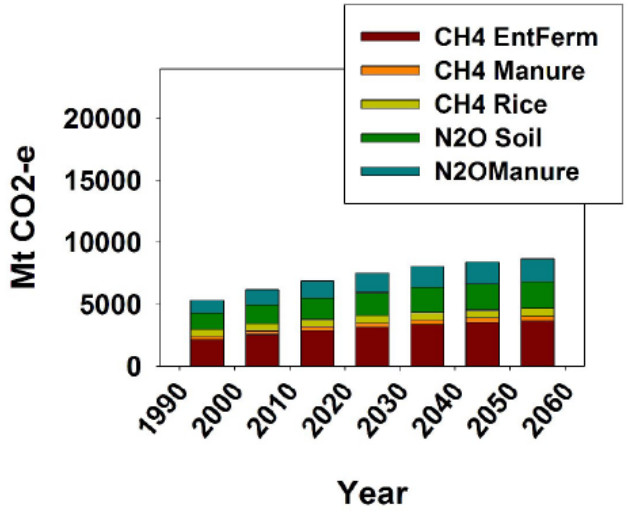
Area Conserved in 2050



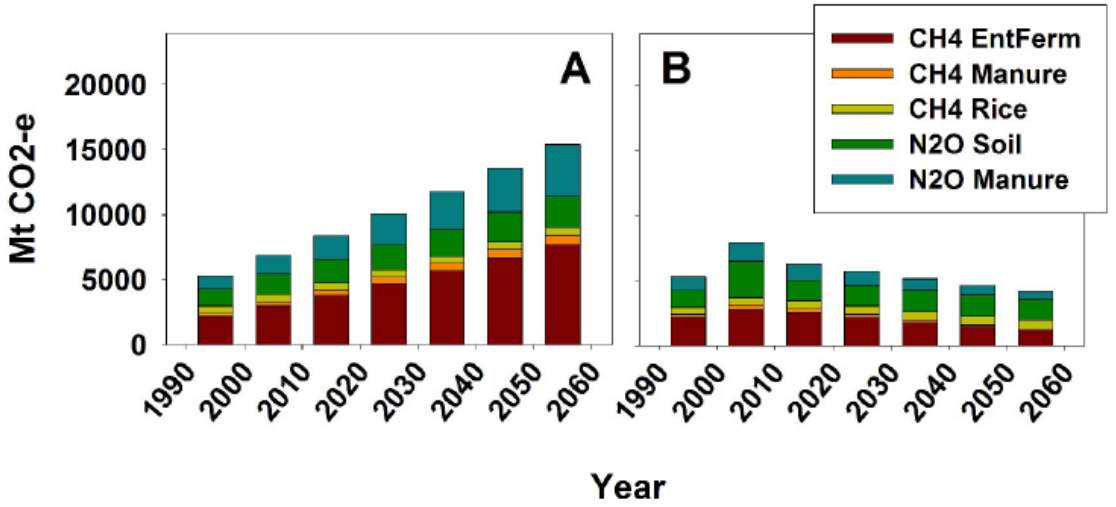
Source: IMPACT Model Projections

Livestock Production: Emission Contribution under Alternative Diets

Constant diets



More meat



Less meat

Source: Popp, Lotze-Campen, Bodirsky, GEC 2010 using Potsdam Institute MAgPIE model

CONCLUSIONS

Conclusions

- Increased investment in agricultural research and development, rural infrastructure, and irrigation and water use efficiency generates
  - Increases in food supply and income
  - Improved food security and nutrition
  - Reductions in hunger, stunted children, water use, GHG emissions, and forested area
- Dietary change provides
  - Greater reductions in GHG emissions
  - Further reductions in hunger and agricultural land use
- Achieving more resilient and sustainable food systems will require
  - Sustainable productivity growth
  - Improved value chains
  - Significant dietary change