INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

sustainable solutions for ending hunger and poverty

Supported by the CGIAR

IFPRI®

Intensifying sustainable agricultural productivity to meet SDG2 (2.3 & 2.4)

Roundtable Forum for the
Global Action Plan for Agricultural Diversification
(GAPAD)

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Scientist, IFPRI

Acknowledgements

Quantitative Foresight Modeling	Climate Smart Agriculture	Gender, Assets, and Property Rights
Daniel Mason D'Croz	Alessandro De Pinto	Ruth Meinzen-Dick
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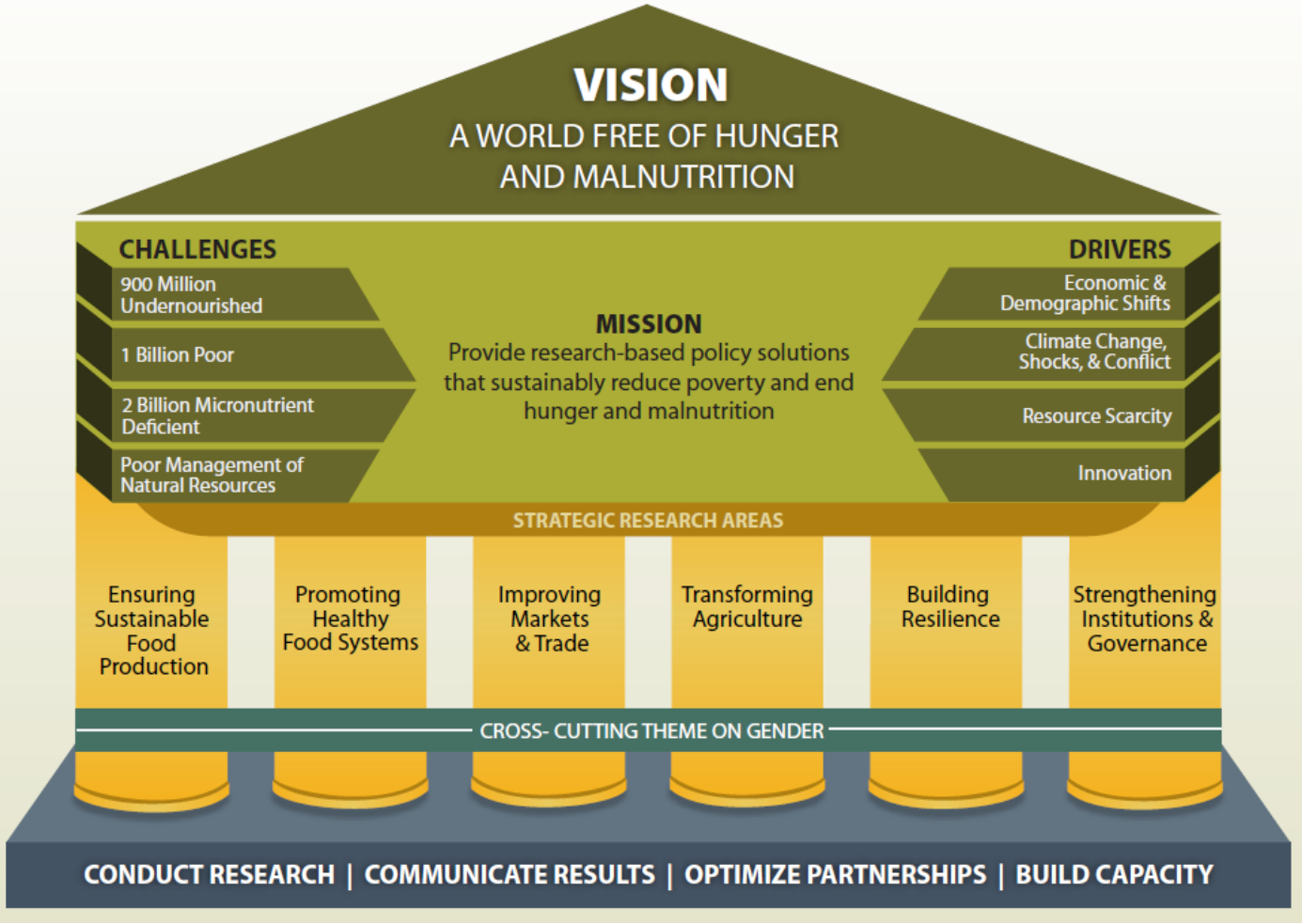
Shahnila Islam	Jawoo Koo	Sophie Theis
Nicola Cenacchi	Tingju Zhu	
Mark Rosegrant		
Keith Wiebe	…and many others…	

Sustainable Development Goals by 2030: Focus on 2.3 & 2.4

- **2.3** – Double agricultural productivity and incomes
  - For small-holders, family farmers, women, indigenous people, and other marginalized producers through land rights and access to resources, services, and opportunities
- **2.4** – Ensure sustainable food production
  - Implement resilient agriculture: increasing productivity while maintaining ecosystems and strengthening capacity for adaptation to climate change and extreme weather events

SUSTAINABLE DEVELOPMENT GOALS

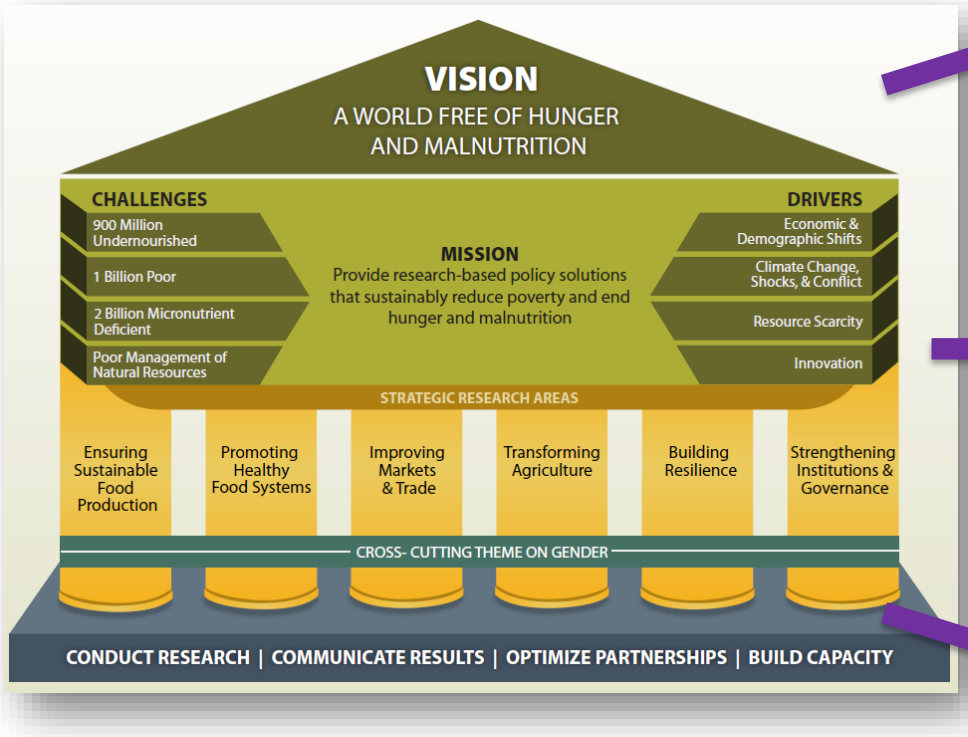
Provide evidence-based policy solutions to end hunger and reduce poverty



IFPRI's research and outreach at the global level and at regional and country level in Africa, Asia, Latin America, and the Middle East

3 examples from IFPRI's research portfolio to address SDG 2

http://www.ifpri.org/



Gender, Assets, and Property Rights

Climate Smart Agriculture

Quantitative Foresight Modeling

http://www.ifpri.org/topic/gender

http://www.ifpri.org/search?keyword=climate+smart+agriculture

https://www.ifpri.org/program/impact-model and http://globalfutures.cgiar.org/

GENDER

Why gender matters

- Women make up a large percentage of the agricultural labor force in developing countries (on average 43%, 50% in Africa);
- Women are disadvantaged in productive asset ownership (including land and livestock), control of productive inputs (including access to credit, insurance, technology etc.);
- There are gender gaps in base education levels, access to extension and information services, natural resource knowledge;
- Female farmers produce less than men not because they are less efficient/able farmers, but because they lack equal access to resources.

Takeaways from 20+ Years of Gender Research at IFPRI

- Household decision making
- Asset access, control, and ownership
- Closing gender gaps
- Land rights
- Legal institutions and governance
- Social capital
- Sustainability
- Climate change and adaptation
- Nutrition and health
- Violence against women
- Empowerment
- DATA

GENDER RESEARCH

Takeaways from twenty years of gender and rural development research at IFPRI: Improving measurements of women's empowerment and data on gender

OCT 9, 2015

This blogpost, the final in a 4-part series on IFPRI gender research, shares key takeaways from research on themes of: decision making; women's empowerment; and improving data on gender.

GENDER RESEARCH

Takeaways from twenty years of gender and rural development research at IFPRI: The elements of resilience

OCT 8, 2015

This blog post, part three in a four-part series on IFPRI gender research in the past 20 years, shares key takeaways from research on themes of: groups and social capital; sustainability; shocks and climate change; nutrition and health; and violence against women

GENDER RESEARCH

Takeaways from twenty years of gender and rural development research at IFPRI: Closing gender gaps in agriculture through property rights and governance

OCT 7, 2015

This blog post, part two in a four-part series on IFPRI gender research in the past 20 years, shares key takeaways from research on themes of: closing gender gaps in agricultural productivity; access, control, and ownership of assets; and rights; and legal institutions and governance.

GENDER RESEARCH

Takeaways from twenty years of gender and rural development research at IFPRI: Household decision making and women's control over resources

OCT 6, 2015

In this blog series, we review key takeaways from the last 20 years of IFPRI gender research. This first blog of four explores two early themes of IFPRI gender research: unpacking the "black box" of household decision making; and understanding the impact of resources controlled by women.

Takeaways - http://bit.ly/2dEX3mu

Women's Economic Empowerment

- Linked to over 50% of reductions in all child stunting from 1970-1995 (Smith & Haddad 2000)

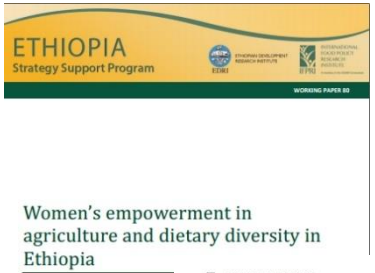
- Shown in many studies, in many parts of the world: women's income has greater impact on child nutrition and food security than men's (UNICEF 2011).

- However, recent review shows there is limited or mixed rigorous evidence for standard poverty programs on measures of direct women's empowerment (micro-credit, cash transfers, agriculture interventions) (van den Bold et al. 2013).

- Need more rigorous research on agriculture and women's empowerment outcomes – historically not measured – or measured indirectly without standardized understanding of indicators or methodology.

Women's Empowerment and Children's Nutritional Status

- New tool: Women's Empowerment in Agriculture Index (WEAI)
  - New survey-based index (PRIMARY, not secondary data)
  - Men and women from the same household are interviewed
  - Focus on men's and women's empowerment in agriculture
- Evidence from Ethiopia and Nepal
  - Interventions which increase women's empowerment contribute to improving child nutrition and household well-being



http://www.ifpri.org/topic/weai-resource-center
http://dx.doi.org/10.1017/S1368980015000683
http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/129781

CLIMATE SMART AGRICULTURE

What is CSA?

- Integrative approach to address interlinked challenges of food security and climate change
  - **Sustainably increasing agricultural productivity** to support equitable increases in farm incomes, food security, and development;
  - **Adapting and building resilience** of food systems and farming livelihoods to climate change at multiple levels; and
  - **Reducing greenhouse gas emissions** from agriculture, **where possible**

https://www.ifpri.org/blog/climate-smart-agriculture-key-ending-hunger

Simulated Global Adoption of Selected CSA Practices

Average global impact of adoption (%)			
	Maize	Wheat	Rice
Production	+2.4	+2.3	+2.2
Price	-5.2	-6.8	-7.8
Area	-0.3	-1.1	-1.3

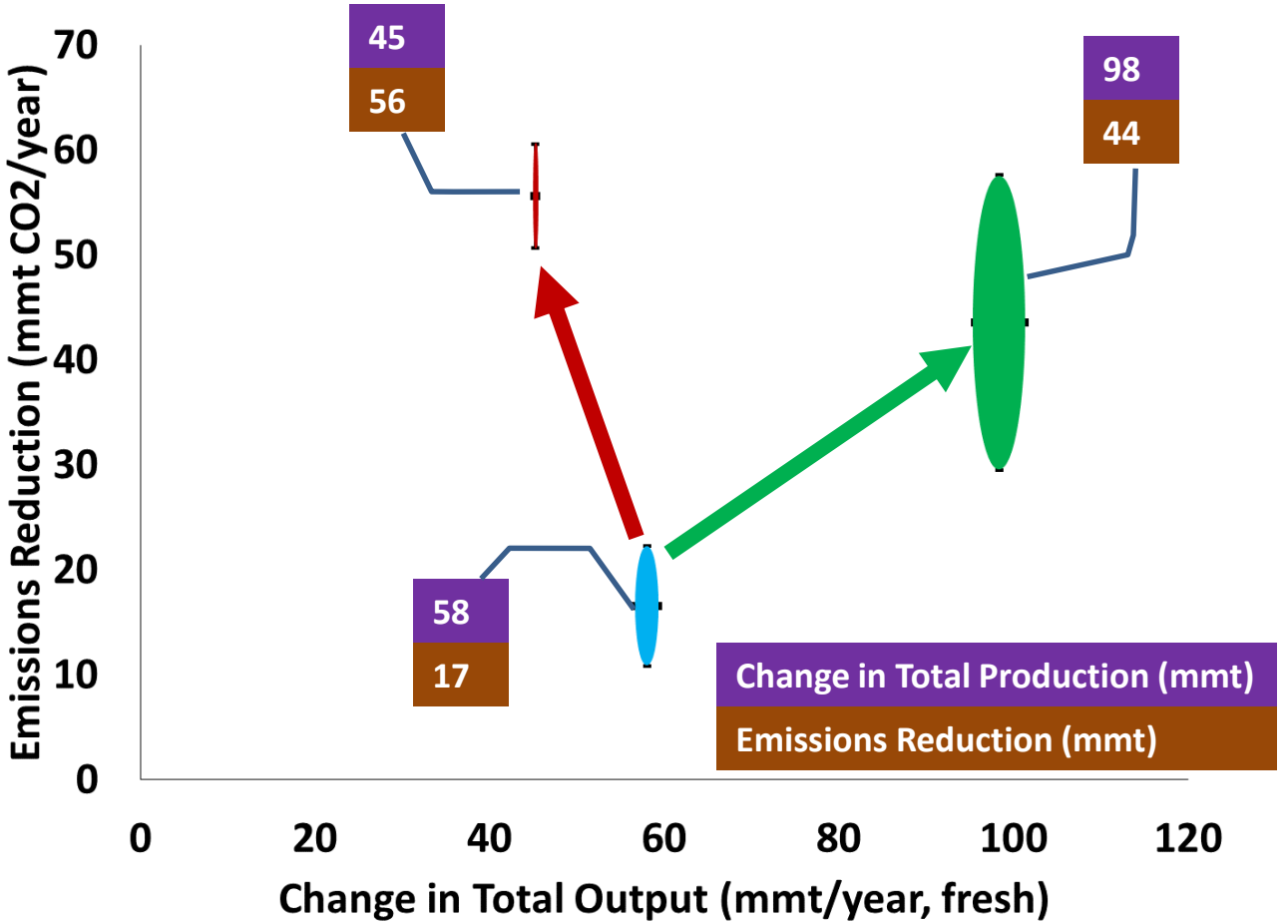
Aggregated global impact across CSA	
Pop risk of hunger (%)	-3.3
Undernourished children (%)	-0.9
Emission reduction (mmt CO2/year)	17.2

Impacts by 2050

- Simulations using IFPRI's IMPACT system of models and DSSAT crop model
- Maize, Wheat, and Rice only (~41% global harvested area)
- No-till; Integrated Soil Fertility Management (ISFM); Alternate Wet and Dry (AWD); Urea Deep Placement (UDP)
- Two CC Scenarios (SSP2/RCP 8.5): GFDL and HadGEM GCMs
- Baseline adoption rates by 2050 (%): No-till = 70; ISFM, AWD, UDP = 40

Potential Tradeoffs from CSA Policy Options

- Baseline adoption of CSA
- Adoption focus increases abatement AND production
- Emissions reduction focus increases total abatement at cost of total production

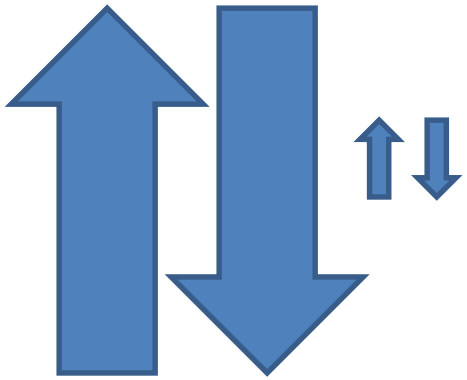


Maize/Wheat/Rice CSA Options - No-till/ISFM/AWD/UDP
Size of oval shows range across climate change scenarios

QUANTITATIVE FORESIGHT MODELING

Quantitative Foresight Modeling

- Forward-looking modeling for agricultural and food security futures
- Structural modeling informed by theory, expert knowledge, and latest science
- Critical context necessary for making informed policy and decision-making
- **DIRECTION & MAGNITUDE** of changes: UP/DOWN + BIG/SMALL

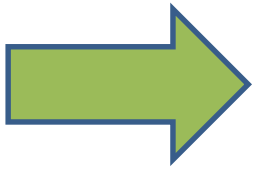


In this case:

- Precision helps inform the modeling
- But policy is not informed by the precision

Drivers of change

- Today, this season, this year
  - Weather, pests, markets, conflict, migration…
- Medium term
  - Agricultural policies, trade policies, markets…
- Long term
  - Population, income, resources, climate, preferences, technology…

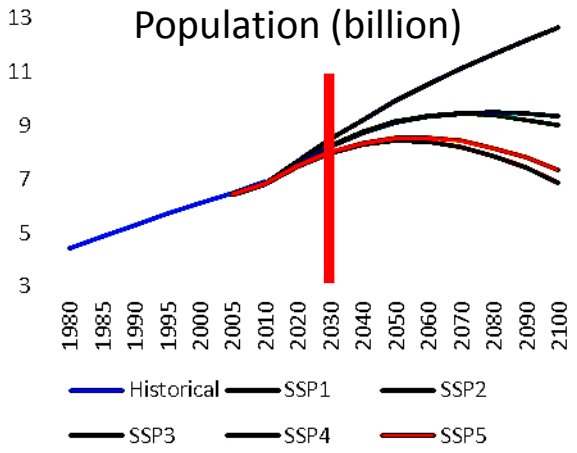


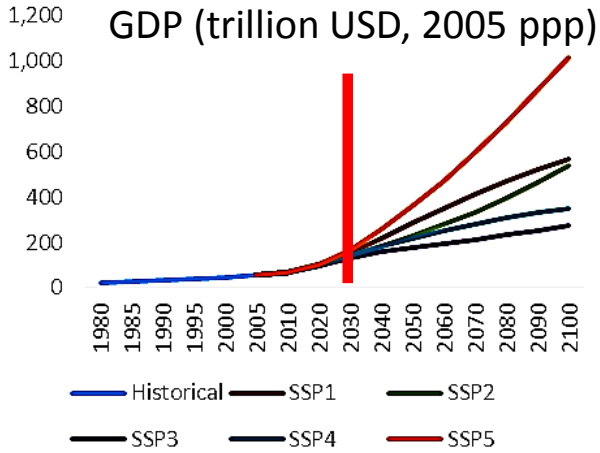
Shared Socioeconomic Pathways (SSPs)

Representative Concentration Pathways (RCPs)

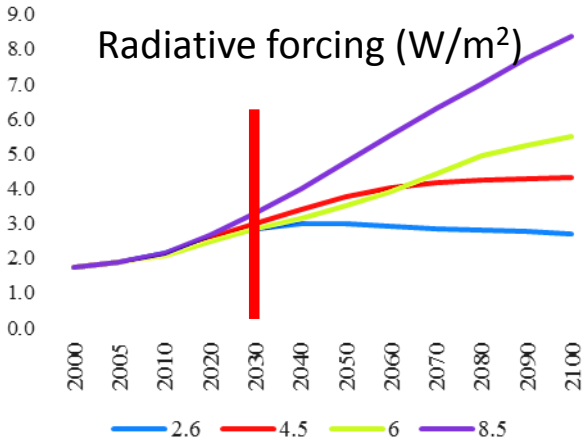
Socioeconomic and climate drivers

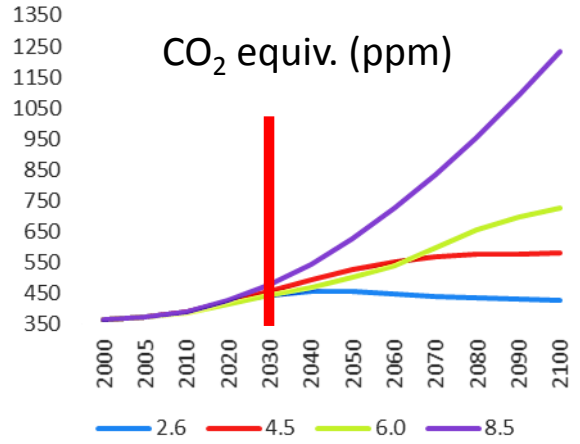
Shared Socioeconomic Pathways (SSPs)





Representative Concentration Pathways (RCPs)



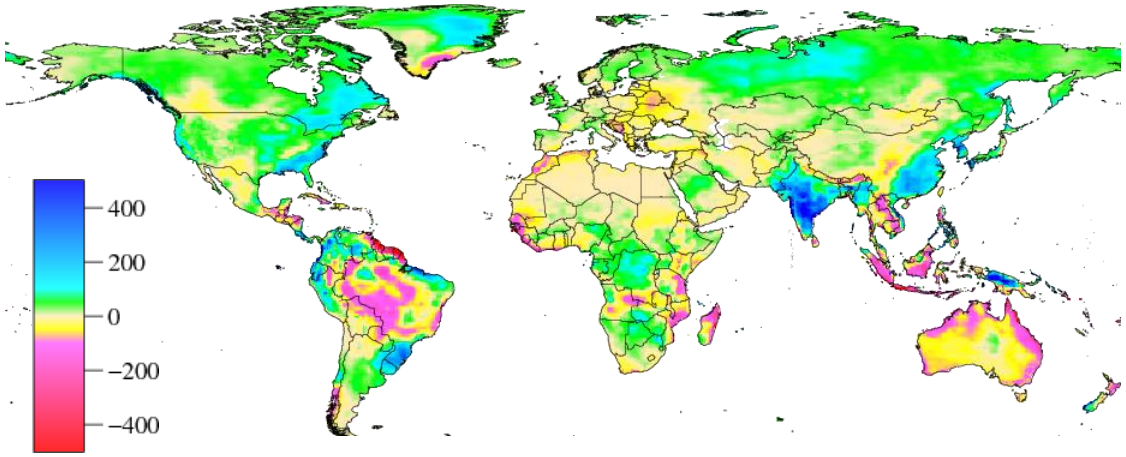


2030 useful for SDGs, but the challenge continues far beyond

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.

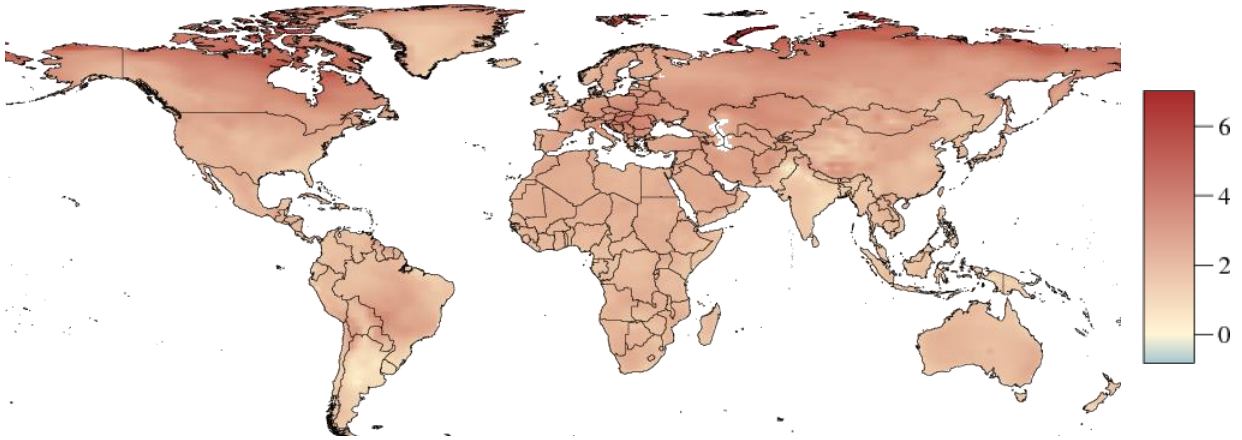
Climate Change Scenario Assumptions

Changes in annual precipitation (mm) and max temperature (°C) by 2030



Changes in precipitation across Africa are variable. We can see some increases in Central and Southern Africa with declines in Northern, Western, and Eastern Africa

Temperatures across all of Africa are projected to increase by about 1 to 2 *°C* without much variation



Note: Climate change scenario uses RCP 8.5 and the Hadley Climate Model

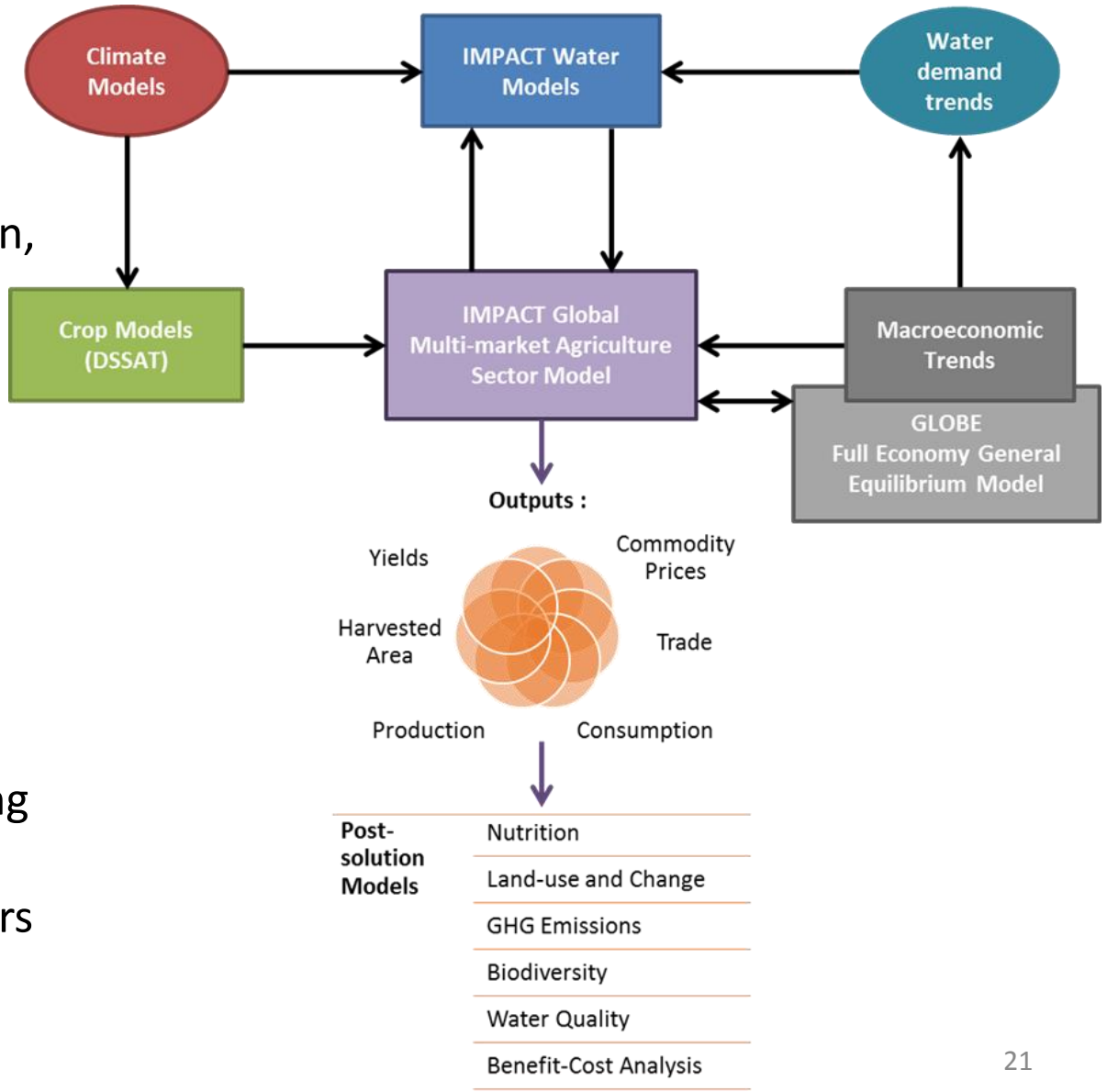
International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT)

- A partial equilibrium agriculture sector model designed to examine alternative futures for global food supply, demand, trade, prices, and food security
- Allows:
  - Fundamental, global baseline projections of agricultural commodity production and trade and malnutrition outcomes
  - Along with cutting-edge research results on quickly evolving topics such as bioenergy, climate change, changing diets and food preferences, and many other themes

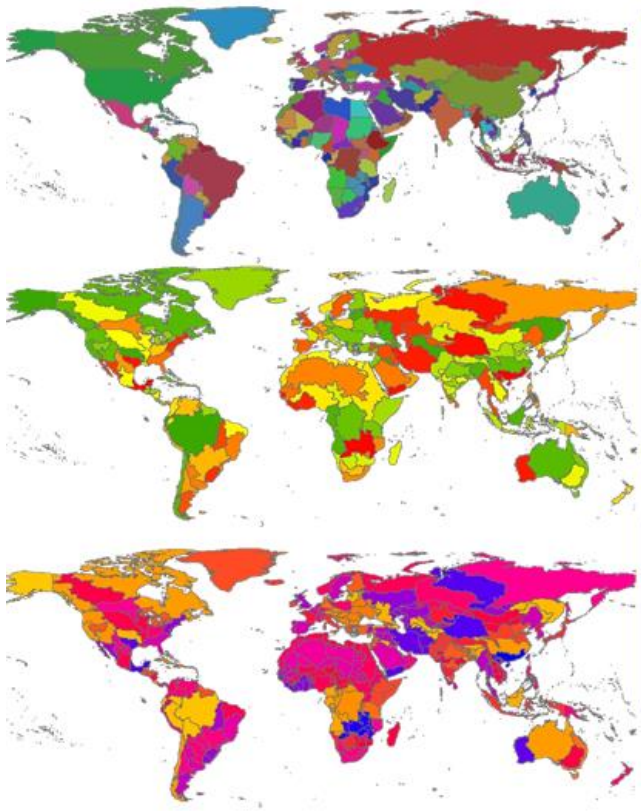
Brief description here, more info at http://www.ifpri.org/program/impact-model

IFPRI's IMPACT Model

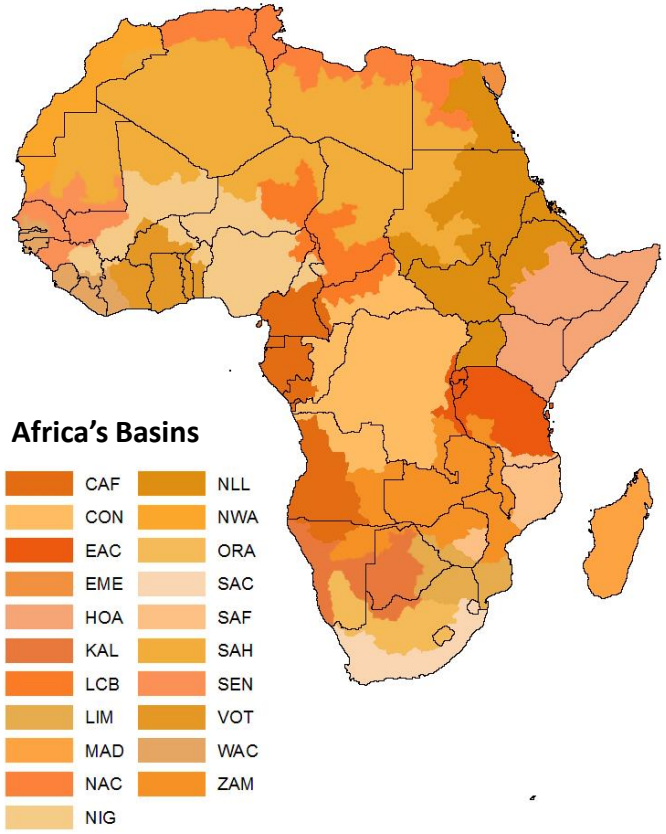
- Linked climate, water, crop and economic models
- Estimates of production, consumption, hunger, and environmental impacts
- High level of disaggregation
  - 159 countries
  - 154 water basins
  - 60 commodities
- Links to global modeling groups through AgMIP and all 15 CGIAR centers through GFSF



IFPRI's IMPACT Model: Spatial Disaggregation



- 159 • Countries
- 154 • Water Basins
- 320 • Food Production Units



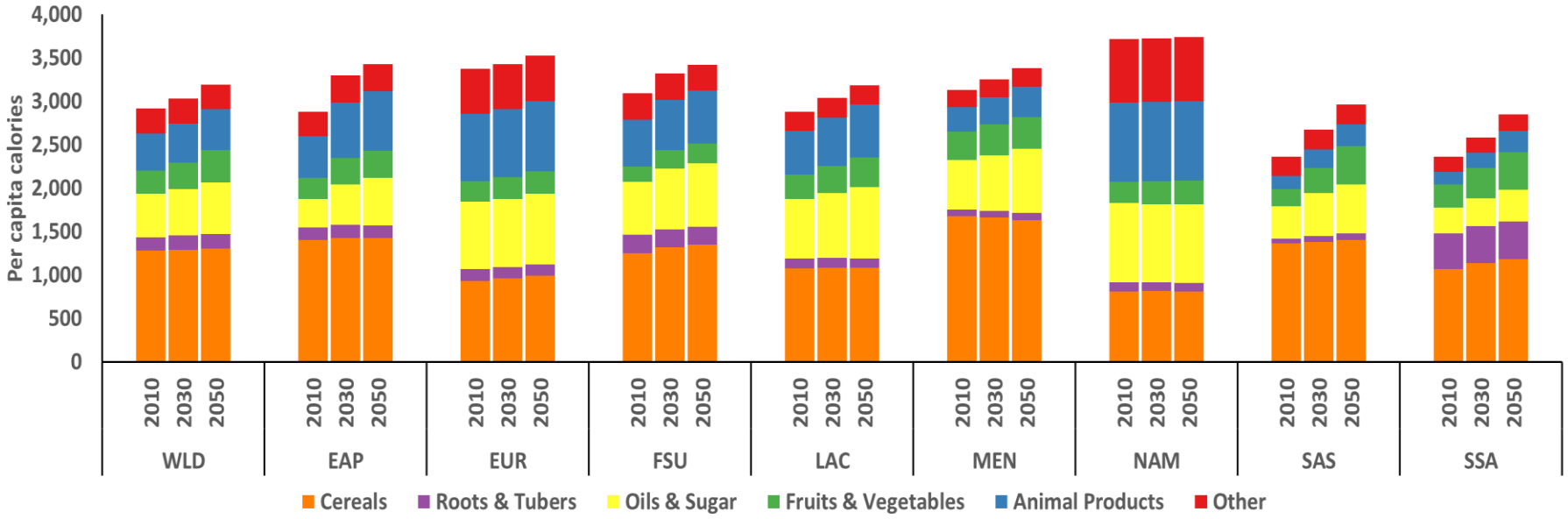
IFPRI's IMPACT Model: Commodity Disaggregation

Spatially disaggregated irrigated and rainfed agricultural production by water basin

Cattle	Barley	Bananas
Dairy	Maize	Plantains
Eggs	Millet	Sub-tropical fruits
Pigs	Other cereals	Temperate fruits
Poultry	Rice	Vegetables
Sheep/goat	Sorghum	
	Wheat	
Groundnuts	Cocoa	Beans
Other oilseeds	Coffee	Chickpeas
Oil palm fruit	Cotton	Cowpeas
Palm kernel	Tea	Lentils
Rapeseed		Other pulses
Soybeans		Pigeonpeas
Sunflower		
Cassava	Sugarbeet	Others…
Other tubers	Sugarcane	
Potato	Refined sugar	
Sweet potatoes		
Yams		

SSP2 No Climate Change

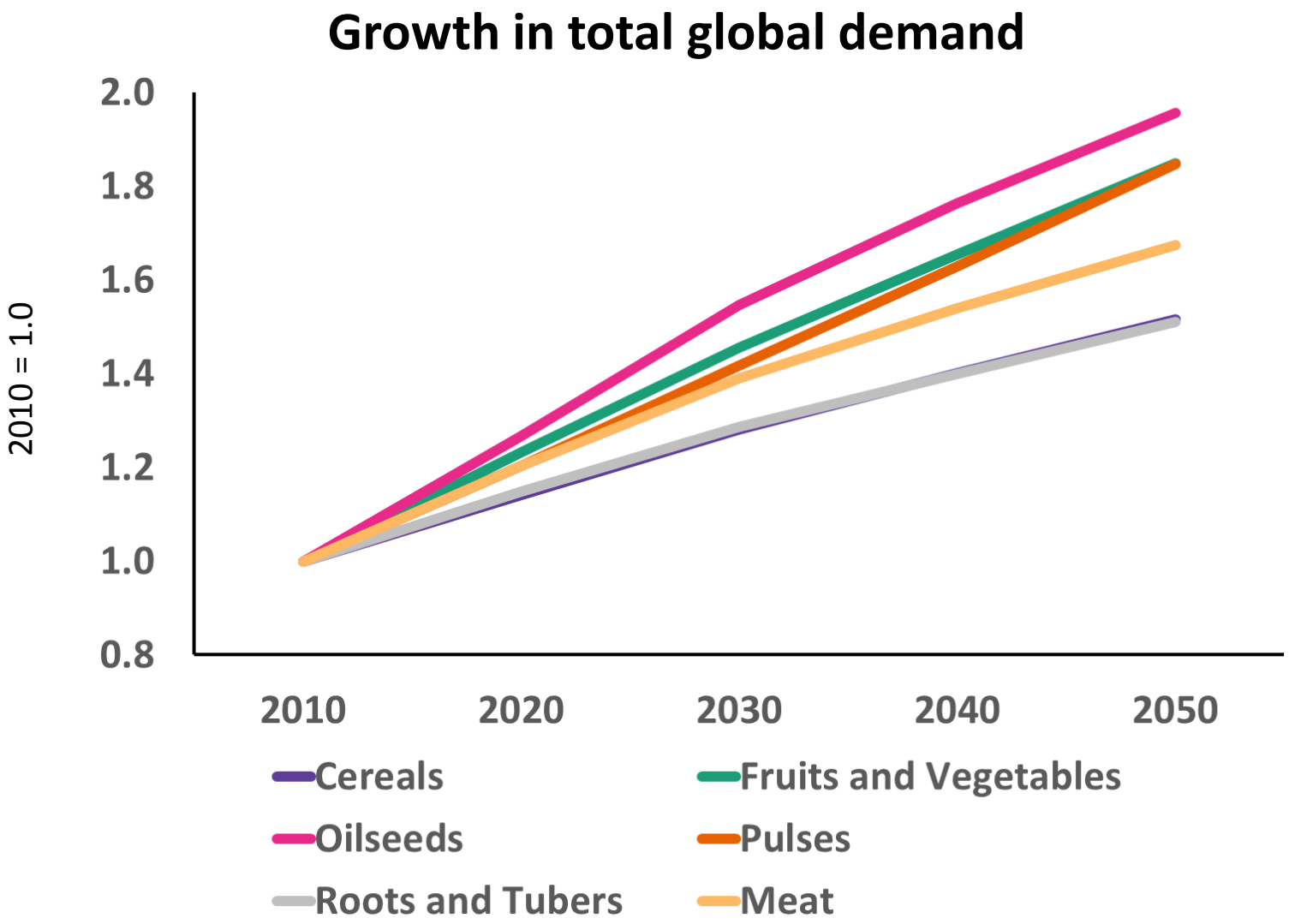
Changing composition of diets



WLD = World; EAP = East Asia and Pacific; EUR = Europe; FSU = Former Soviet Union; LAC = Latin America and Caribbean; MEN = Middle East and North Africa; NAM = North America; SAS = South Asia; SSA = Sub-Saharan Africa

Source: IFPRI, IMPACT version 3.2, November 2015

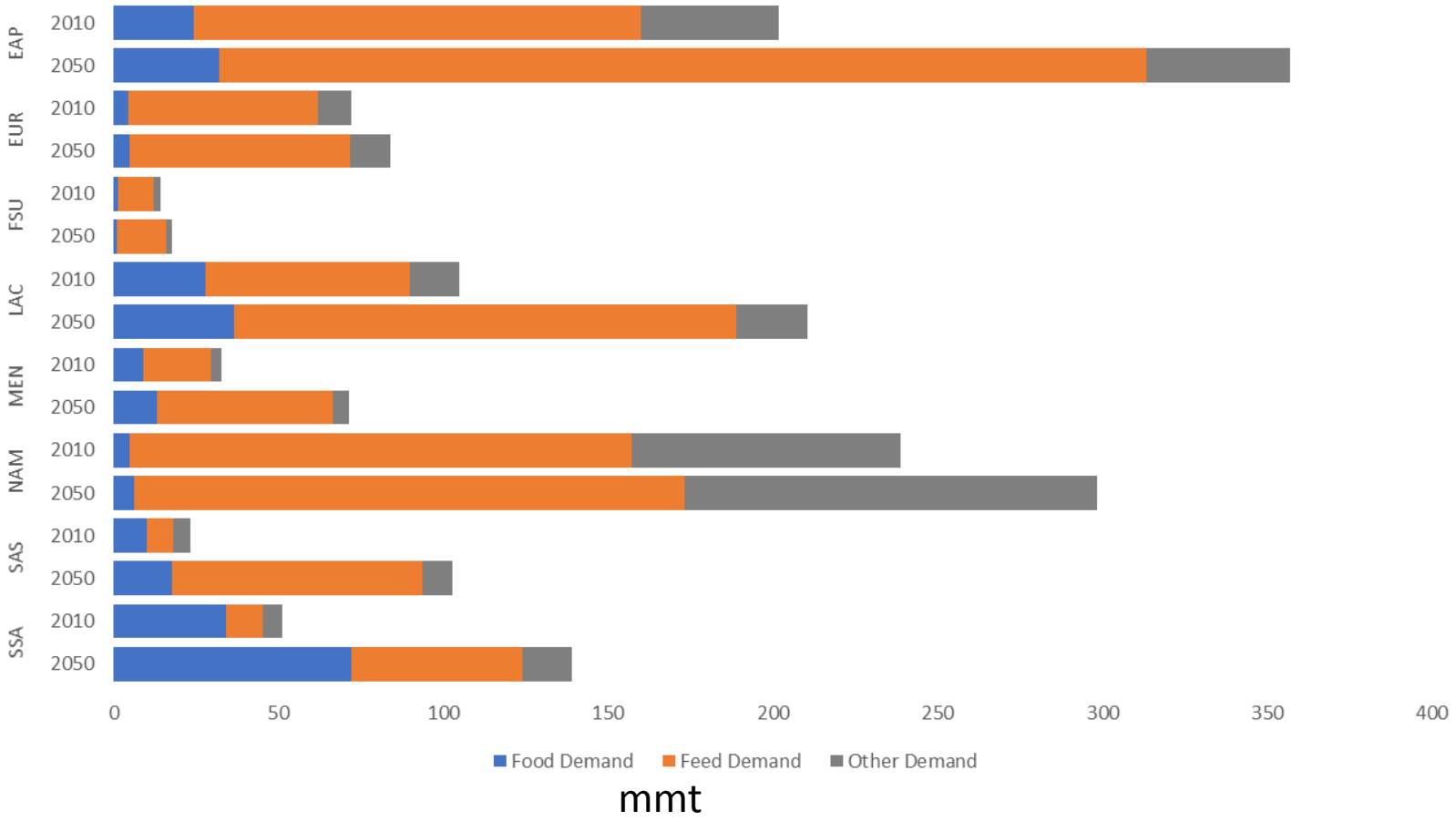
SSP2 No Climate Change



Source: IFPRI, IMPACT version 3.2, November 2015

SSP2 No Climate Change

Maize demand composition



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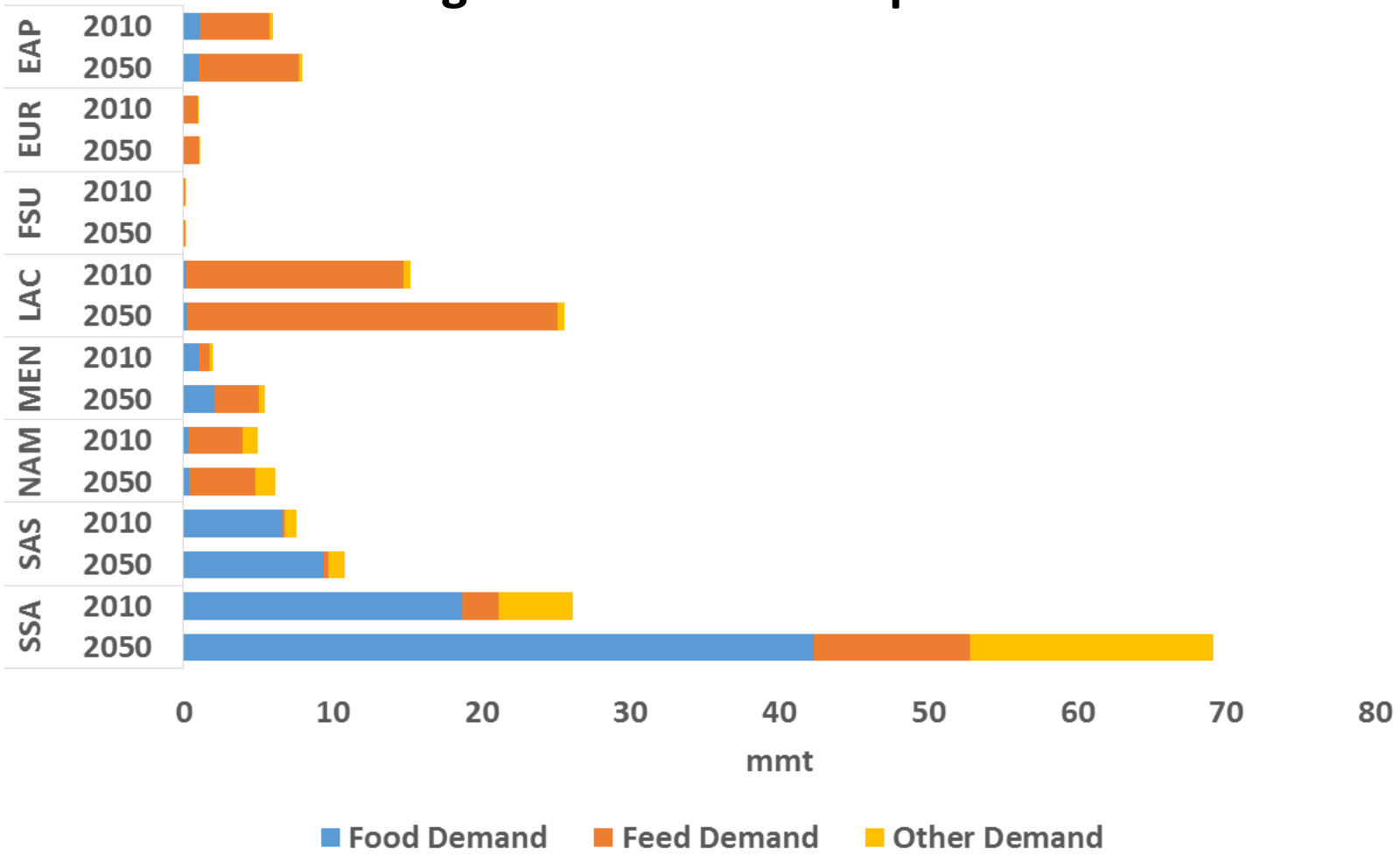
SSP2 No Climate Change

Sorghum demand composition



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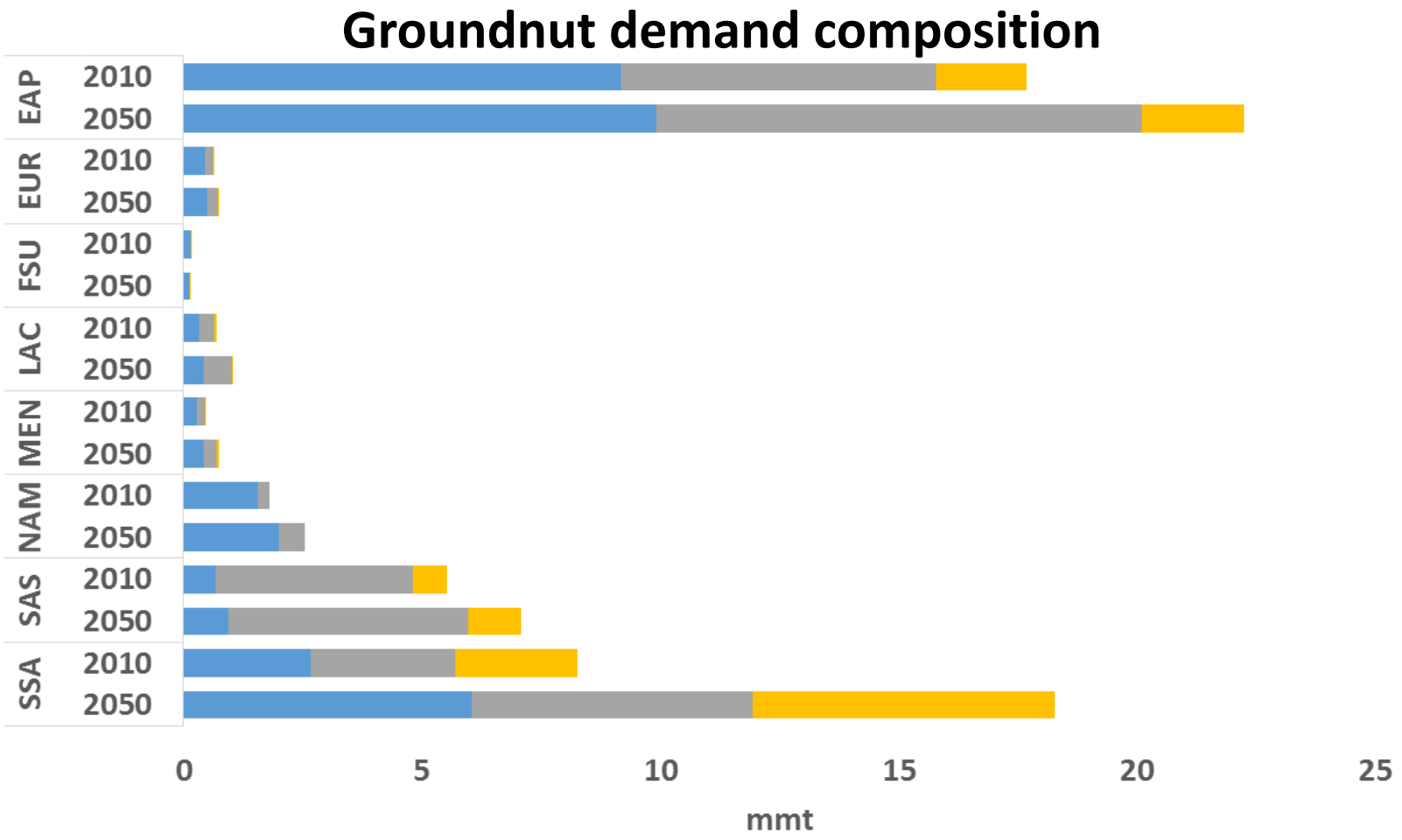

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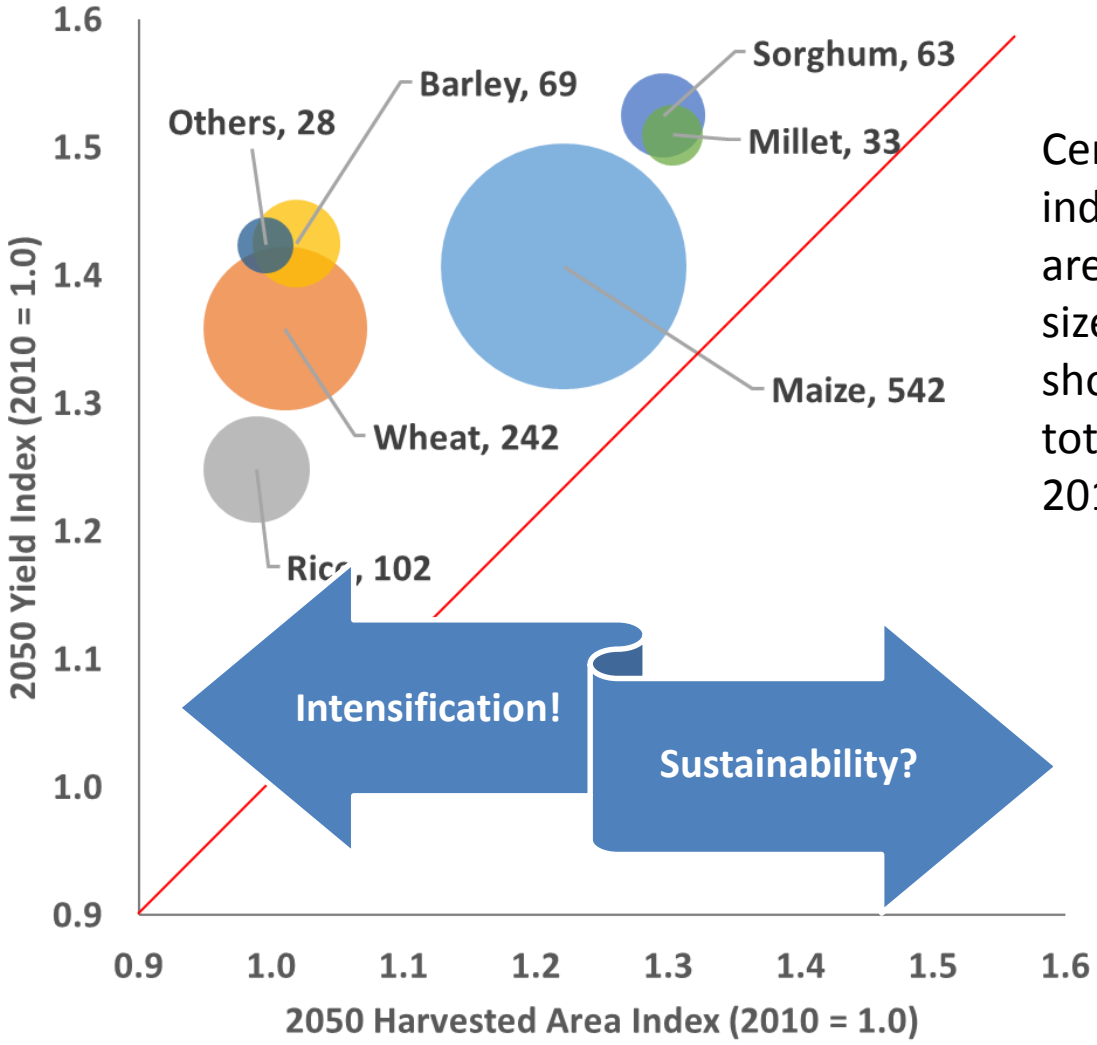
Source: IFPRI, IMPACT version 3.2, November 2015

SSP2 No Climate Change

Growth in global cereal production

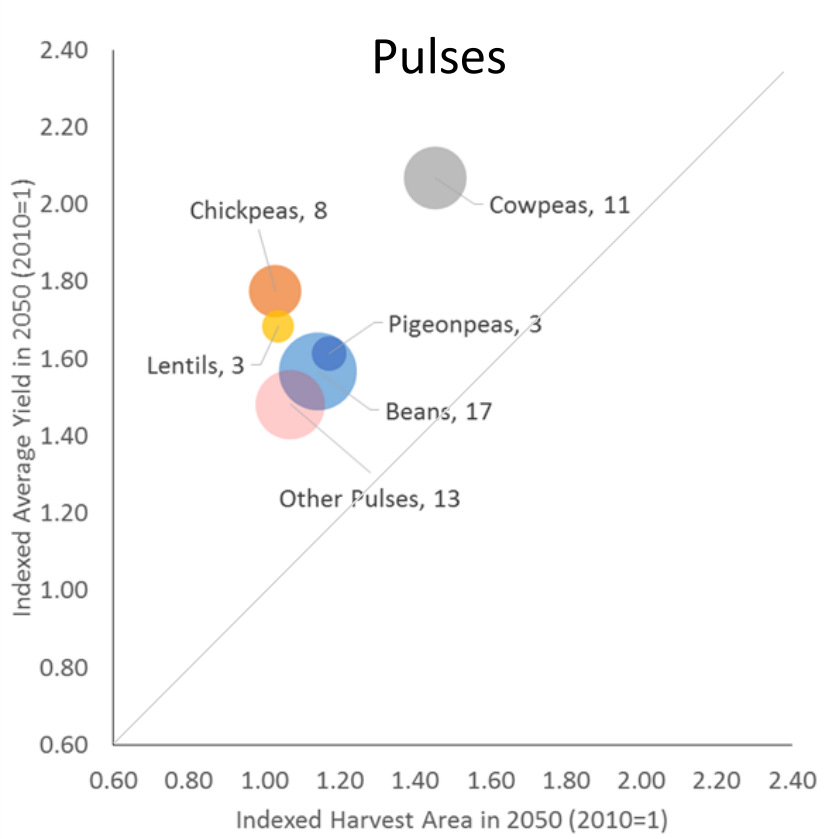


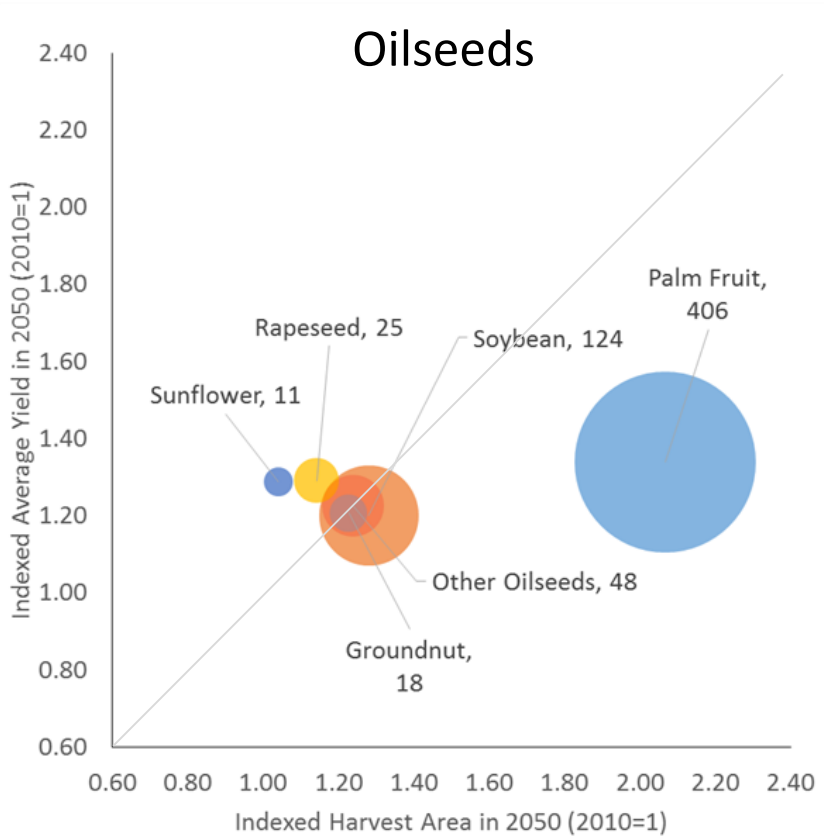
Center point shows index of change in areas and yields; size of bubbles show change in total production 2010-2050

Source: IFPRI, IMPACT version 3.2, November 2015

SSP2 No Climate Change

Growth in global production of pulses and oilseeds

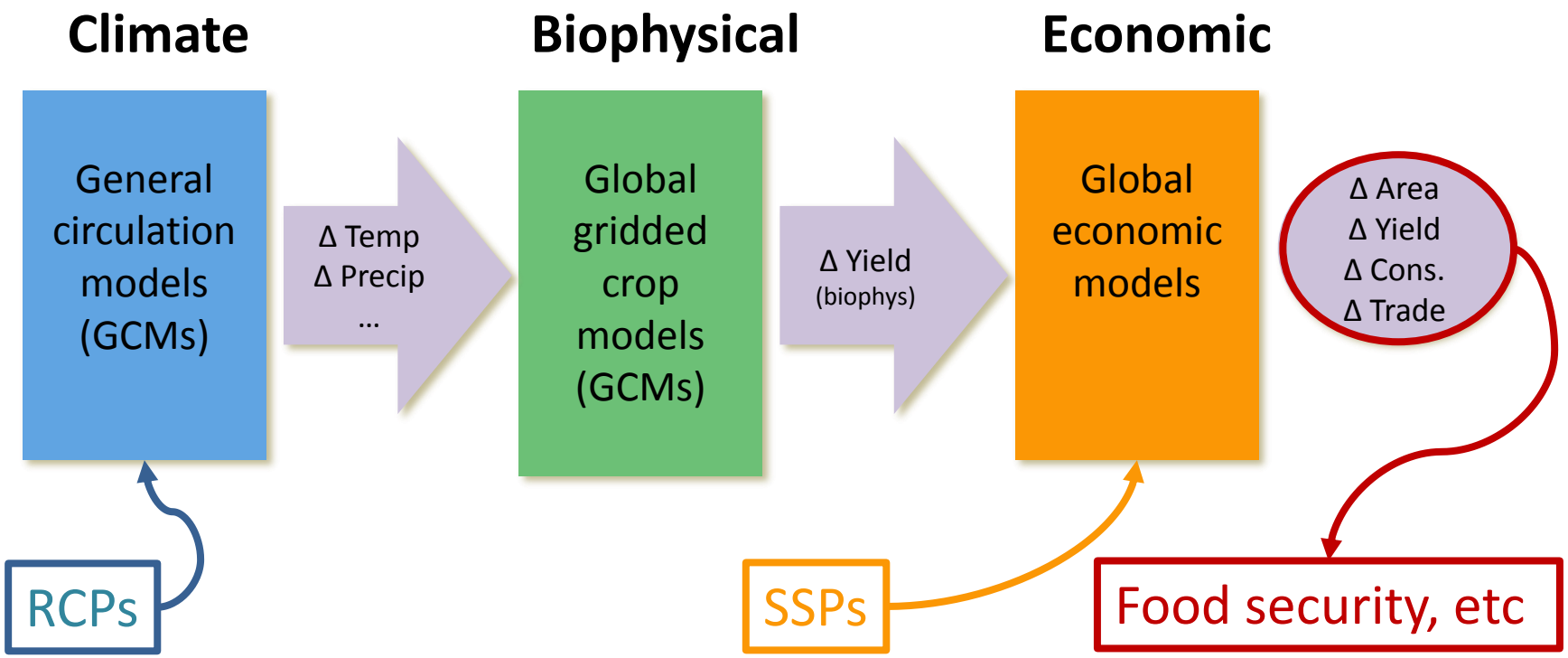




Source: IFPRI, IMPACT version 3.2, November 2015

SSP2 WITH Climate Change

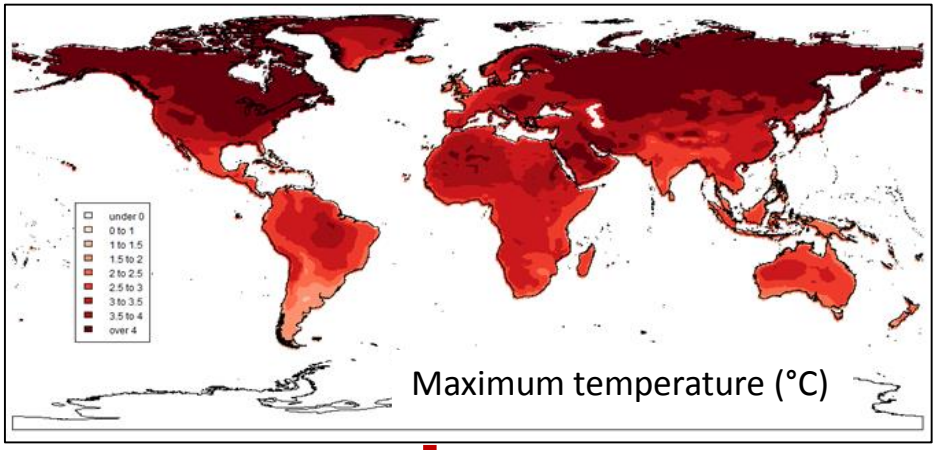
Modeling climate impacts on agriculture: biophysical and economic effects



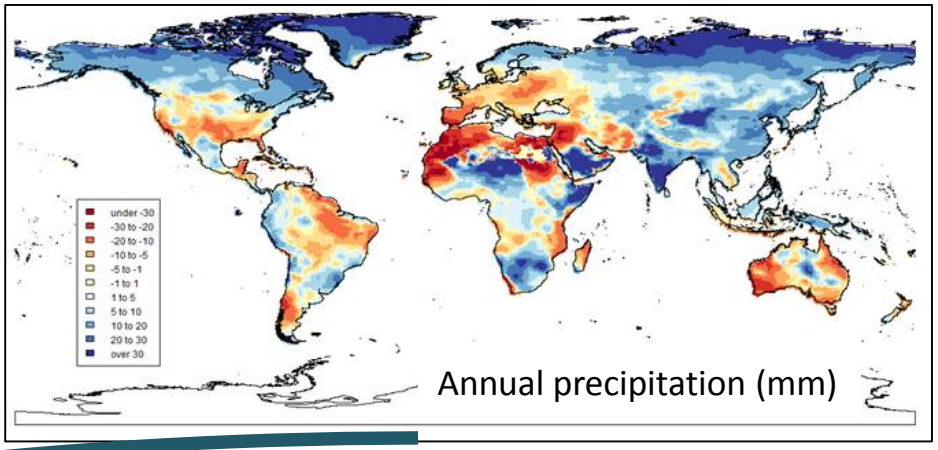
Adapted from Nelson et al., *Proceedings of the National Academy of Sciences* (2014)

SSP2 WITH Climate Change

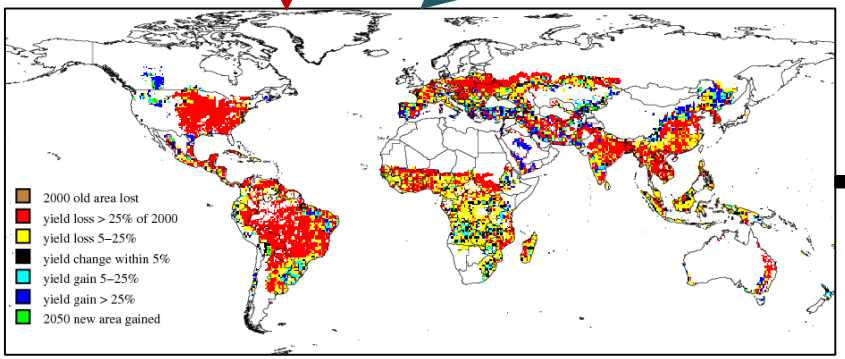
Maize yields example: HadGEM (RCP8.5) to DSSAT to IMPACT (SSP2)



Maximum temperature (°C)

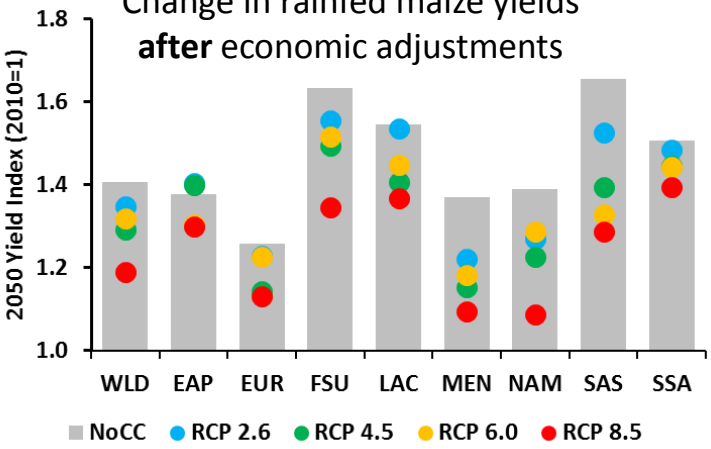


Annual precipitation (mm)



Change in rainfed maize yields **before** economic adjustments

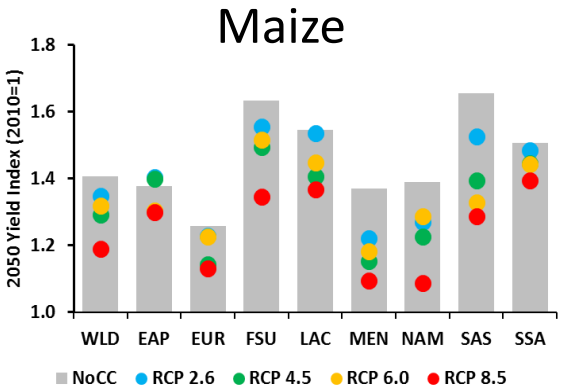
Change in rainfed maize yields **after** economic adjustments

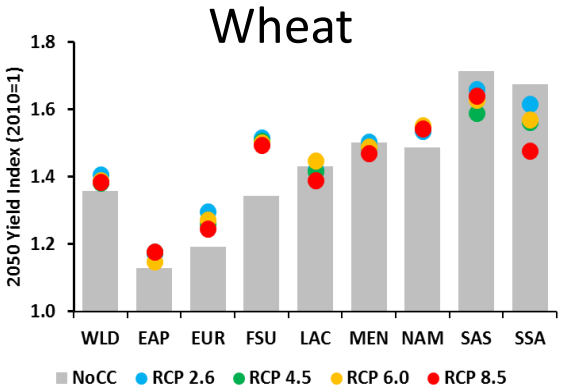


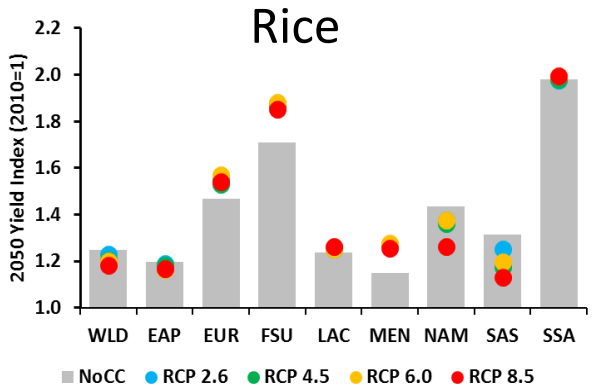
Source: IFPRI, IMPACT version 3.2, November 2015

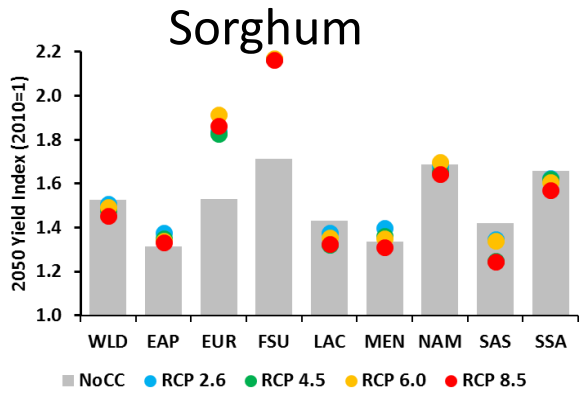
SSP2 WITH Climate Change

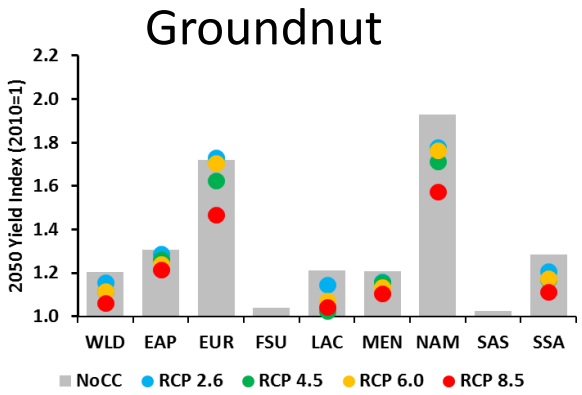
Climate change impacts on yields after economic responses











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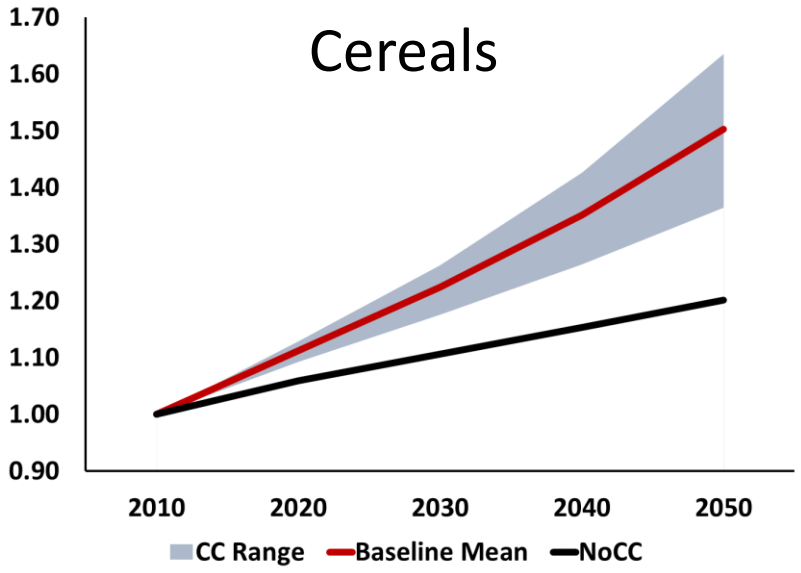
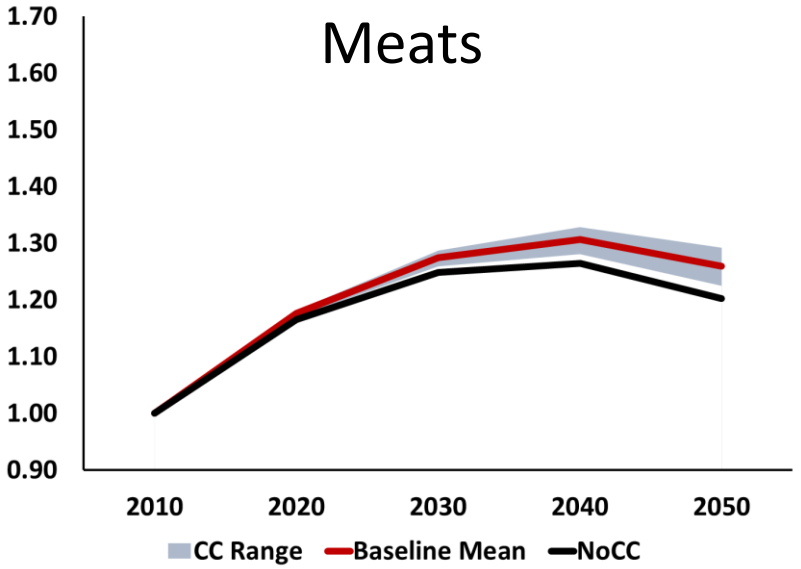
Source: IFPRI, IMPACT version 3.2, November 2015

SSP2 WITH Climate Change

Indexed Global Prices

- Cereals - most severe global impacts of climate change on prices: 25% increase compared to NoCC in 2050; 50% higher than 2010
- Meat - relatively modest 5% impact (indirect) of CC



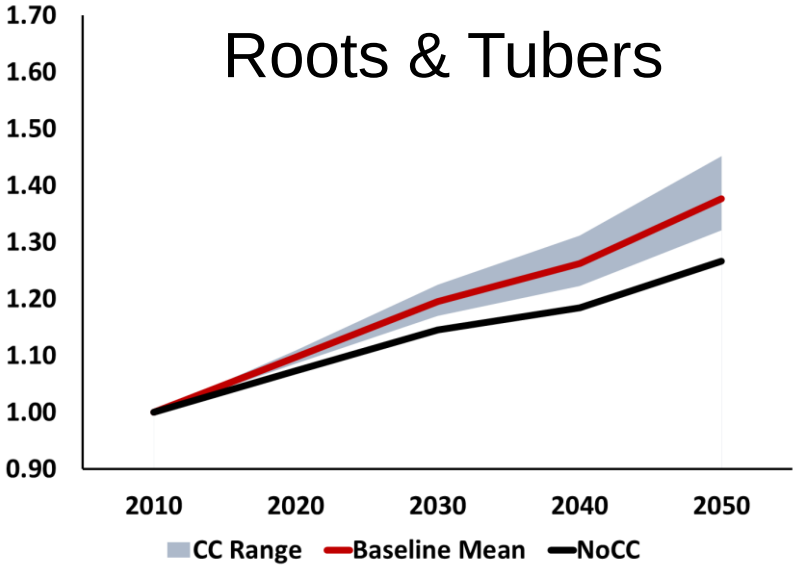


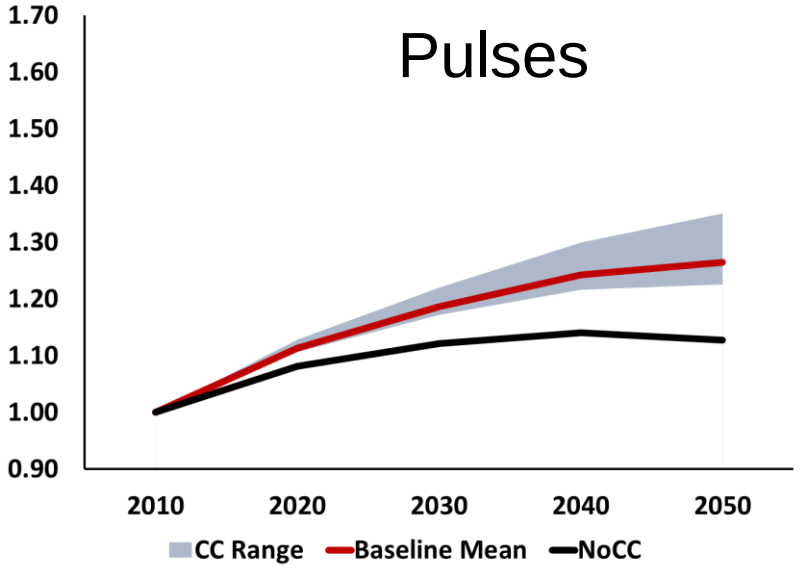
Source: IFPRI, IMPACT version 3.2, November 2015

SSP2 WITH Climate Change

Indexed Global Prices

- Fruits and vegetables, pulses, and roots and tubers: 9% to 12% increase with CC in 2050 (about 30% above 2010 levels)
- Importance of price changes depend on integration with world markets; Opportunity for exporters; Challenge for net





Source: IFPRI, IMPACT version 3.2, November 2015

Potential for Sustainable Intensification: Alternative Scenario Specification

- Building on previous work, current project aimed at evaluating the CGIAR research portfolio; focused on CGIAR
- Intensification scenarios
  - Investments in agricultural research and development (R&D)
  - Improvement in agriculture water management
  - Changes in postharvest losses and agricultural marketing
  - A comprehensive scenario combining elements of above three
- All 15 CGIAR Centers involved through GFSF
  - AfricaRice, Bioversity, CIAT, CIFOR, CIMMYT, CIP, ICARDA, ICRAF, ICRISAT, IFPRI, IITA, ILRI, IRRI, IWMI, WorldFish

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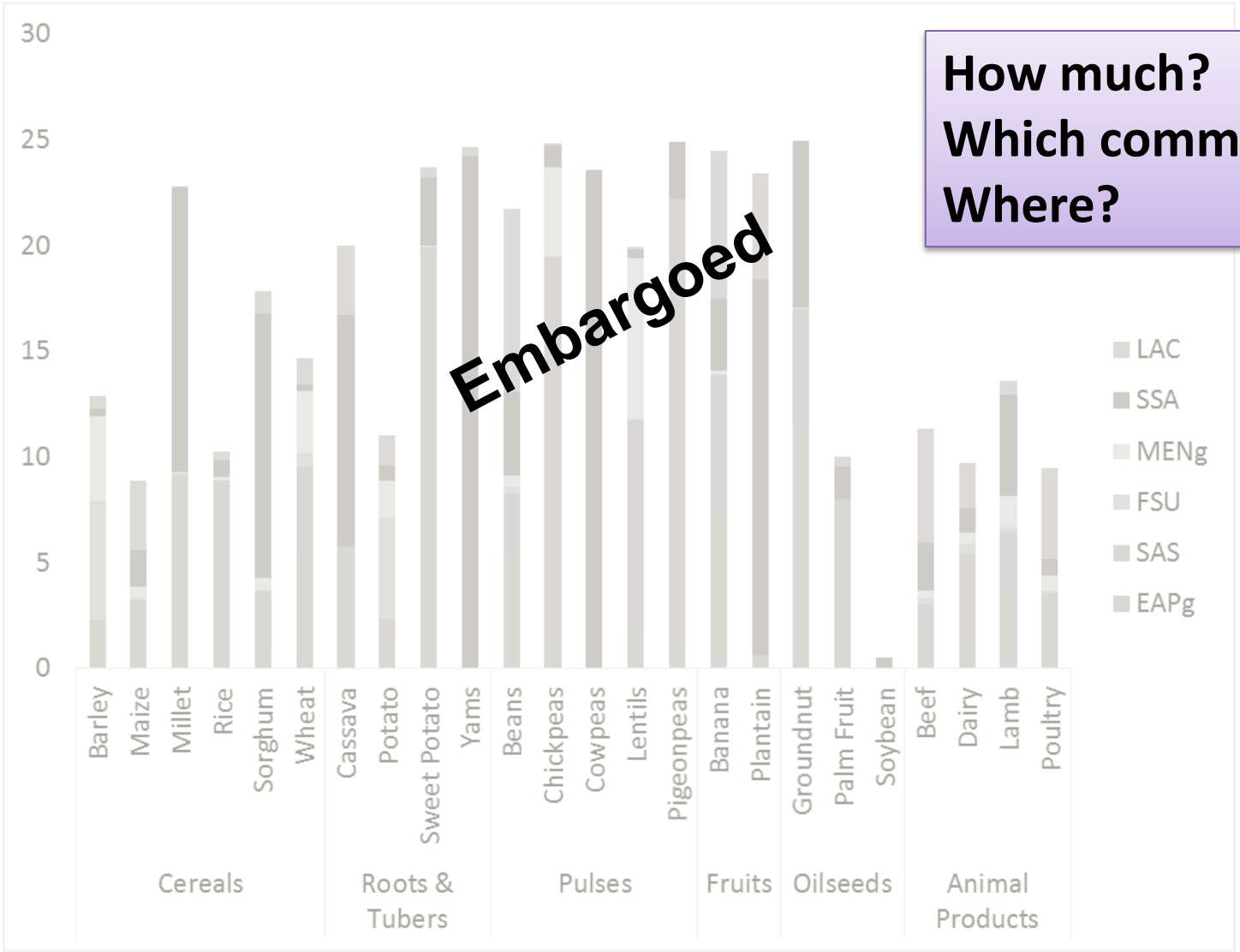
Alternative Scenario Specification



Potential for Sustainable Intensification

Scenario	Avg. Annual Cost	2030						2050					
		SLO1	SLO2		SLO3			SLO1	SLO2		SLO3		
		GDP	Ag Supply	Hunger	Water Use	GHG	Forest	GDP	Ag Supply	Hunger	Water Use	GHG	Forest
MED	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	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	-1	0.06	4.2	7.5	-20.0	-0.4	-26.9	0.22
REGION	2.5	1.1	2.4	-10.9	-0	-6.5	0.03	3.1	5.1	-15.4	-0.3	-22.6	0.18
IX	3.6	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	8.3	0.4	0.9	-3.1	-7.2	-1.9	0.01	0.5	0.9	-2.7	-7.5	-0.2	-0.01
ISW	5.0	0.2	0.5	-2.1	-1.5	-0.5	0.00	0.5	0.9	-3.0	-2.9	-1.1	0.01
RPHL	11.9	2.4	4.9	-16.6	-0.3	-5.5	-0.02	3.0	4.8	-12.1	-0.5	-15.7	0.07
RMM	11.9	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	26.4	4.1	9.8	-30.6	-9.0	-11.5	0.07	5.7	11.5	-24.4	-11.0	-25.4	0.22

Embargoed

- System Level Outcomes (SLOs) align and overlap with SDGs (but not precisely the same)
- Using indicators where the modeling is most robust
- Tradeoffs obvious among different types of investments, the comprehensive scenario (COMP) achieves the best outcome

Conclusion

- Many opportunities to address SDGs, but it requires a more comprehensive approach that recognizes that these types of outcomes are intertwined and part of a complex system (agricultural diversity is one solid block of this mosaic)
- A key element from IFPRI's perspective is the need for solid data and science to back up policy recommendations
  - From the quantitative modeling perspective (ie, the IMPACT model), we really need to extend our capabilities to work with disaggregated fruits and vegetables given the VERY high demand for analysis of nutrition and health outcomes
  - Cash crops are also critical production alternatives to consider with respect to their key role in household income and livelihoods
  - Gender dimension is crucial to have included in the research/extension activities from the very beginning planning stages

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