INTERNATIONAL TRADE IS CRITICAL TO UNDERSTANDING GLOBAL SUSTAINABILITY

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Presented to a Farm Foundation Workshop

Chicago, Illinois

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Outline of the Talk

- Economic principles and limitations
- Insights from the recent literature on trade and sustainability
- A framework for thinking about future developments in trade and sustainability

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‘First-best’ Economics View of Trade and Sustainability

- Free and fluid trade encourages production to locate where use of resources is most efficient
- This allows consumer demands to be met with the least burden on the planet’s finite resources

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But we don’t live in a First-Best world

- Market failures such as:
  - Insecure land tenure
  - Un-priced externalities (e.g., nitrate leaching)
  - Lack of protection for biodiversity
- In the presence of market failures, international trade can either mitigate or amplify environmental damages

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Over past decade, interest in trade-sustainability linkages has exploded

- Land use ‘leakage’ and ‘spillovers’
- ‘Virtual trade’ in water
- ‘Telecoupling’ of ecological phenomena
- Demand for ‘deforestation-free’ commodities

Many opportunities for trade economists to collaborate with ecologists, climate scientists, hydrologists, and agronomists – I will *explore some of the recent findings*

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Insight #1: Analyses of global resource use that ignore economic responses to scarcity risk overstating global land use change

- Historical perspective:
  - Over 1961-2006 period, crop production tripled but global land use expanded by only about 15% (FAO)
  - Over 2000-2050 period, crop production is predicted to double, but many studies suggest much higher rates of land conversion
- Why the difference? Biophysical analyses ignore the response of consumers and producers to scarcity – these price responses act as a ‘shock absorber’ when transmitting demand growth to land use (Hertel, 2011)
- If ignore economic responses, predictions of historical land conversion over 1961-2006 grows to more than 40% (Baldos and Hertel, 2013)

Insight #2: International trade can generate unanticipated land use spillovers

- In 2006, ethanol was found to be a win-win solution to environment-economic challenges (Farrell et al, *Science*)
- However, in 2008, potential displacement of land had entered the debate – could ethanol program actually lead to global environmental degradation? (Searchinger et al., *Science*)
- Subsequent work has identified chain of 'market-mediated responses' to biofuels (Hertel et al., *BioScience*)

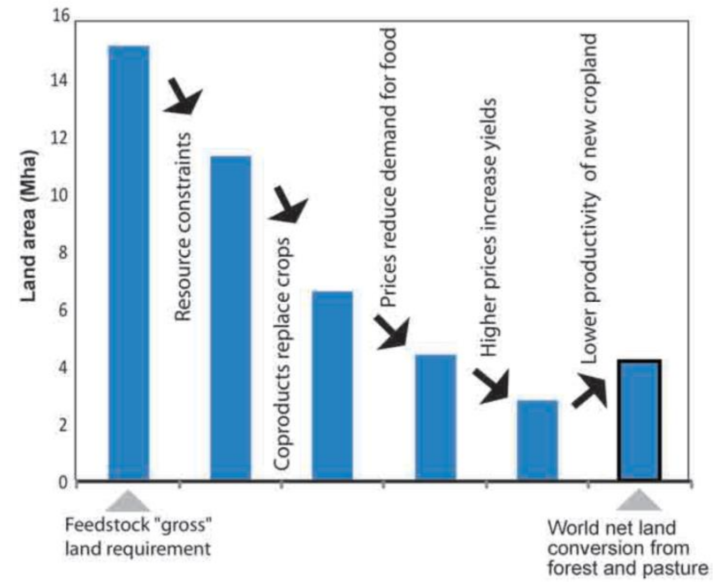
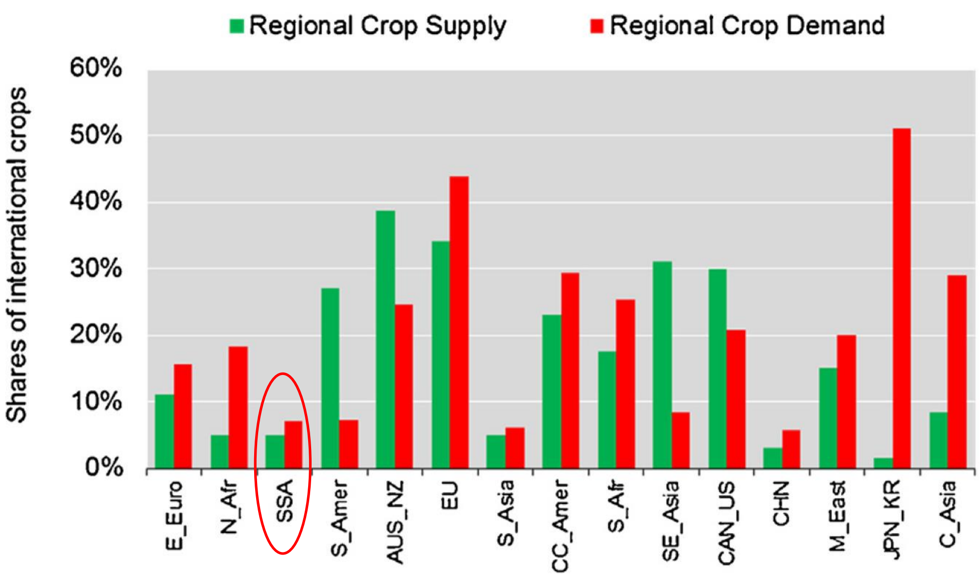


Figure 2. Market-mediated reduction in global cropland conversion from additional 50.15 gigaliters (GL) per year of maize ethanol production (millions of hectares [Mha], based on 2001 yields).

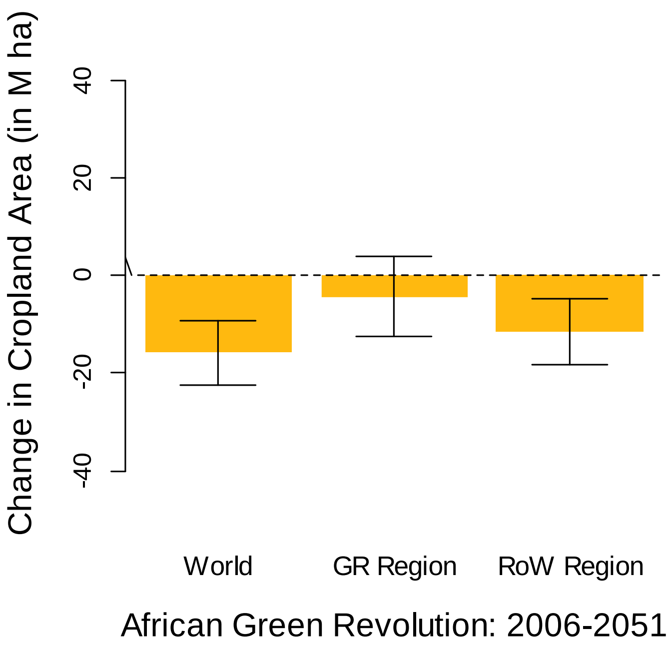
Insight #3: Environmental impact of new agr technologies may hinge on trade

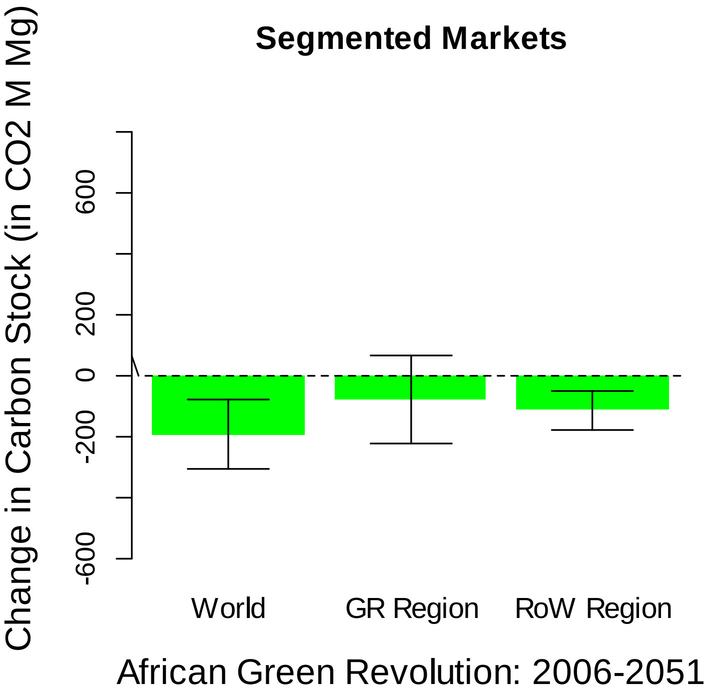
- Evidence suggests that the historical Green Revolution (GR) spared land and reduced carbon emissions (Stevenson et al., PNAS)
- However, the impacts of a prospective African GR will hinge on the degree to which agricultural markets on the continent are *integrated into the international trading system*
- Historically African markets have been *segmented*



Insight #3: Environmental impact of new agr technologies may hinge on trade

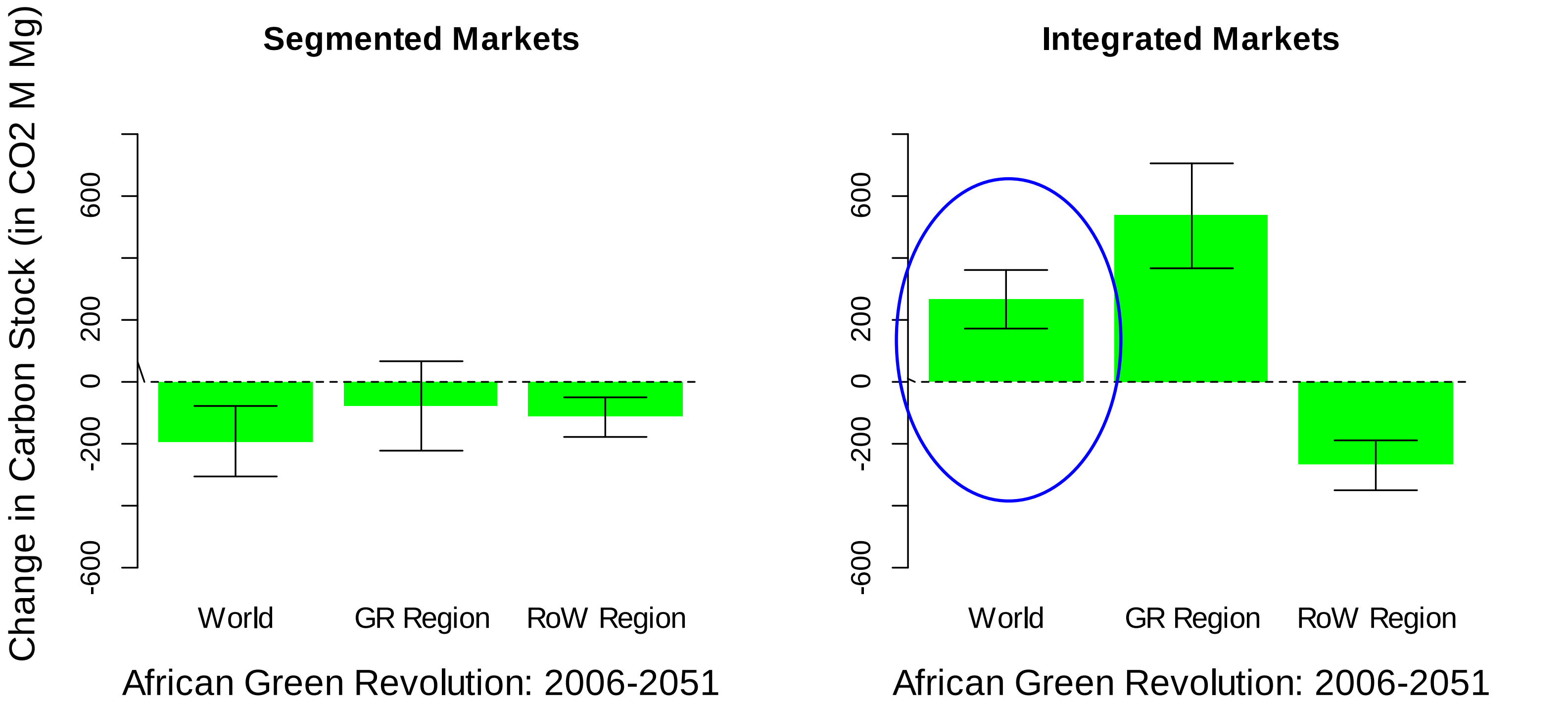
- In the presence of *historically segmented markets*, a GR on a par with the Asian GR would reduce land use globally and also mitigate the growth in land-based carbon emissions





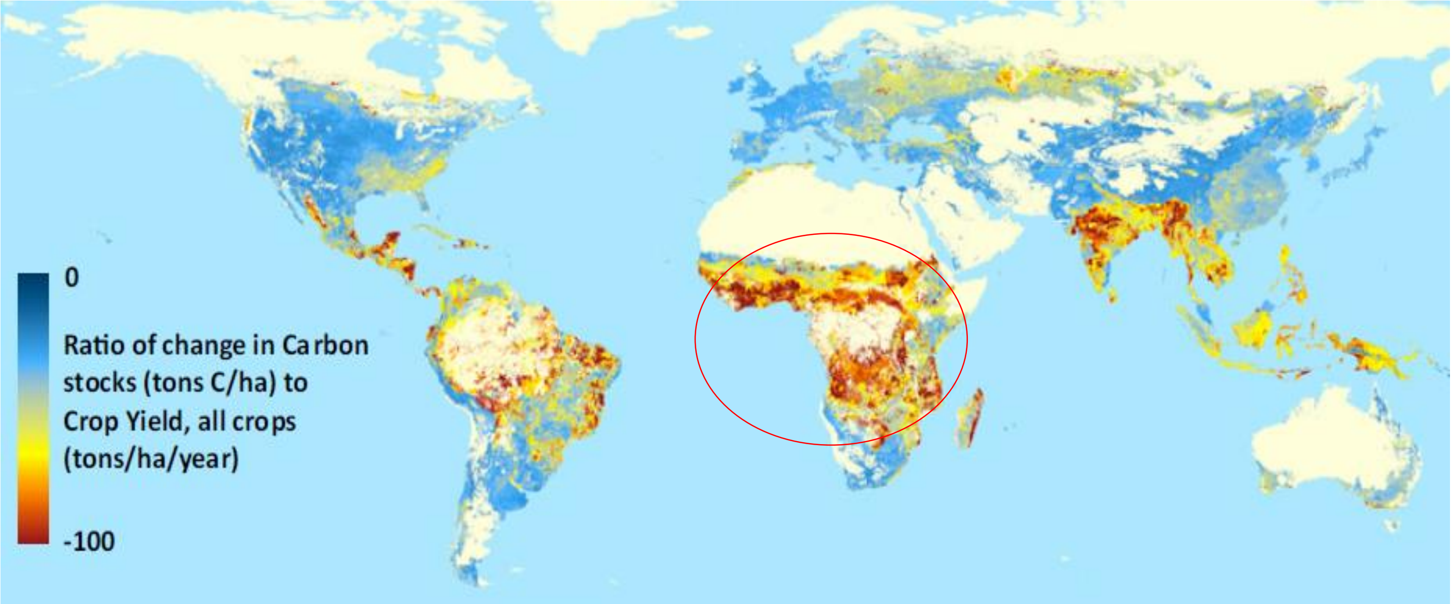
Insight #3: Environmental impact of new agr technologies may hinge on trade

- However, if SSA is fully integrated into world markets, the environmental impact of an African GR could be quite different; increasing carbon emissions (Hertel et al., PNAS)



What is behind this outcome?

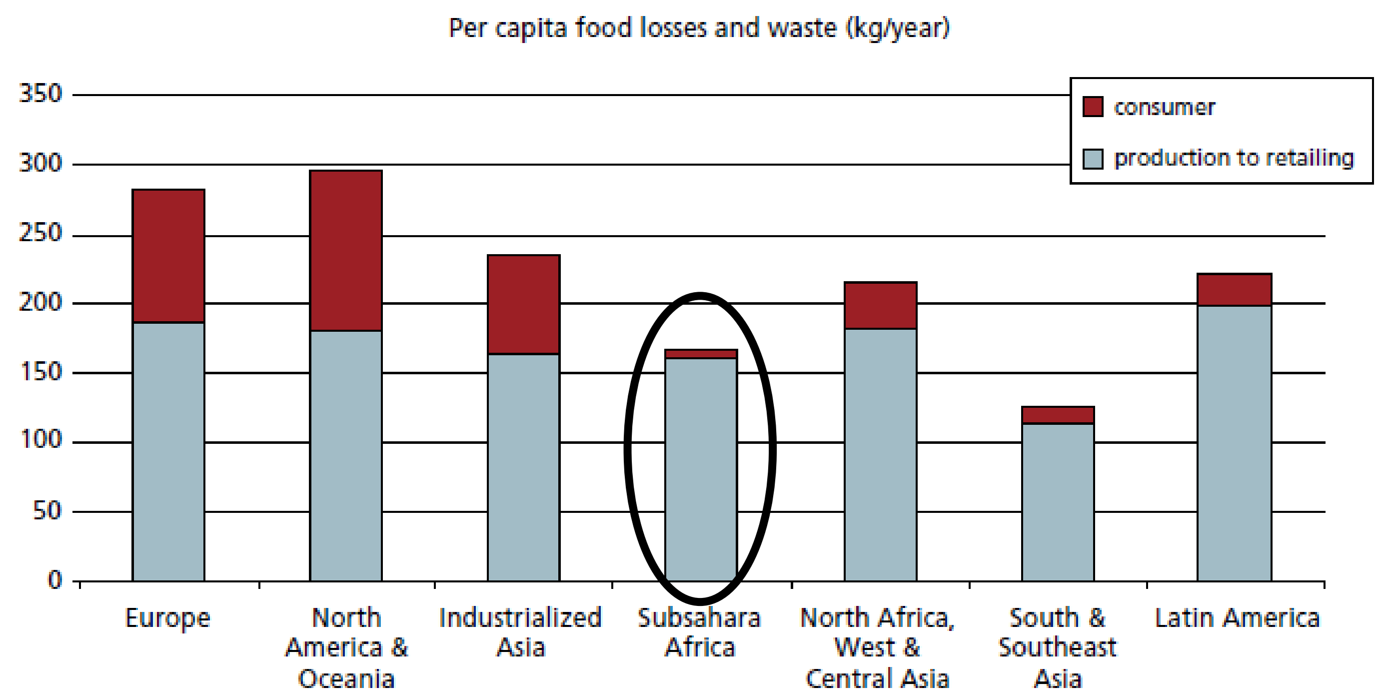
- The SSA region is relatively *carbon-rich*, but exhibits relatively *low crop yields*. When agriculture in this region expands, and carbon-rich regions remain unprotected, global emissions rise, even though emissions in the rest of the world fall
- To overcome this perverse outcome, *it is critical to protect carbon -- and biodiversity -- rich regions*



Source: West et al. PNAS (2010)

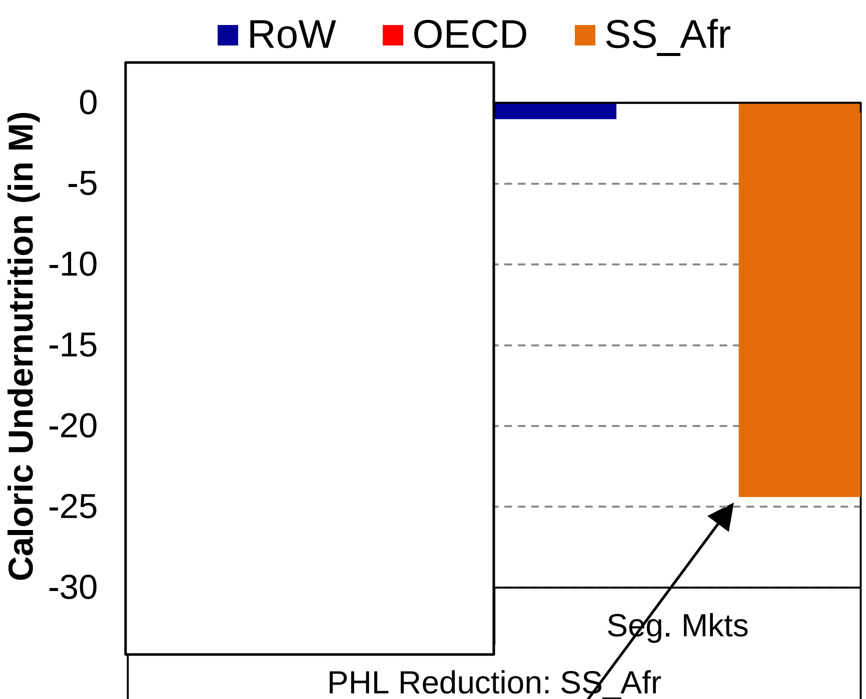
Insight #4: Impact of reducing post-harvest losses (PHL) in Africa also hinges on trade

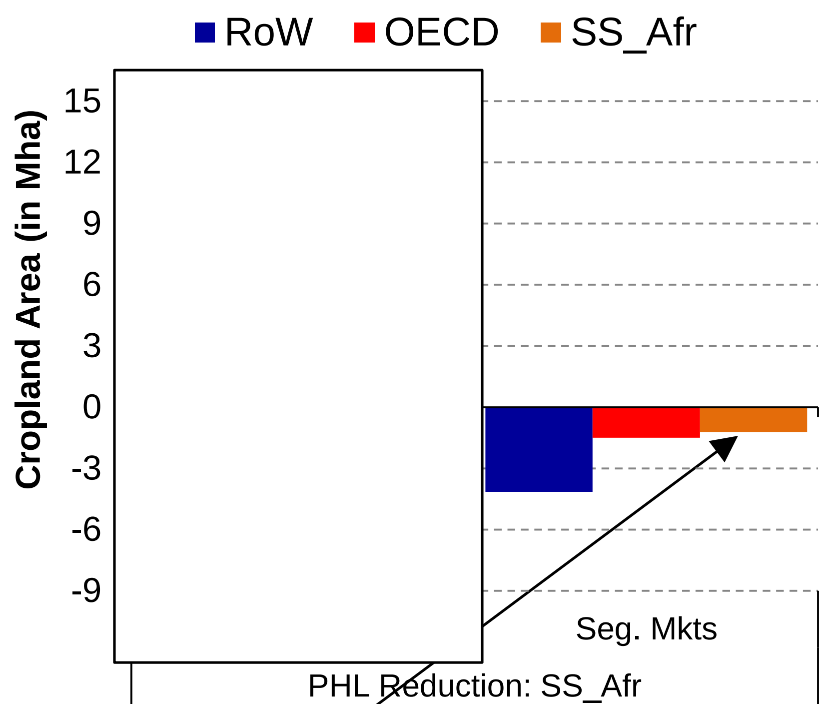
Figure 2. Per capita food losses and waste, at consumption and pre-consumptions stages, in different regions



Examine impact of reducing PHL in SS Africa to the level in Latin America (18%) – so that, at current input levels, 10% more reaches the market

Impact of reducing PHL in SSA: *Segmented Markets*

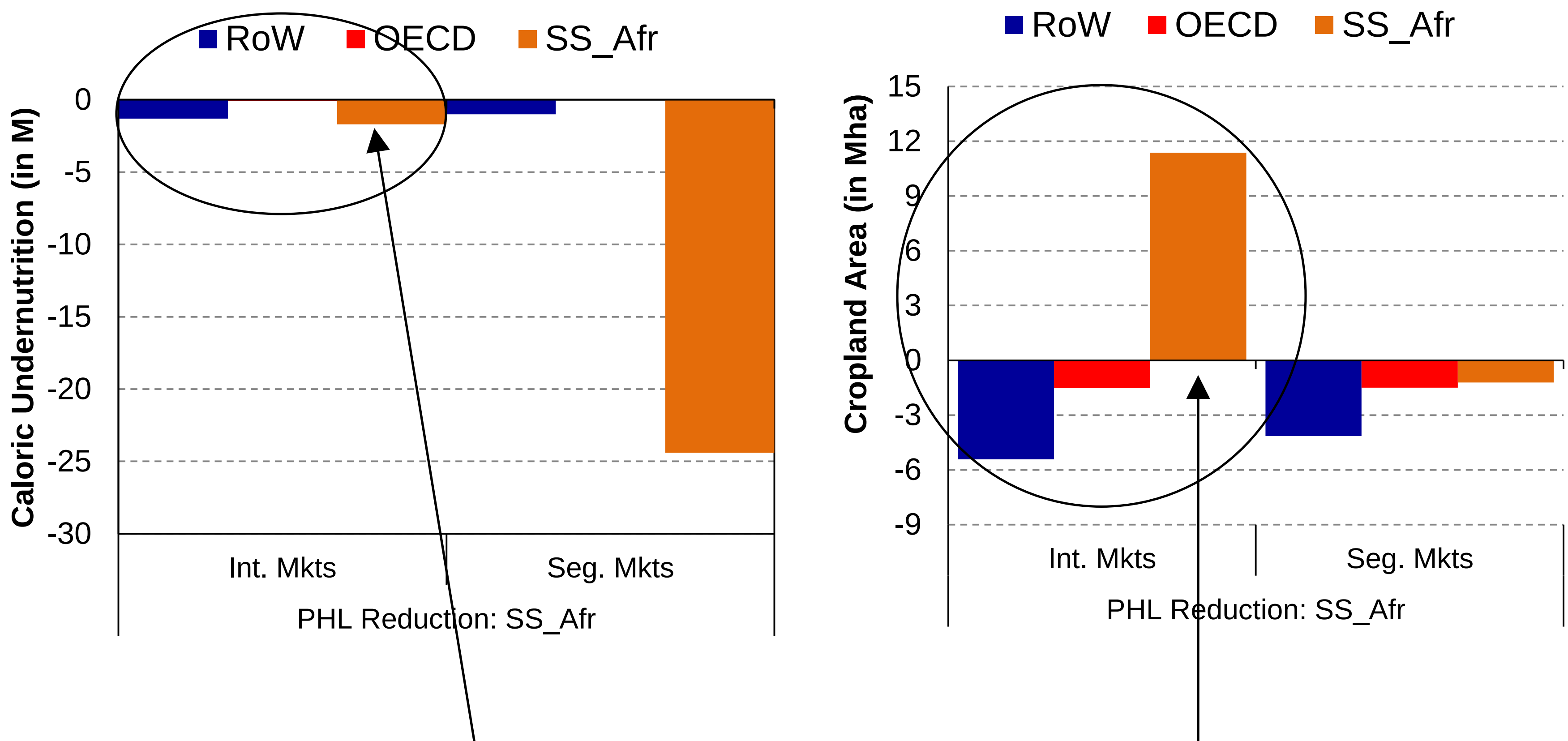




Under ***segmented markets*** SSA prices fall sharply with PHL reduction, non-farm under-nutrition drops and cropland area shrinks

Source: Hertel and Baldos (2016)

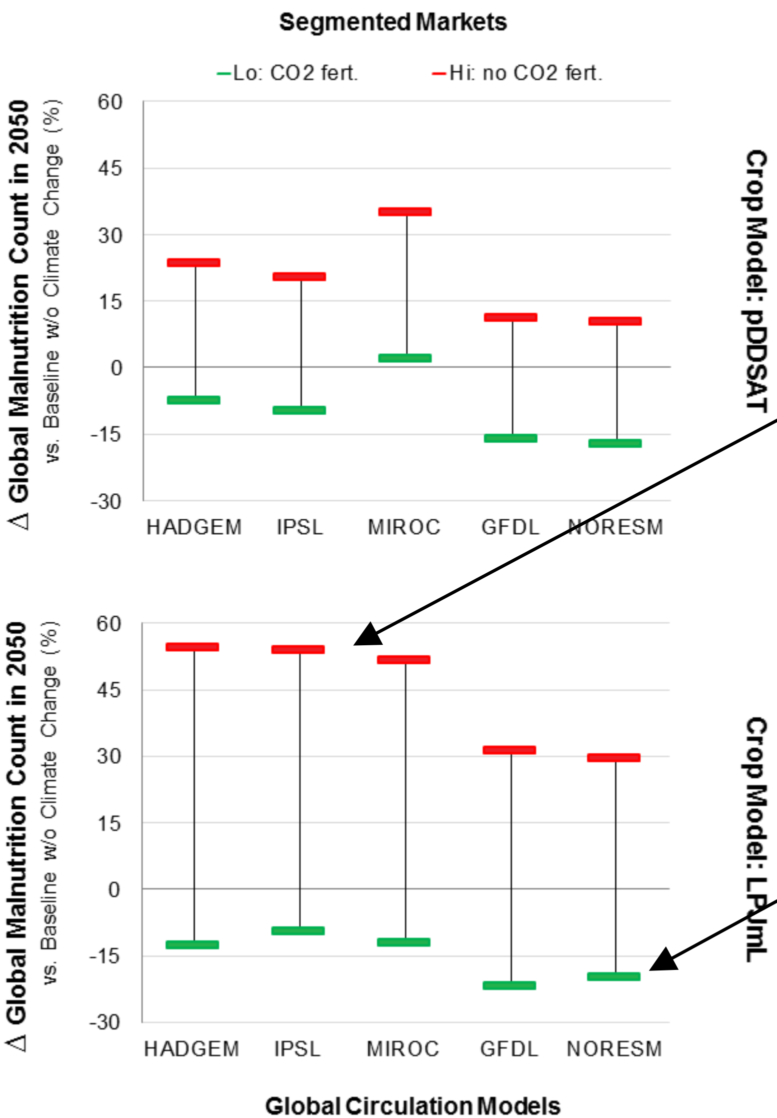
Impact of reducing PHL in SSA: *Integrated Markets*



Under ***integrated markets*** SSA prices barely fall, malnutrition drops very little and *cropland area expands strongly; terrestrial carbon fluxes rise*

Source: Hertel and Baldos (2016)

Insight #5: Trade can provide insurance against worst-case climate impact scenarios



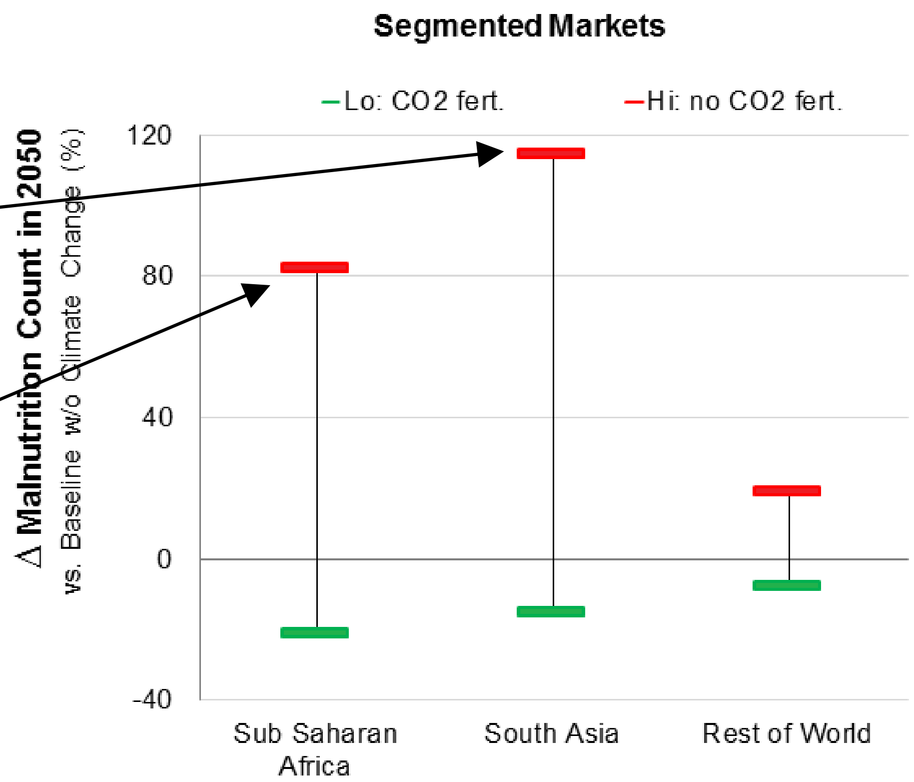
- Worst case CC scenario boosts global undernutrition in 2050 – possibly by as much as 50%, relative to baseline;
- Some climate/crop model combos result in slight improvements in yields in 2050, relative to baseline – lots of uncertainty remains

Source: Baldos and Hertel (2015)

Impact of LR climate change on regional undernutrition:

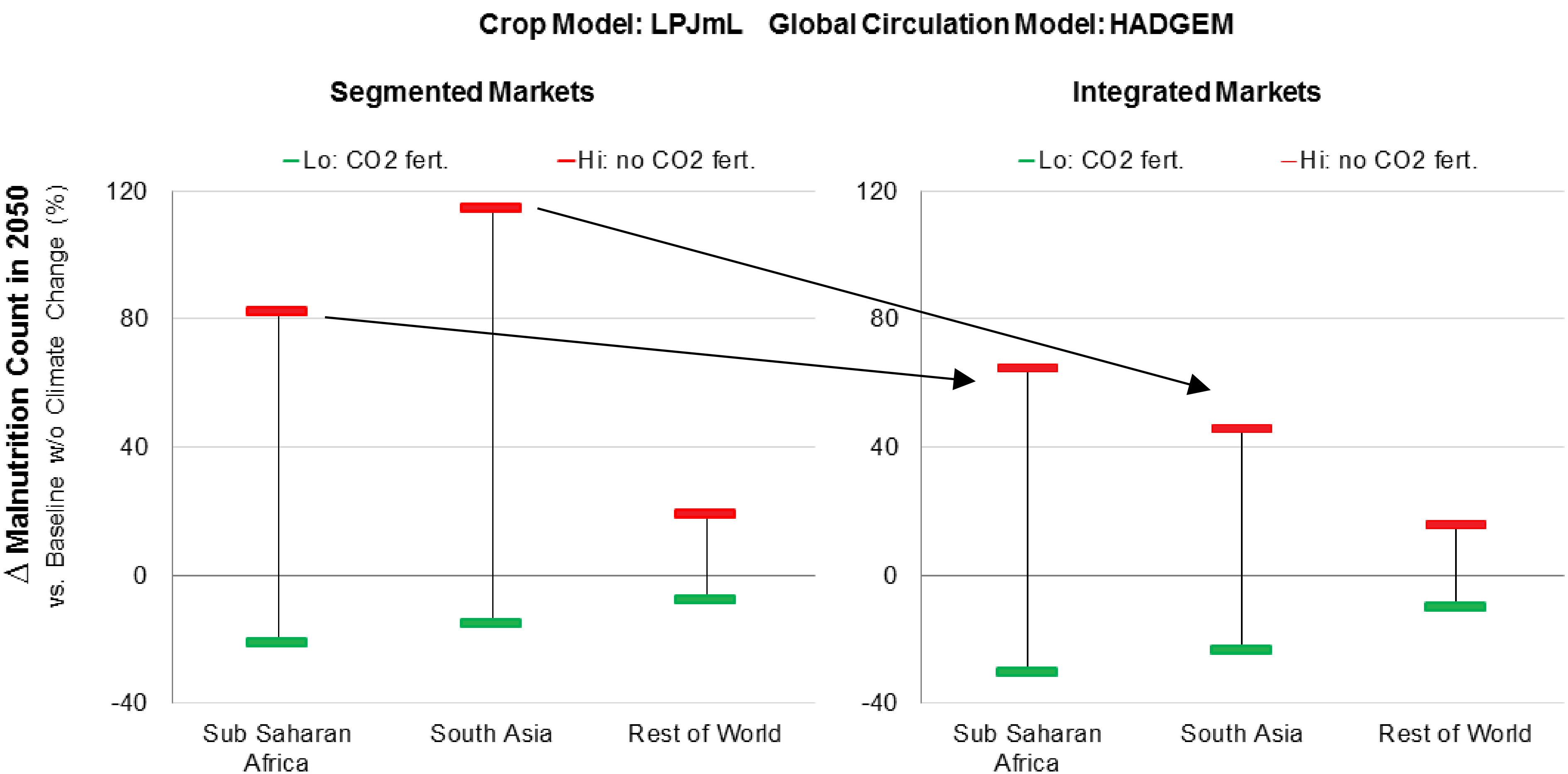
HADGEM/LPJmL model combo only

- Greatest potential for adverse impacts in South Asia (up to 120% rise in malnutrition, relative to the 2050 baseline)
- Sub Saharan Africa, maximum rise is 80%; smaller in Rest of World



Source: Baldos and Hertel (2015)

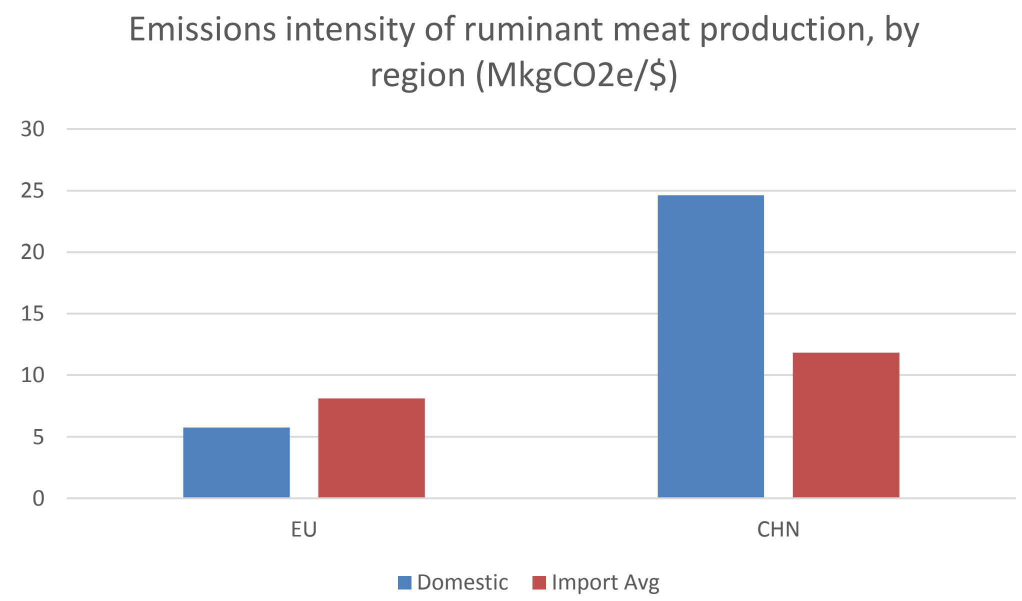
Insight #5: Trade can provide insurance against worst-case climate impact scenarios



Source: Baldos and Hertel (2015)

Insight #6: Consuming local foods may not reduce your carbon footprint

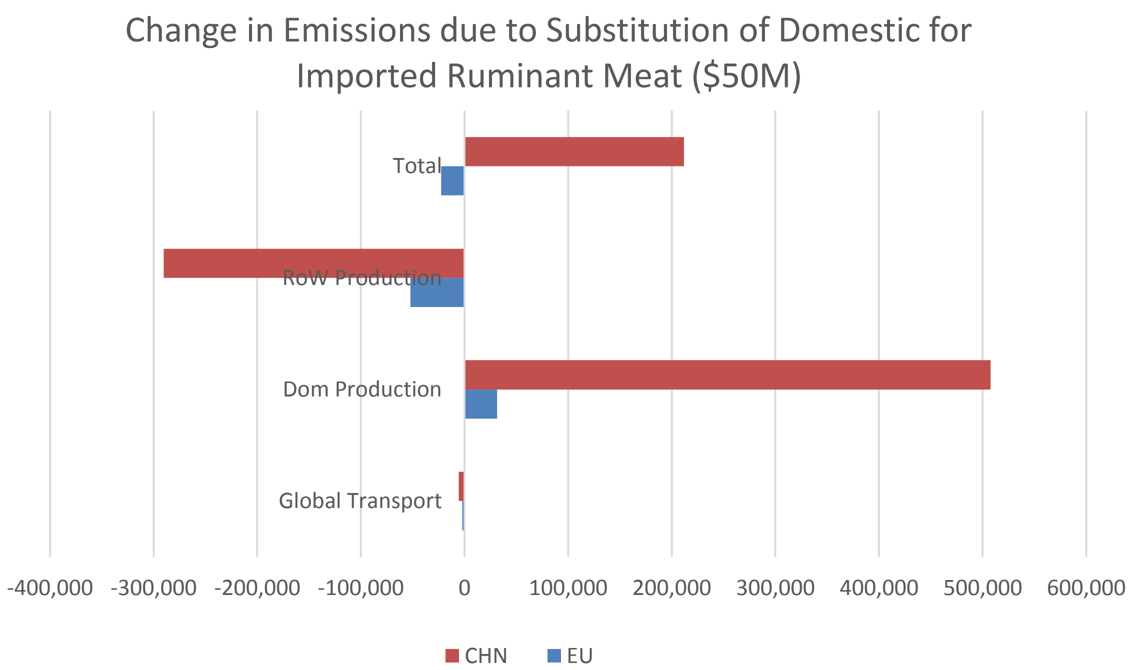
- Popular perception is that consuming locally produced foods will reduce GHG emissions since reduces 'food miles'
- Reduction in transportation costs and emissions is valuable
- However, for many products, these emissions are dwarfed by the emissions associated with agricultural production, which vary greatly by region



Source: Avetisyan et al. (2014)

Insight #6: Consuming local foods may not reduce your carbon footprint

- In EU, consuming locally produced ruminant meats does reduce total emissions; they import more emissions-intensive products
- However, relatively high emissions intensity in China means shifting to local consumption raises global emissions sharply
- Transport-related emissions fall but change is relatively small



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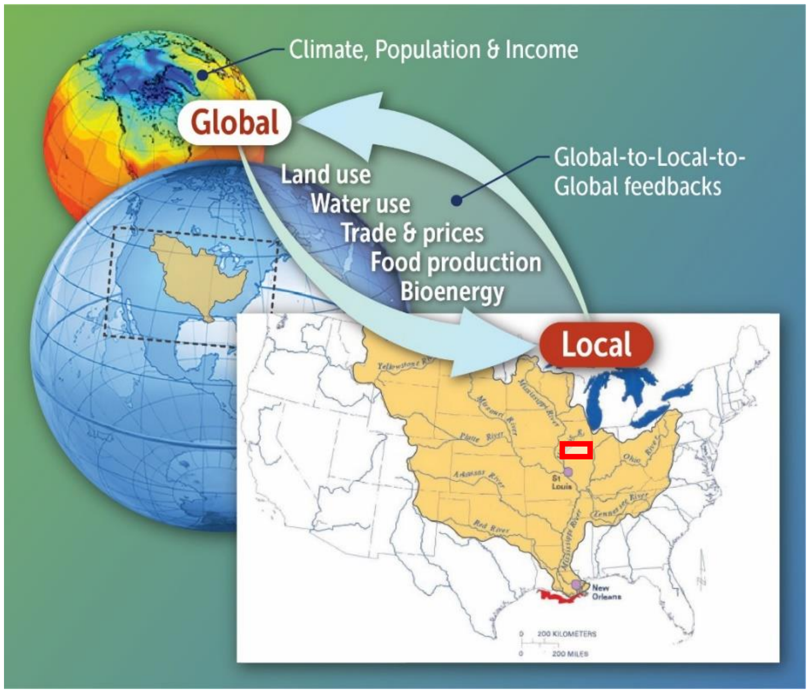
GLASS: A Framework for thinking about trade and sustainability



- Recognizes that Global Forces are often behind Sustainability Stresses
- Yet these Stresses are typically highly localized; vary according to soils, water availability, climate and institutions
- And local responses to Sustainability Stresses can have regional, national and global consequences; need to capture these feedbacks
- Hence the *Global-Local-Global* framework

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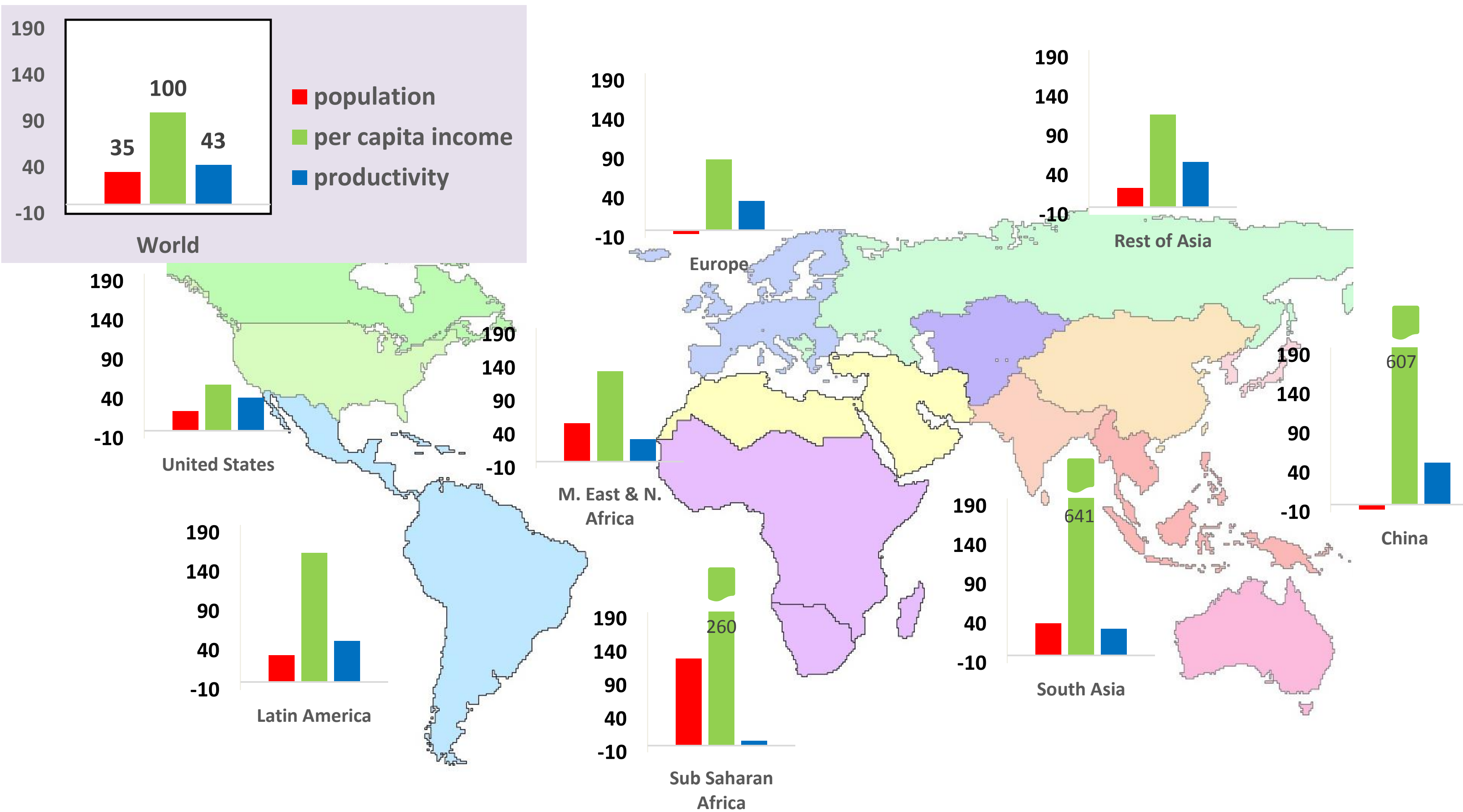
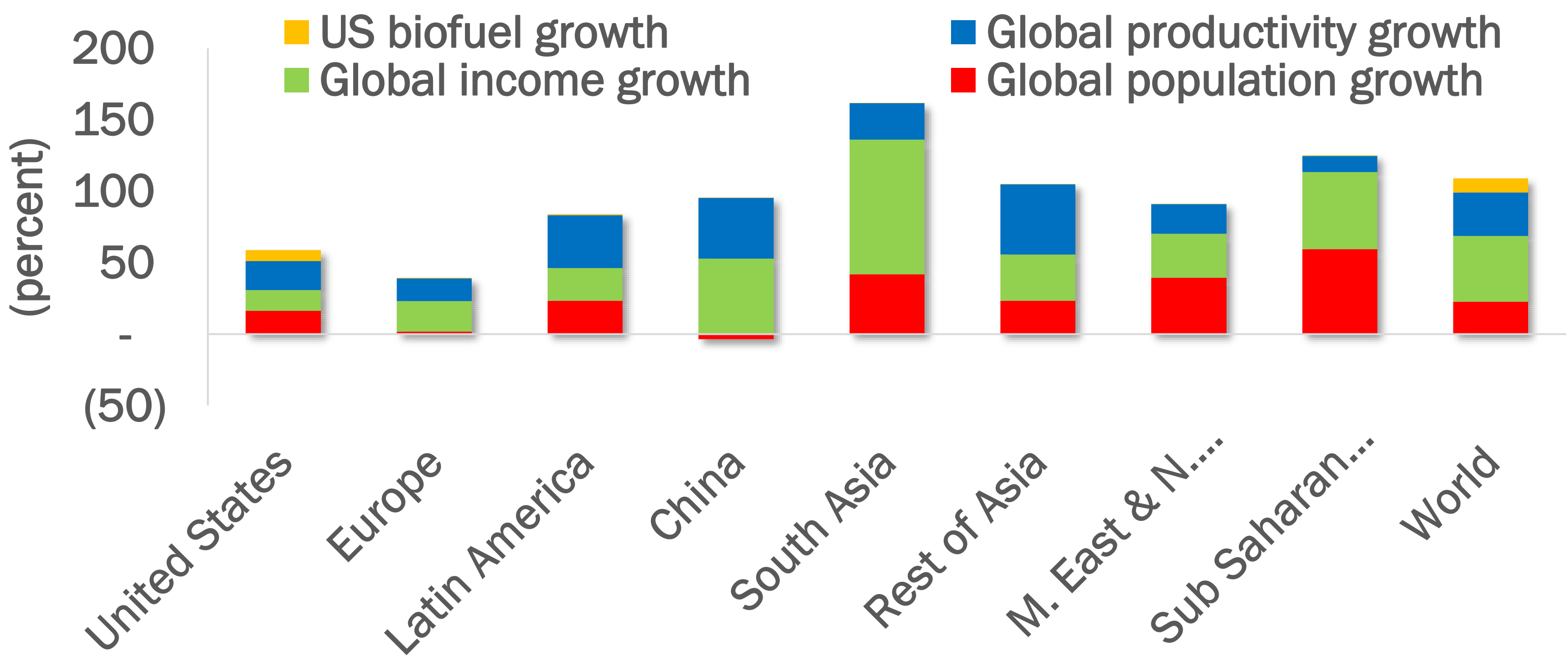
Global Change Drivers: Population, income, and productivity growth by 2050



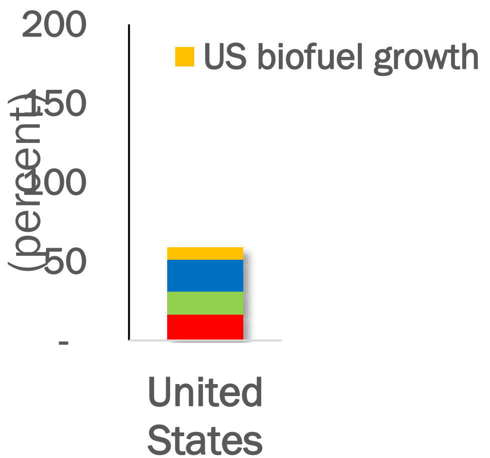
Haqiqi, et al., 2018

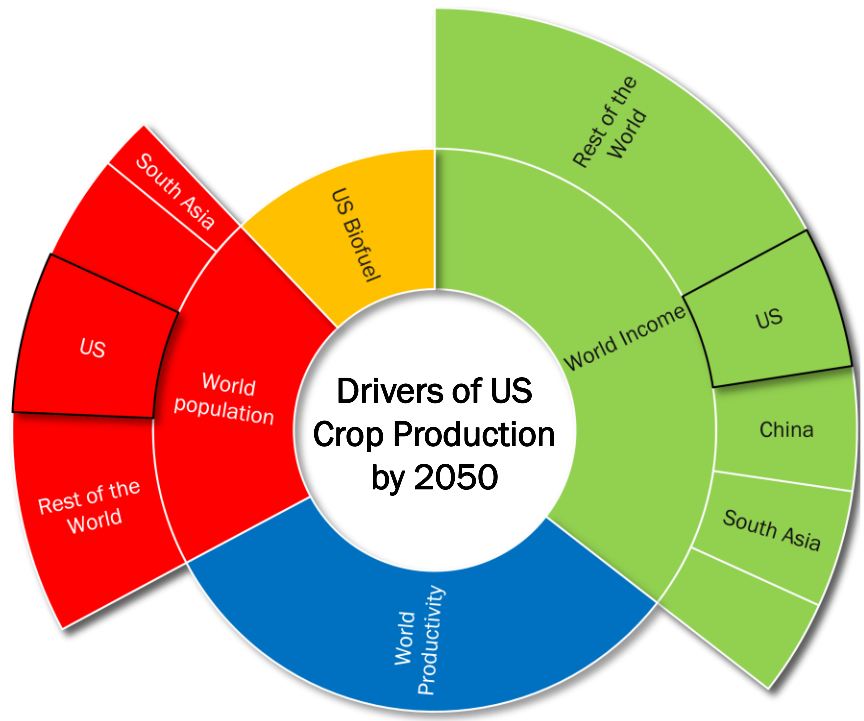
Projected crop production change by 2050 (percentage change from 2010)



Haqiqi, et al., 2018

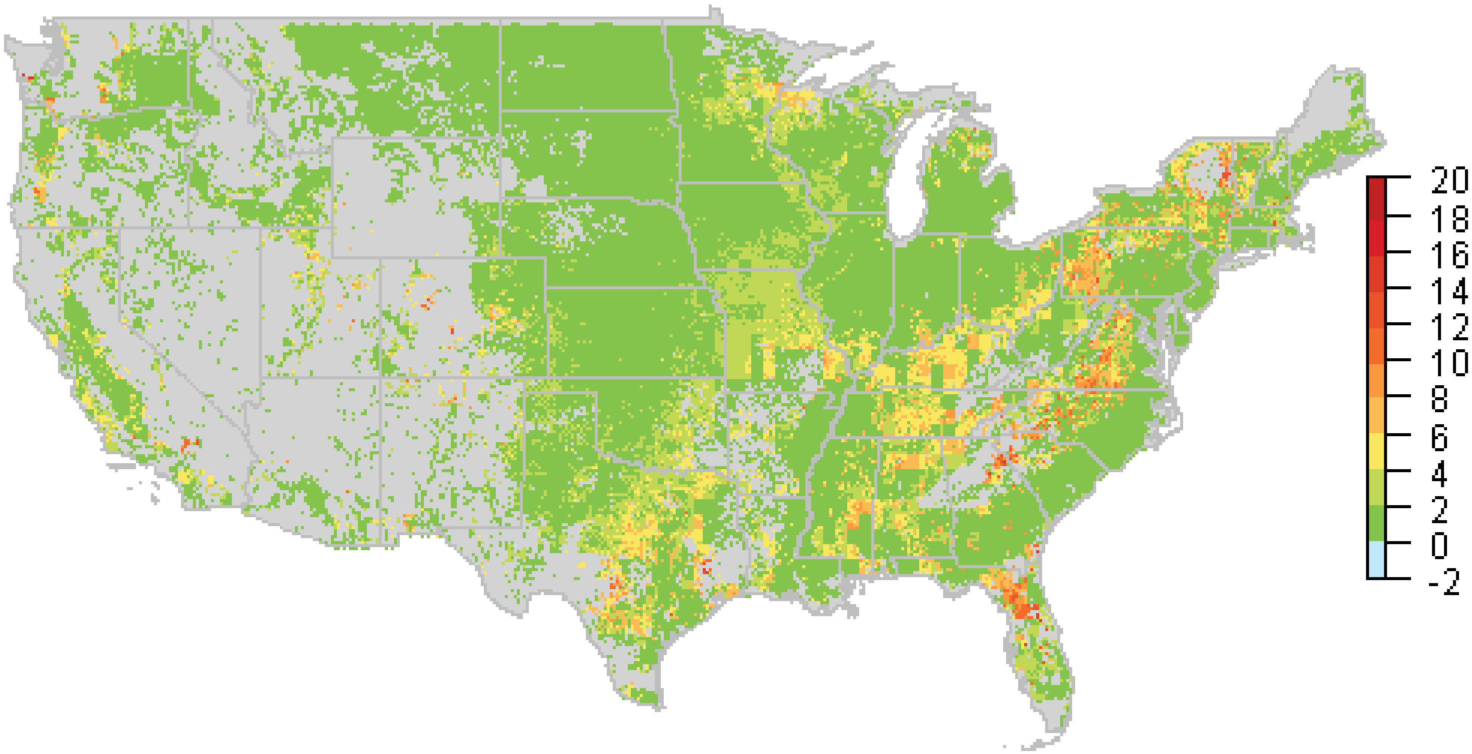
Global drivers of US crop output are more important than US drivers of US output: 2010-2050 (percentage change)





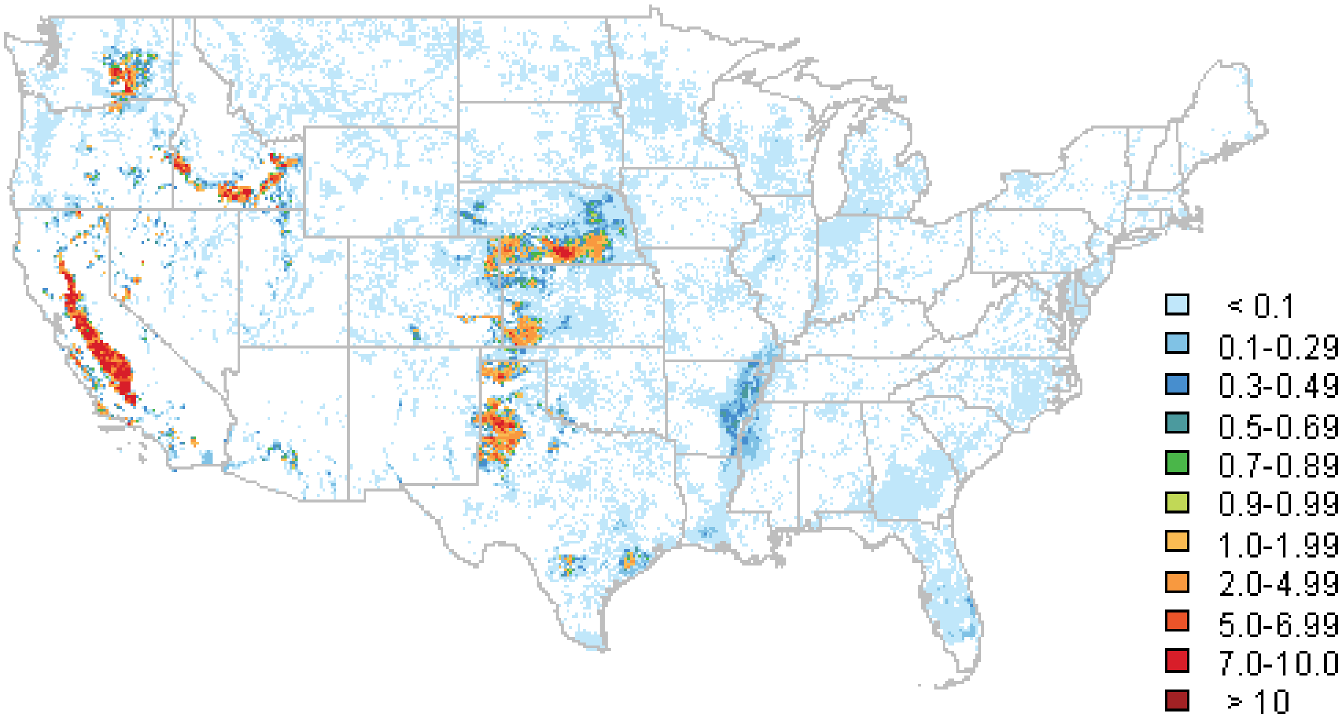
Haqiqi, et al., 2018

Greatest cropland change stress in marginal areas: Projected *% change* in cropland from 2010 to 2050



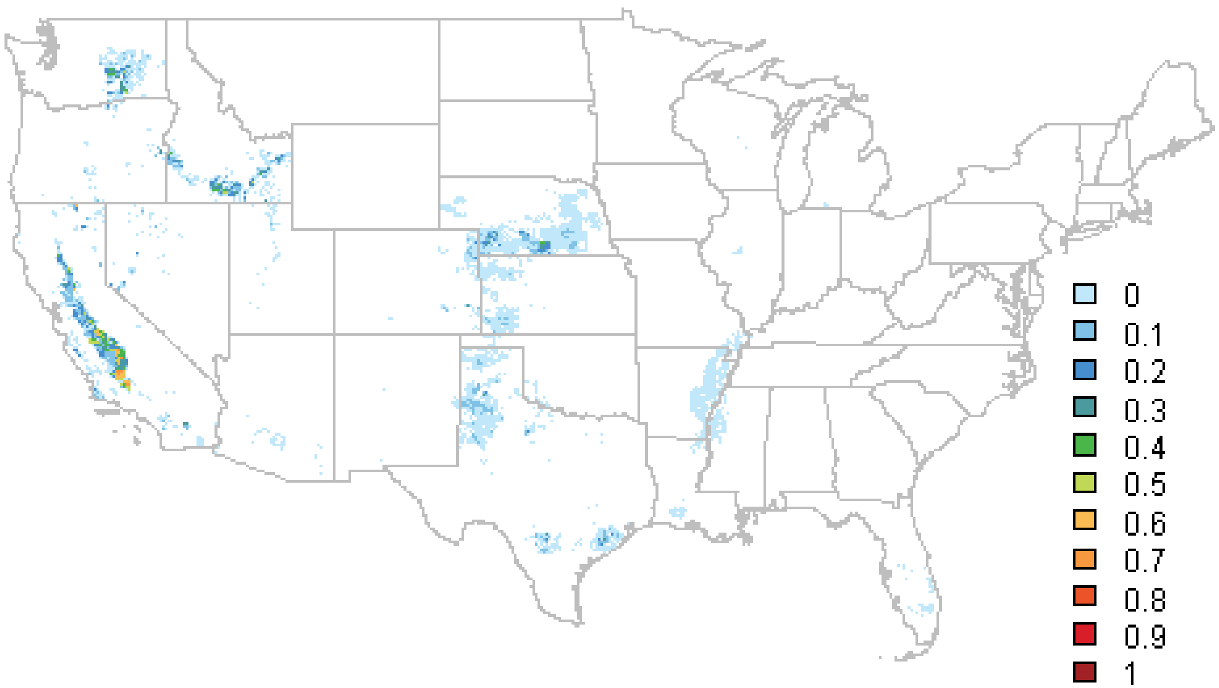
Haqiqi, et al., 2018

US groundwater resources in 2010: withdrawal to recharge ratio



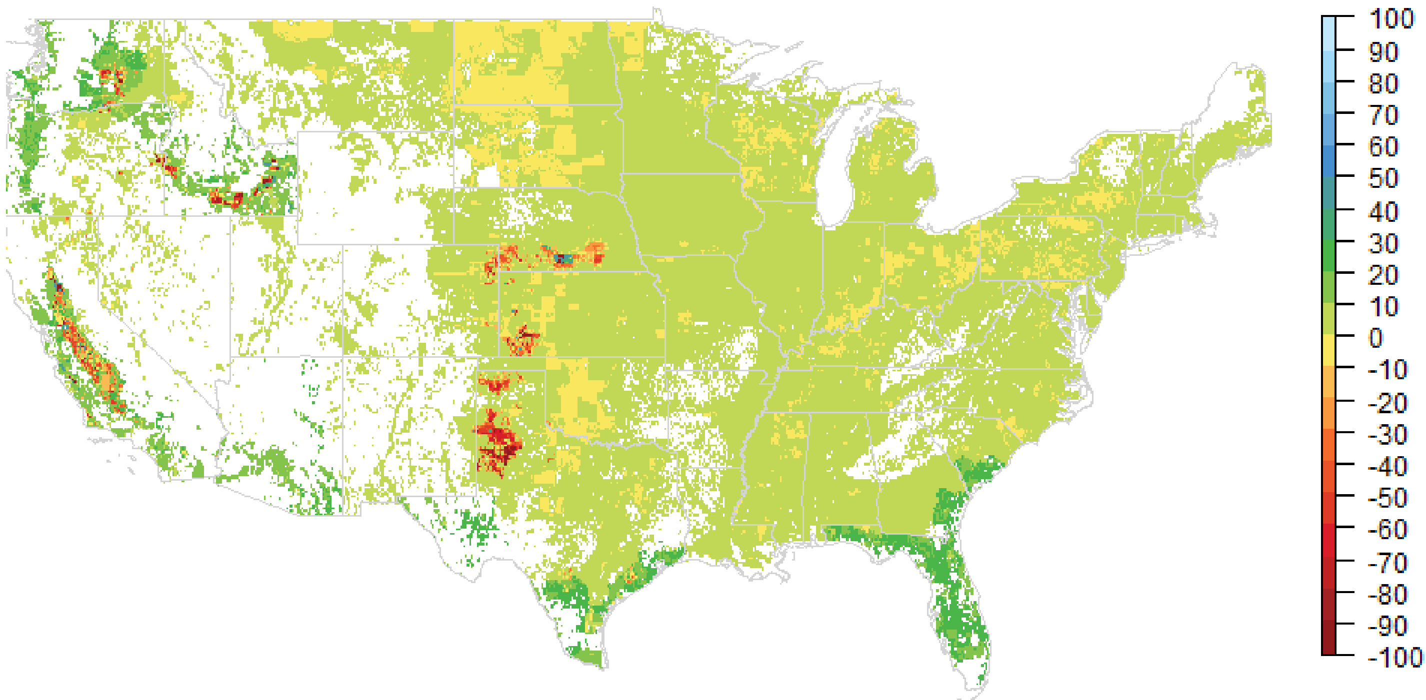
Haqiqi, et al., 2018

Additional pressure on US groundwater by 2050 (growth in withdrawal/recharge ratio)



Haqiqi, et al., 2018

Percentage change in irrigated crop production in response to groundwater sustainability policy



Restrict regional water withdrawal to average annual recharge level

US irrigated area declines

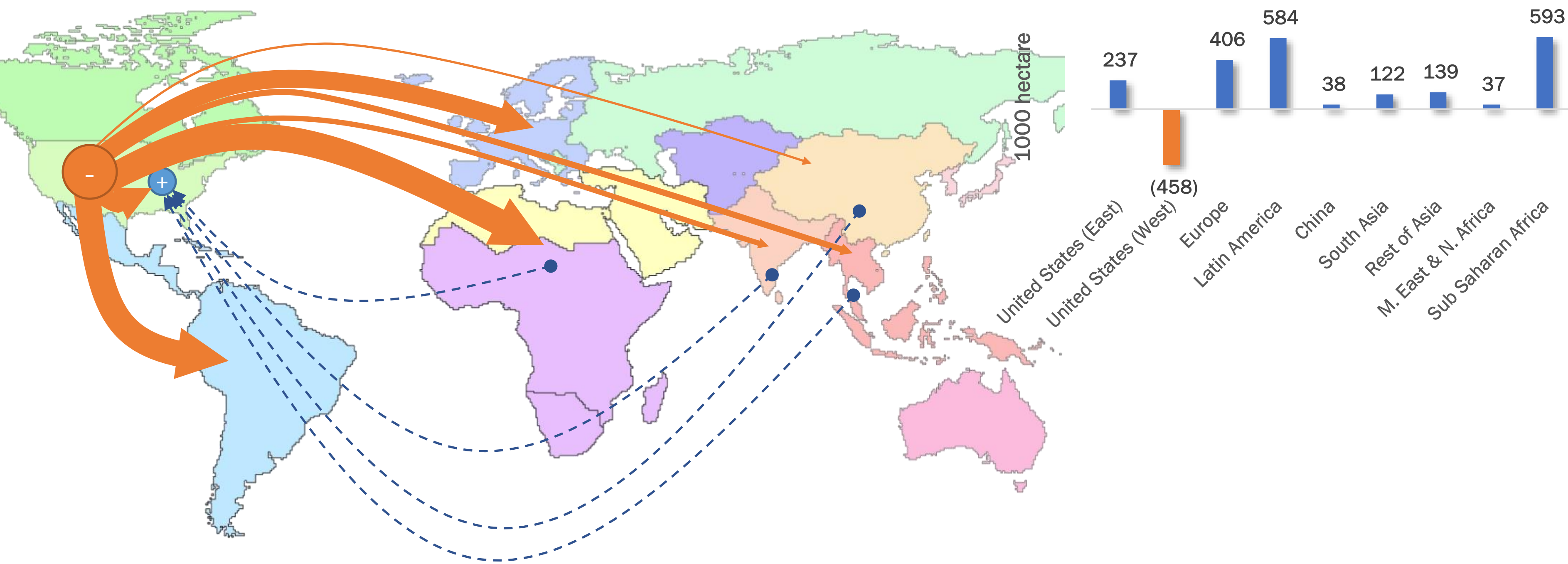
US irrigation efficiency increases

Production increases in Eastern US and rest of the world

Land use increases in Eastern US and rest of the world

Haqiqi, et al., 2018

Illustrating Local-to-Global Linkages: Consequences for crop production of restricting US groundwater withdrawal to sustainable levels



Haqiqi, et al., 2018

Conclusions

- Recent explosion of interest in international trade and its linkages to sustainability
- Economic analysis has key role to play
- But must also account for heterogeneous local biophysical and institutional features of the landscape
- Sustainability analysis is fundamentally an interdisciplinary challenge

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