Evidence and risk-based planning for a climate-smart agriculture

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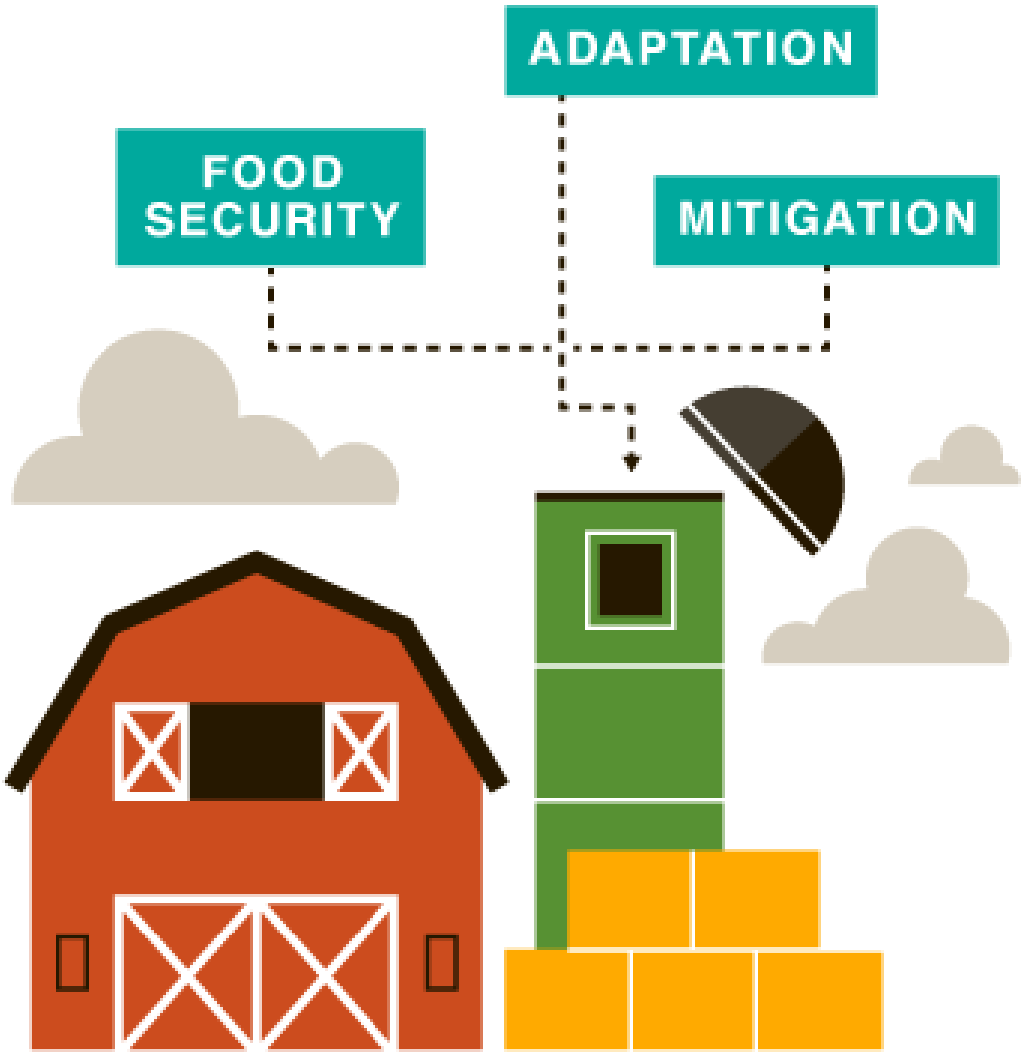
- What is climate-smart agriculture?
- Why CSA?
  - Food security
  - Impacts and adaptation
  - Mitigation
- But… a lack of evidence base?
- Risks-households-options (RHO) modelling for evidence-based CSA planning

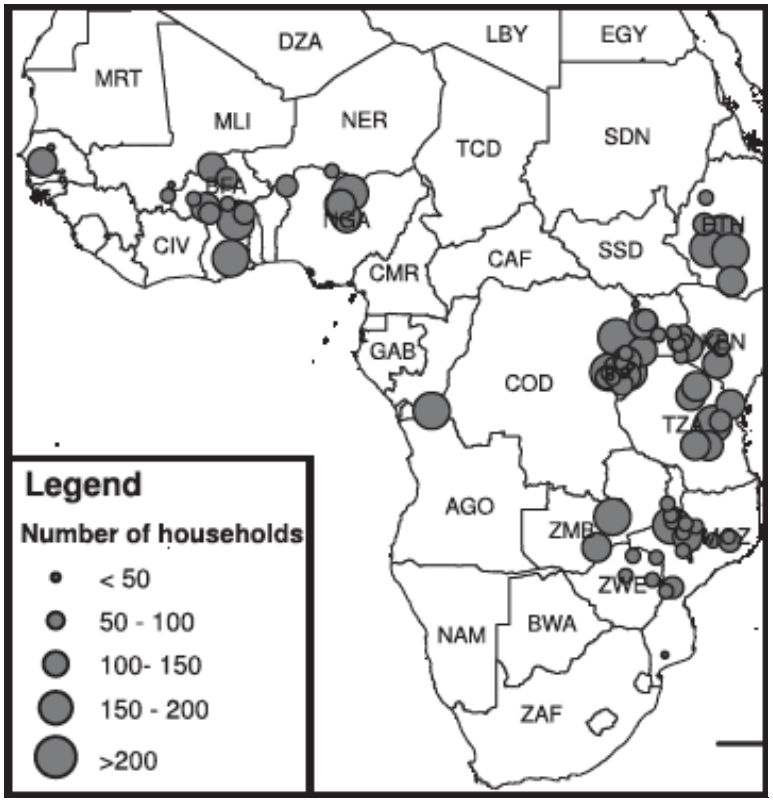
What is climate-smart agriculture?

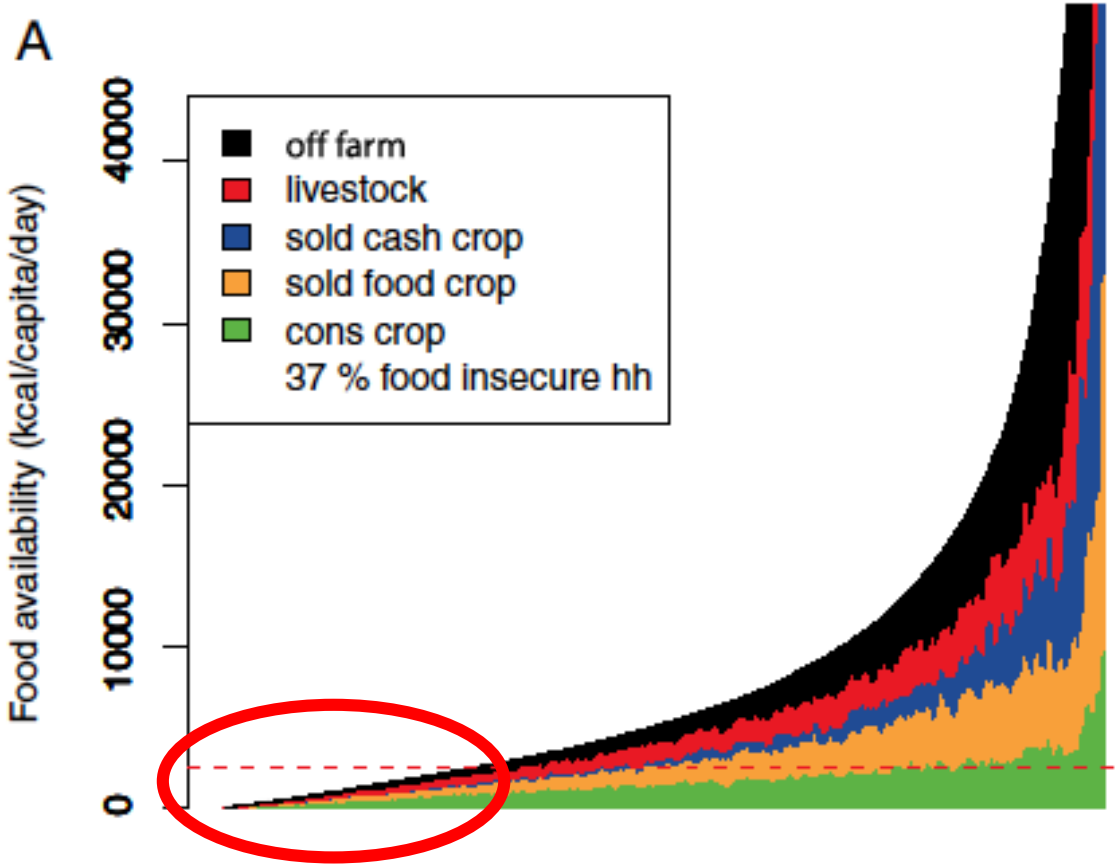
CSA…

- Improves food security
- Enhances adaptive capacity and resilience
- Reduces agriculture's burden on the climate system



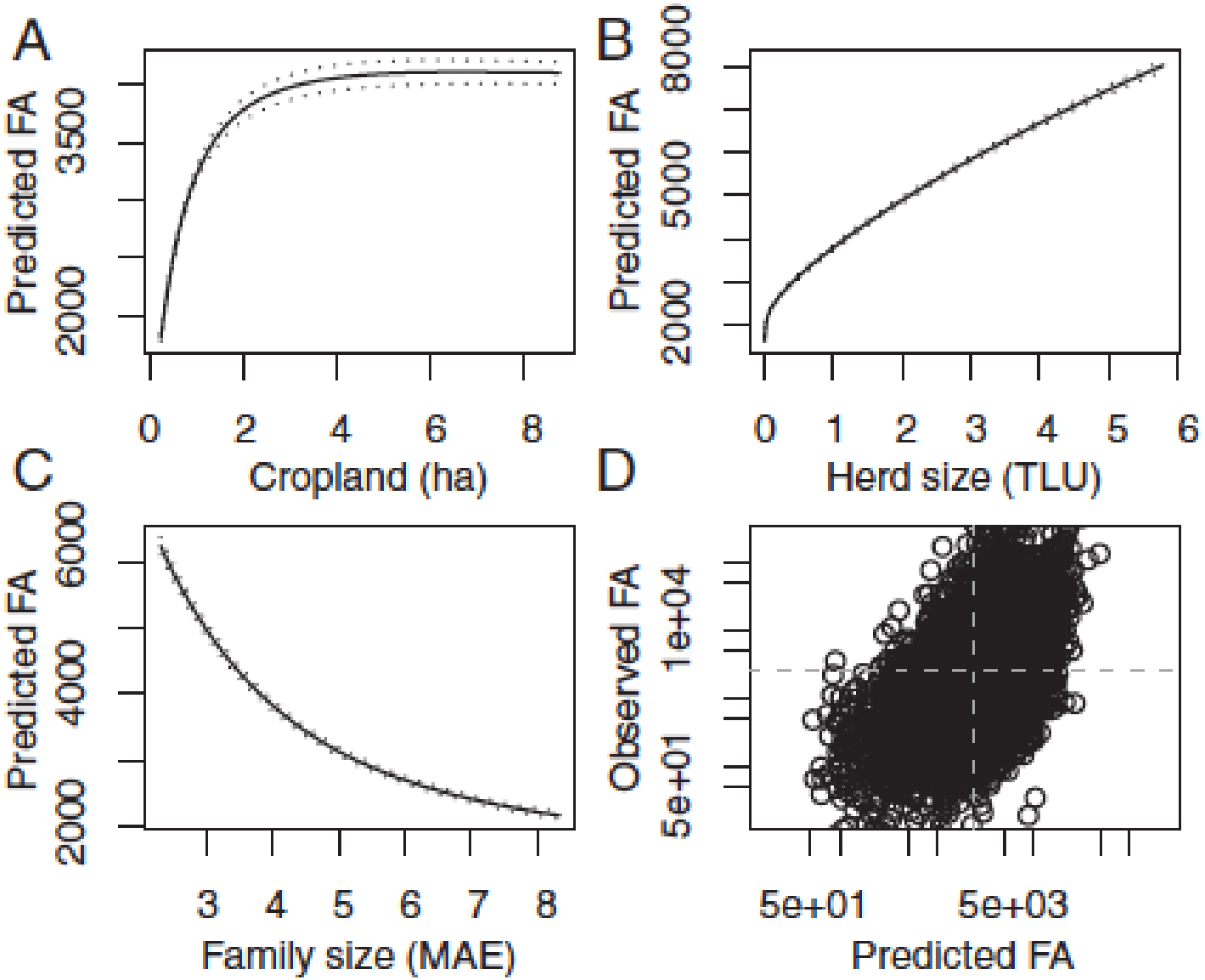
Why CSA? Food security





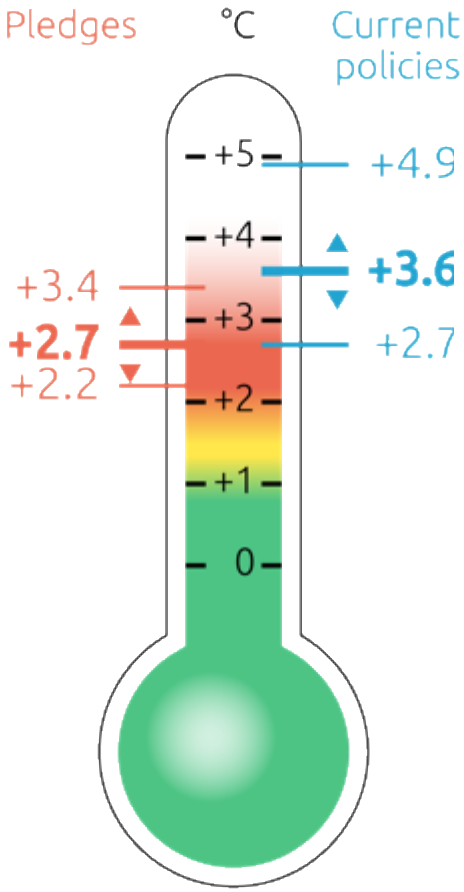
Frelat et al. (2016)

Why CSA? Food security

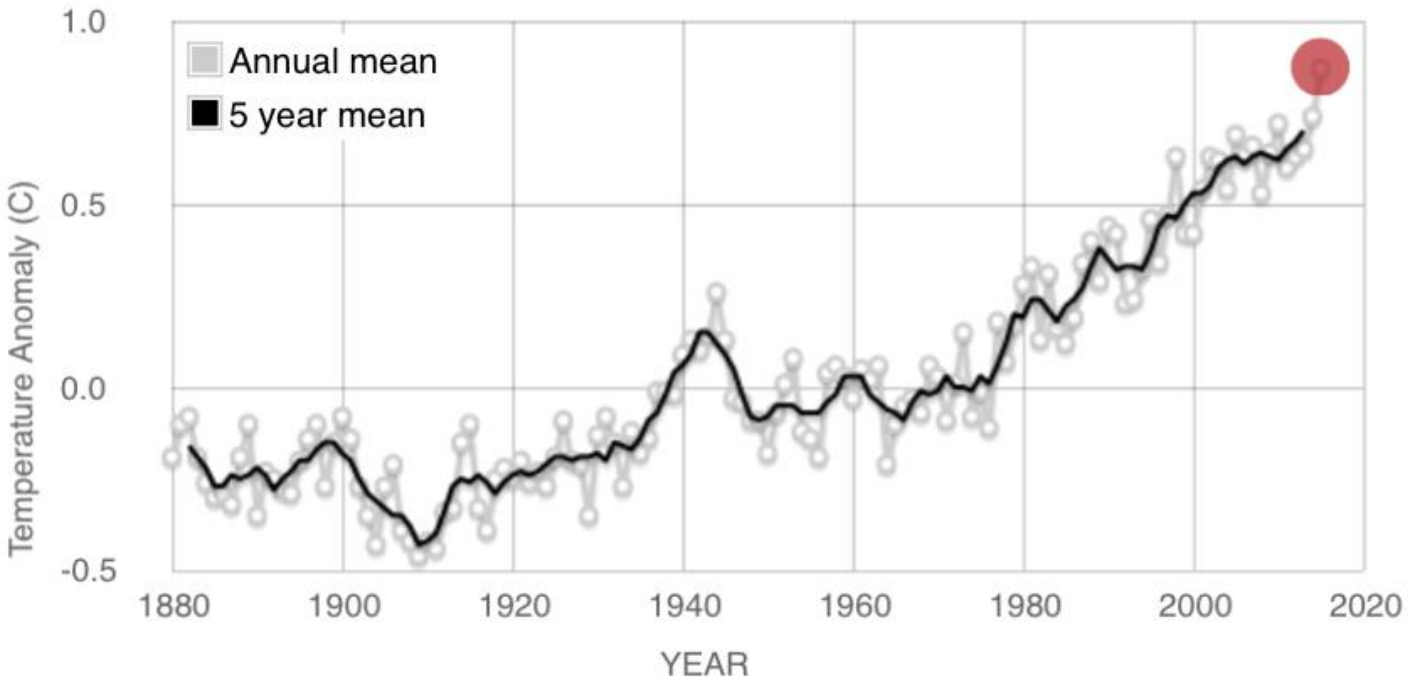


Frelat et al. (2016)

Why CSA? Climate change impacts and adaptation

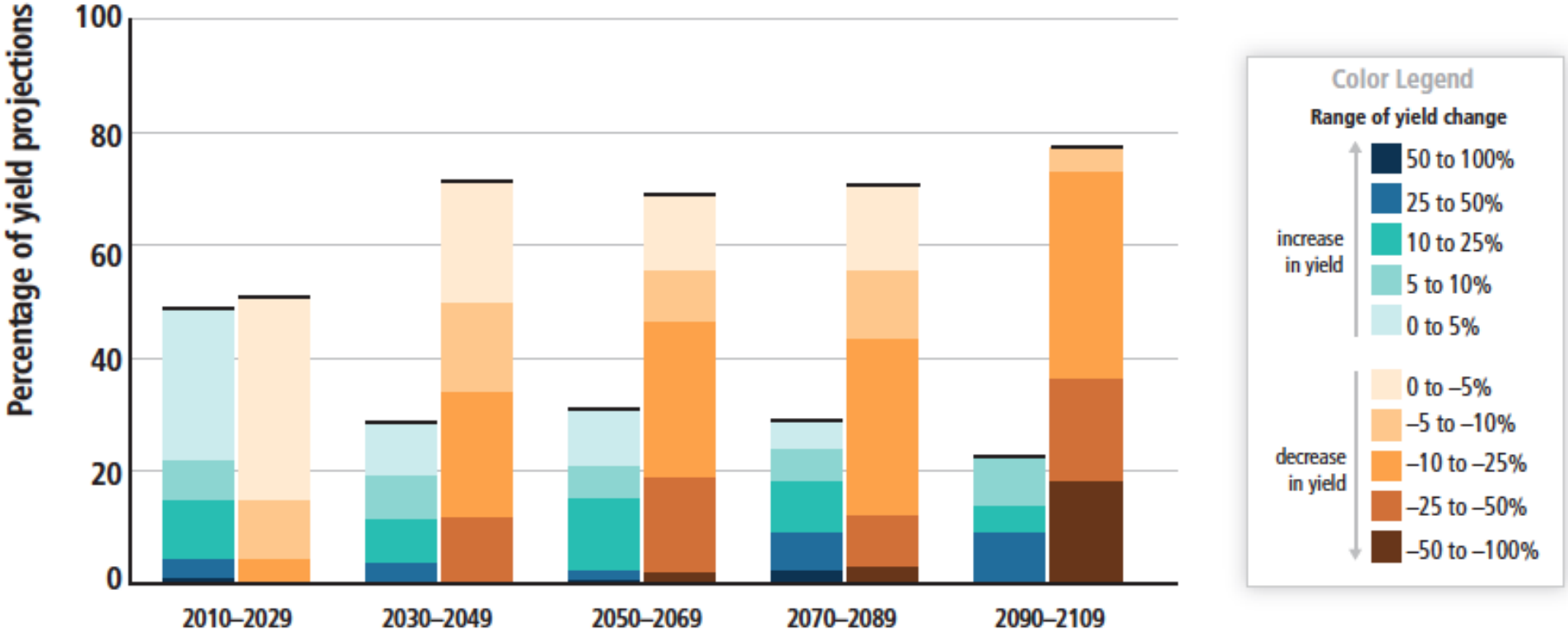


Climate Action Tracker (2016)



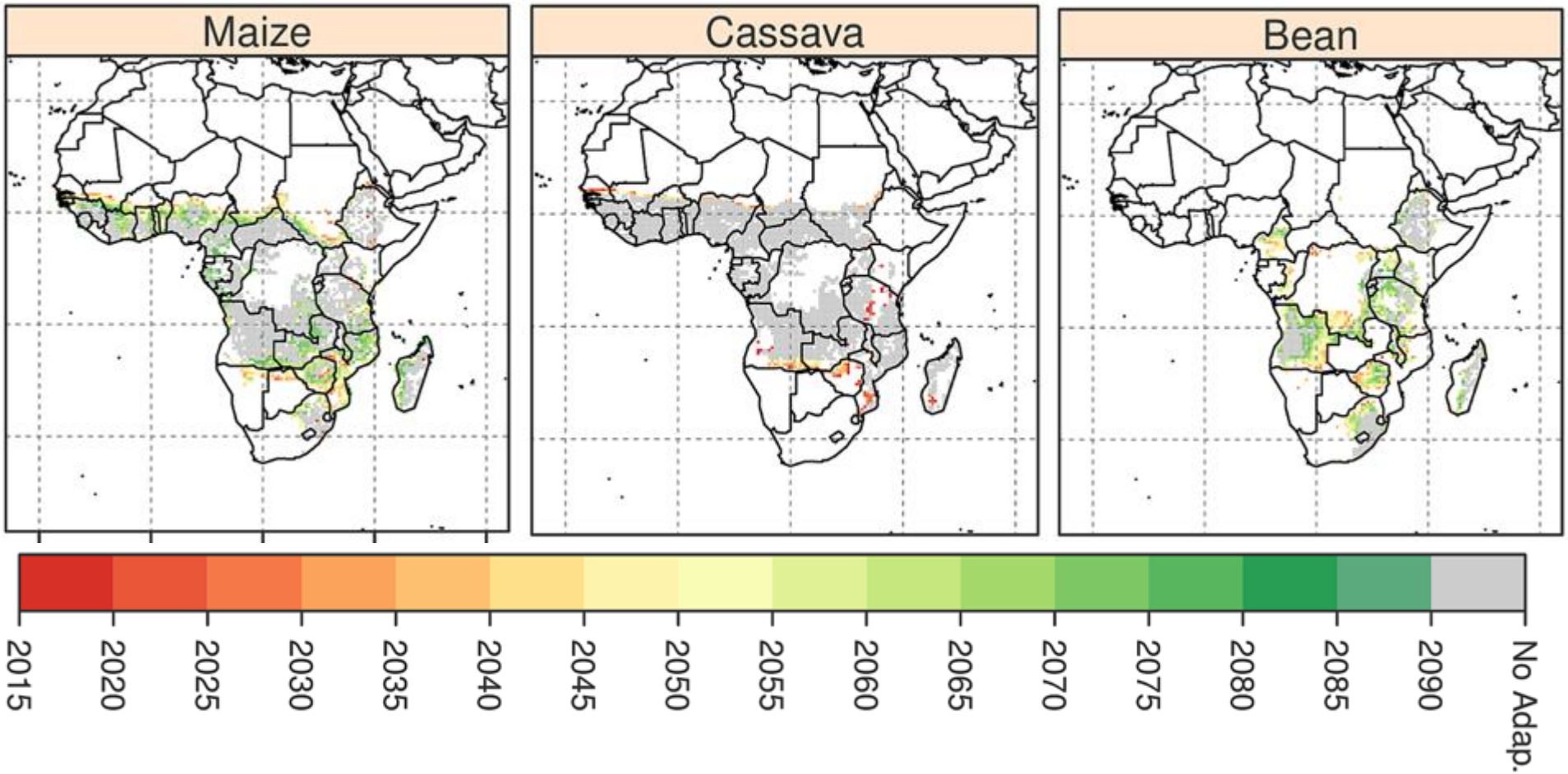
NASA (2016)

Climate change impacts and adaptation



Porter et al. (2014)

Transformational adaptation needs at higher levels of global warming



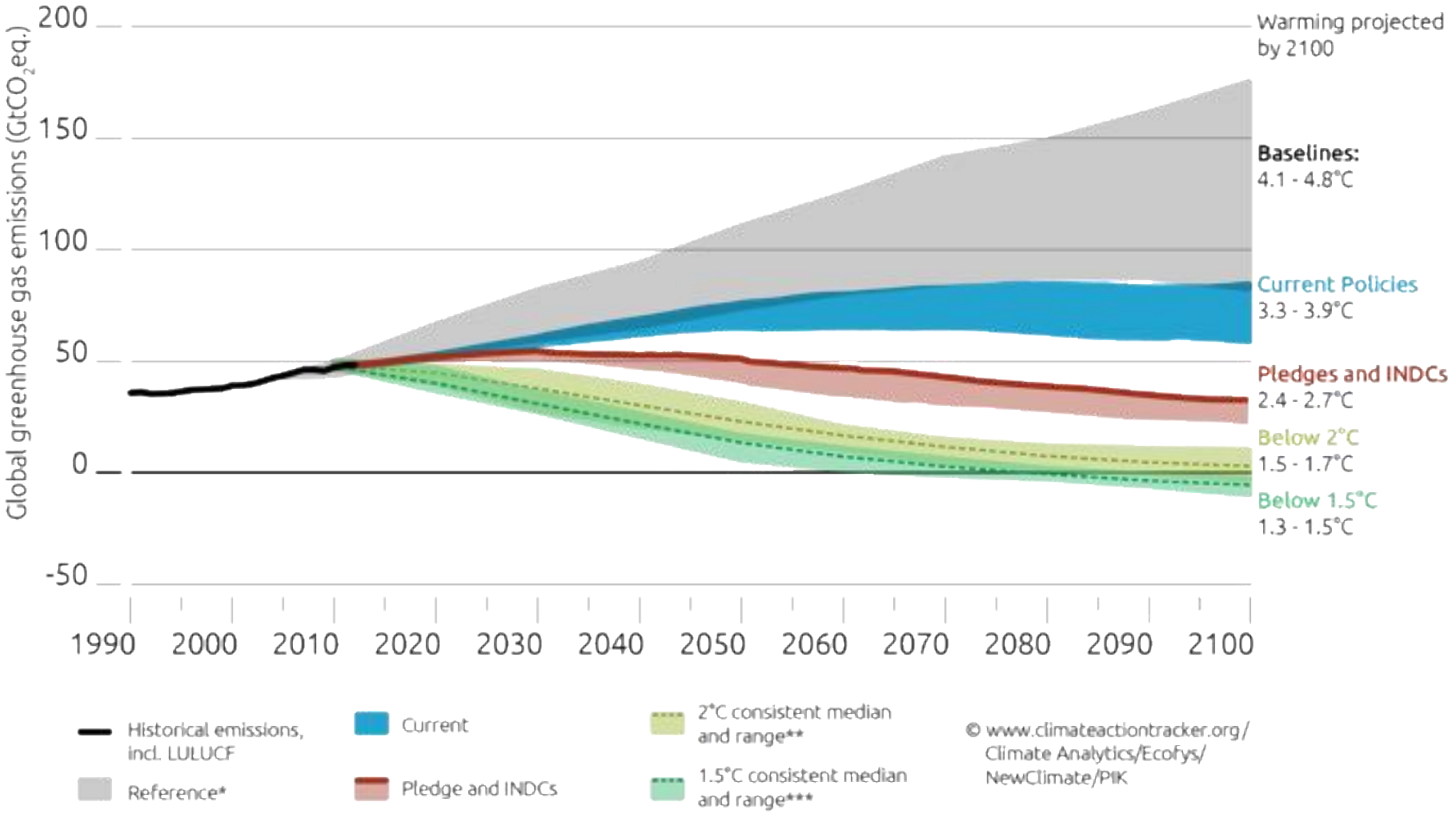
Rippke; Ramirez-Villegas et al. (2016) Nat. Clim. Chang.

opinion & comment

COMMENTARY:

1.5 °C and climate research after the Paris Agreement

Mike Hulme

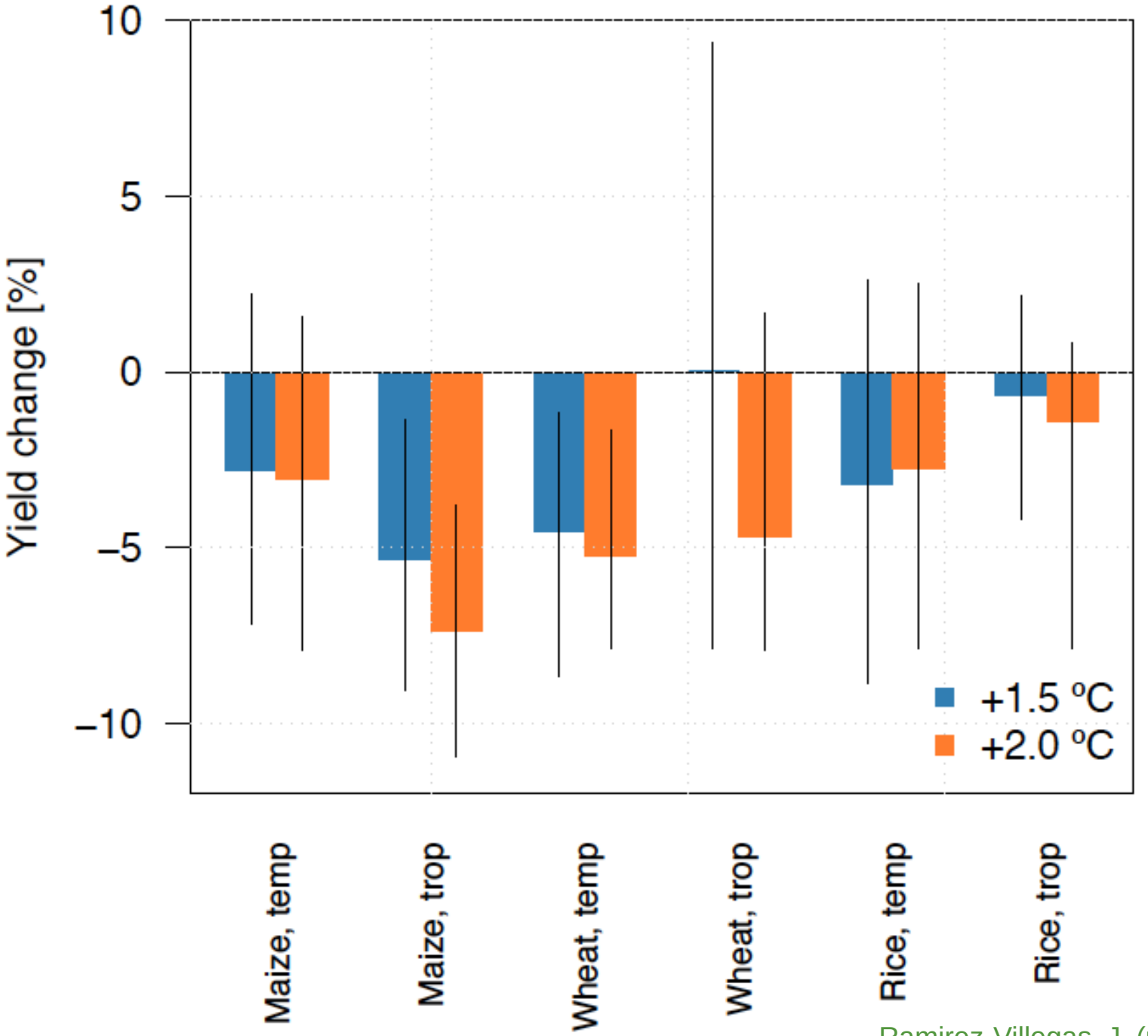


* 5%-95% percentile of AR5 WGIII scenarios in concentration category 7, containing 64% of the baseline scenarios assessed by the IPCC

** Greater than 66% chance of staying within 2°C in 2100. Median and 10th to 90th percentile range. Pathway range excludes delayed action scenarios and any that deviate more than 5% from historic emissions in 2010.

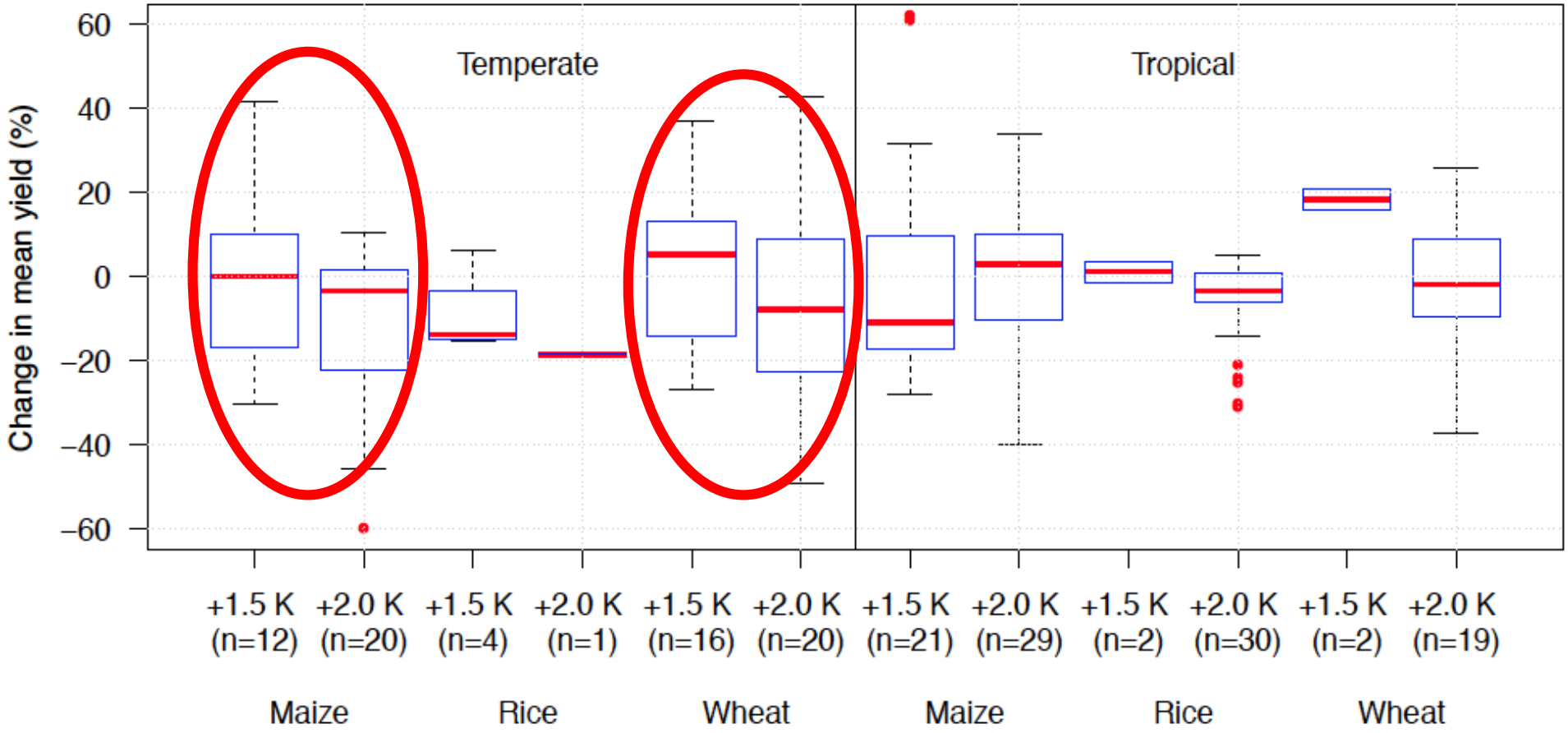
*** Greater than or equal to 50% chance of staying below 1.5°C in 2100. Median and 10th to 90th percentile range. Pathway range excludes delayed action scenarios and any that deviate more than 5% from historic emissions in 2010.

Climate Action Tracker (2016)



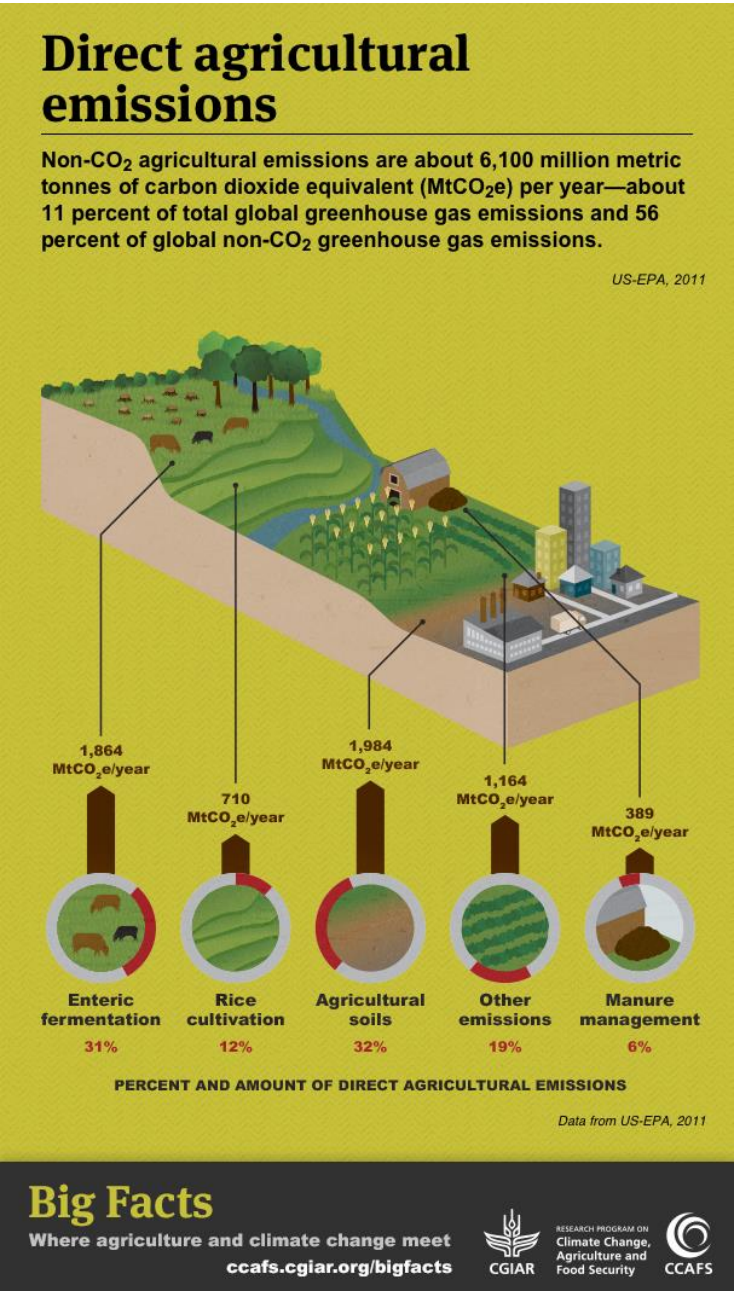
Ramirez-Villegas, J. (unpublished)

Climate change: 1.5 vs. 2 ºC

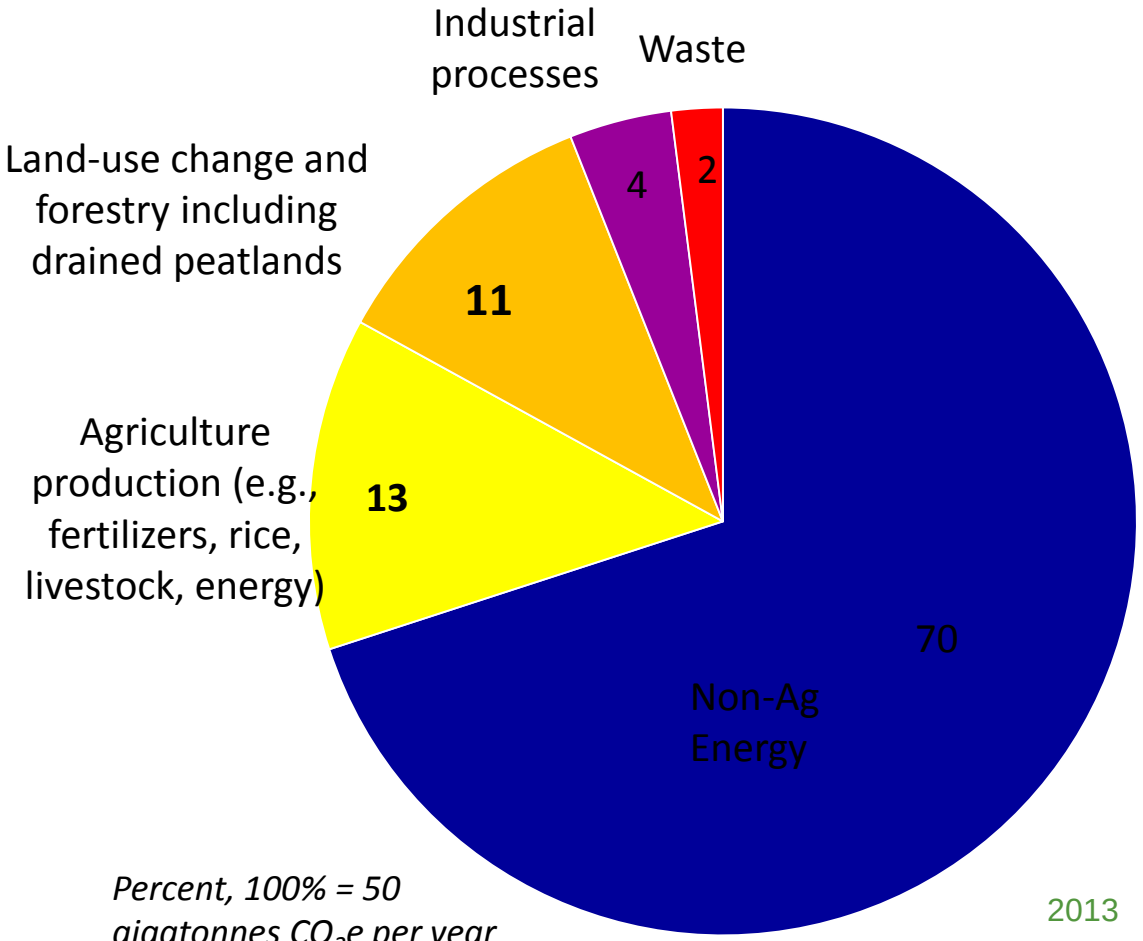


Ramirez-Villegas and Challinor (unpublished)

Why CSA? Mitigation



Agriculture-related activities are 19-29% of global greenhouse gas emissions (2010)

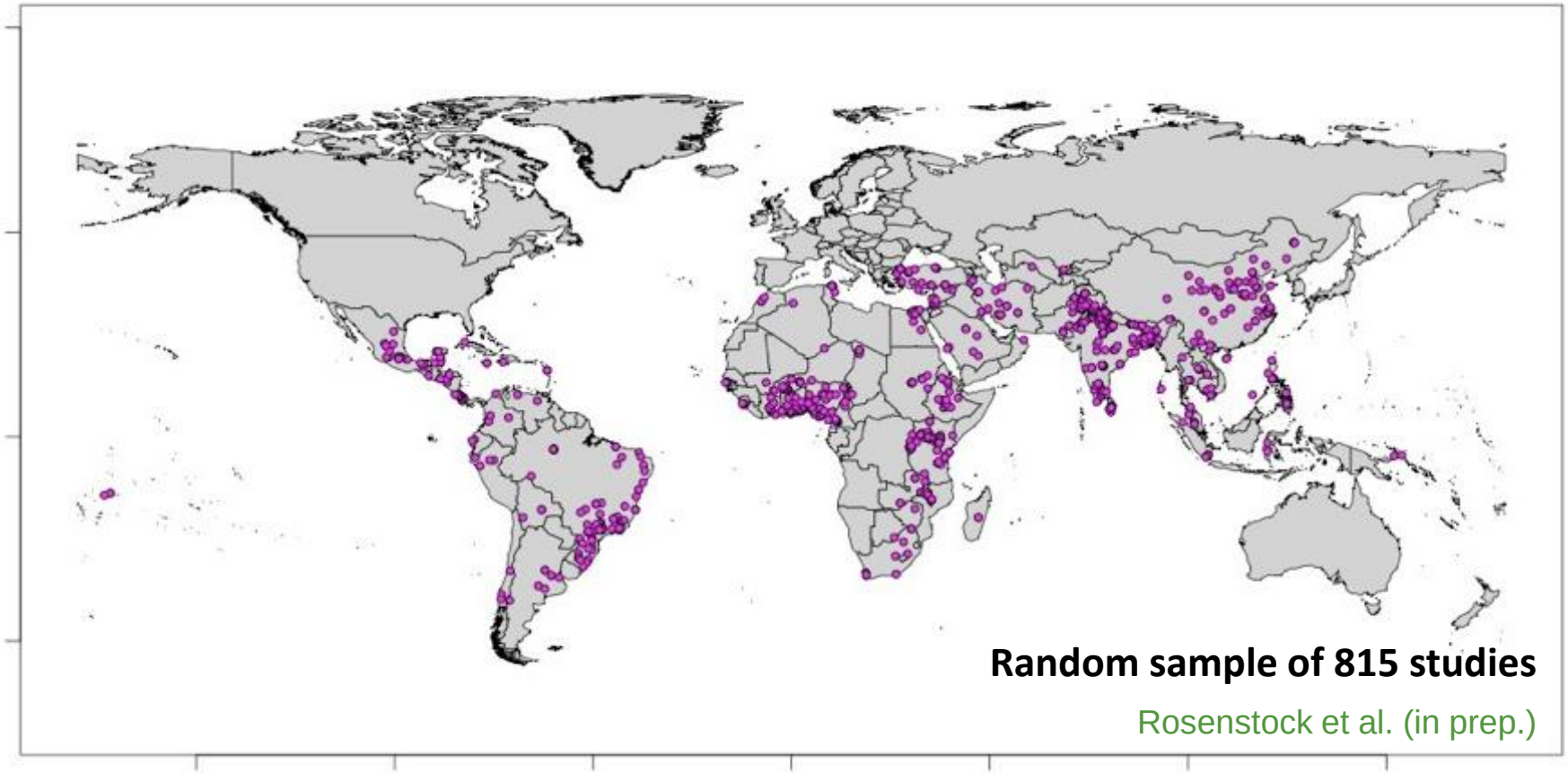


Percent, 100% = 50 gigatonnes CO_2e per year

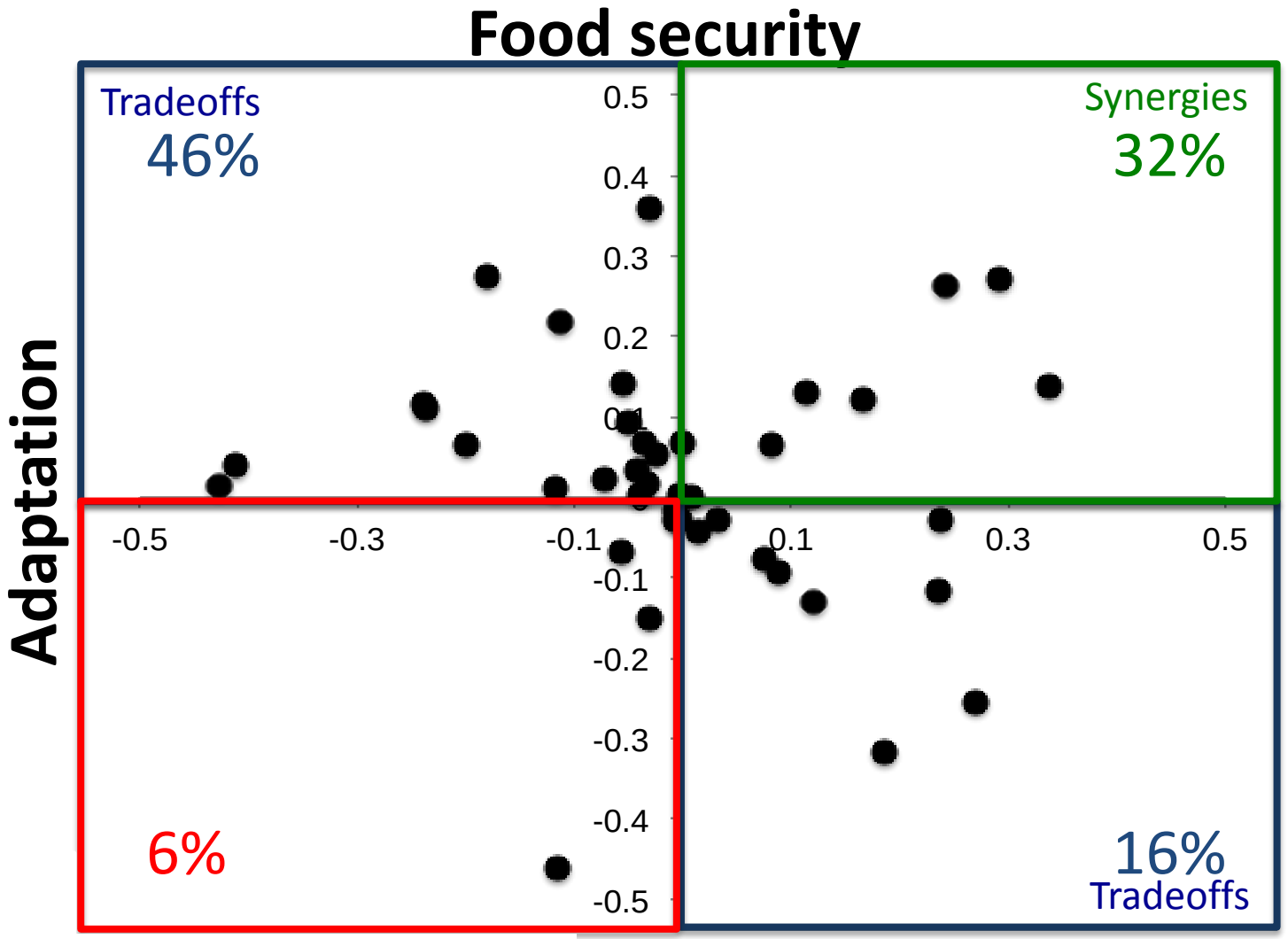
2013

But… a lack of evidence base?

- What is CSA, where, and why? –A large compendium of practices shows many studies assess ≥ 1 CSA pillar



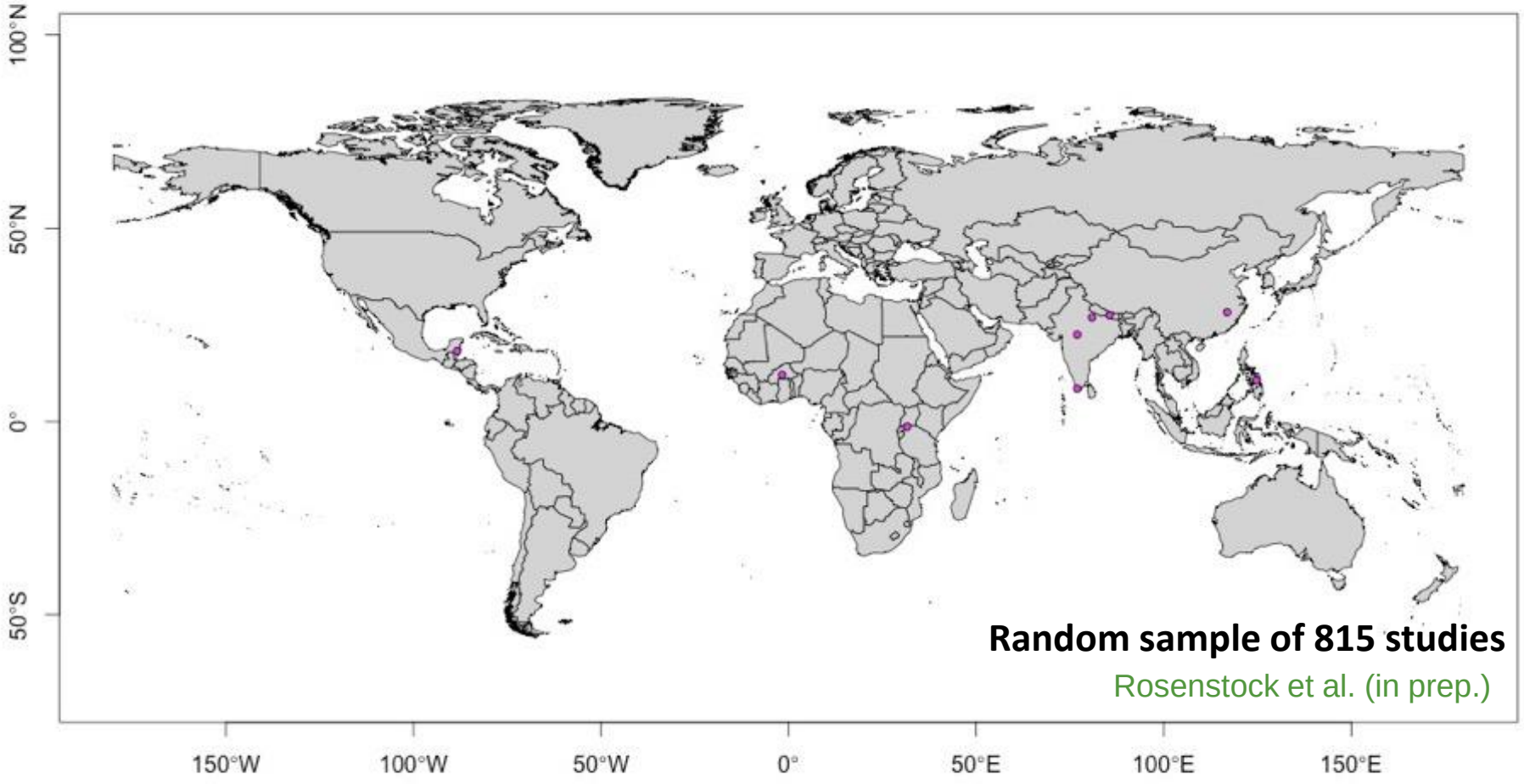
We can start to understand synergies and tradeoffs



Mean effect from random sample of 130 studies (*55 comparisons)*

Rosenstock et al. (in prep.)

But… only a few studies consider the 3 pillars (!)

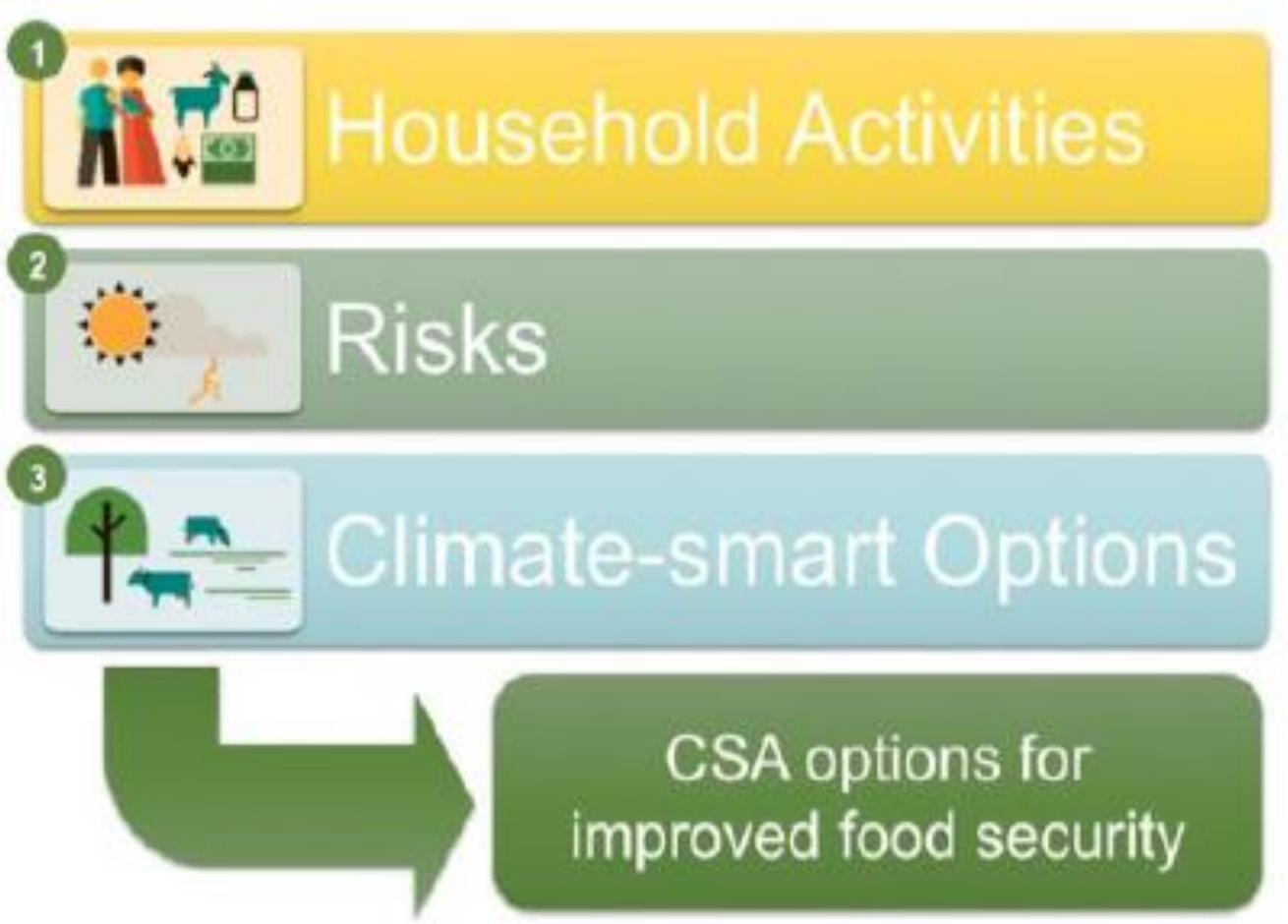


So, we don't really know what is CSA, do we? Need a new paradigm for research

CSA Plan

1. Diagnosis and foresight
2. Prioritization
3. Program design
4. M & E

Risks-Households-Options (RHO) modelling for CSA planning



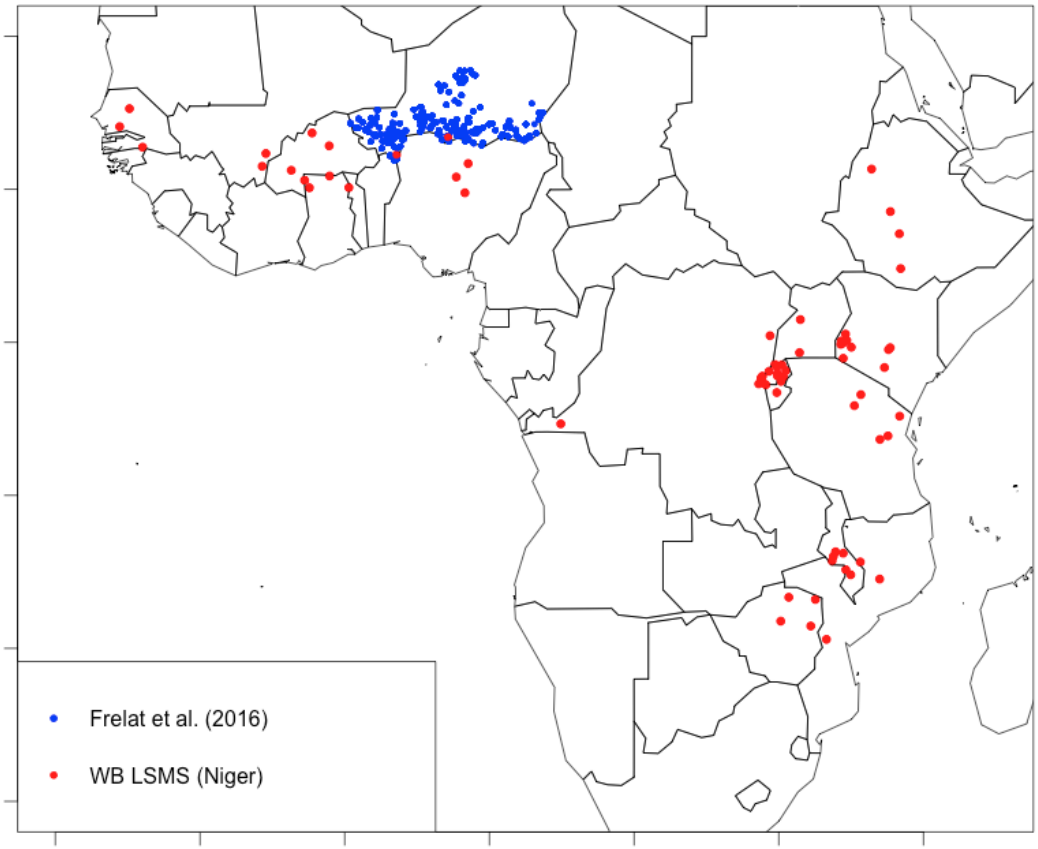
Lamanna; Ramirez-Villegas et al. (2015)

Modelling approach

1. Use household survey (World Bank LSMS, CCAFS) to model yields at household scale (process-based or empirical models)
2. Quantify frequency and intensity of impacts of biophysical risks and vulnerabilities (e.g. soil fertility, drought spell length) on food availability
3. Use CSA compendium to identify promising CSA practices
4. Simulate CSA practice impact on food availability

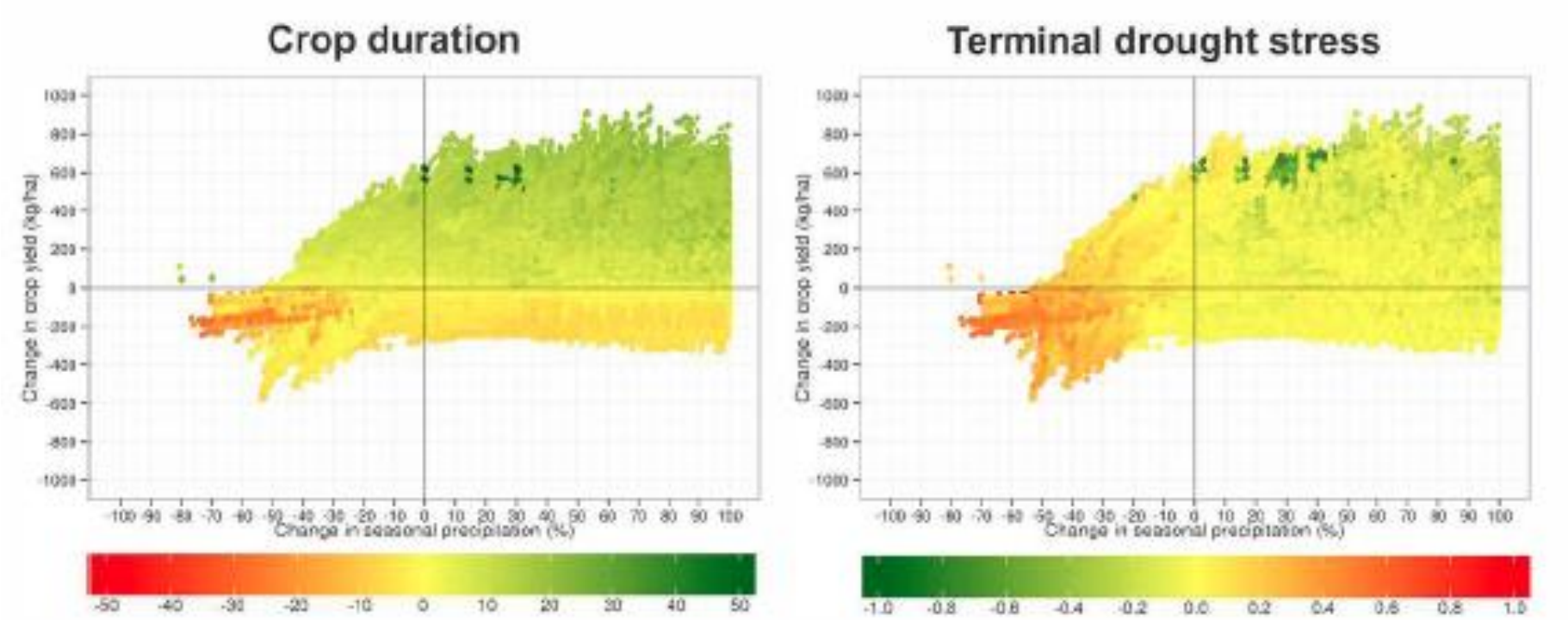
Household survey data

- Frelat et al. (2016) gathered data from 93 survey sites, 17 countries and >13,000 hh
- LSMS-ISA (World Bank)—8 countries in SSA, eg. Niger



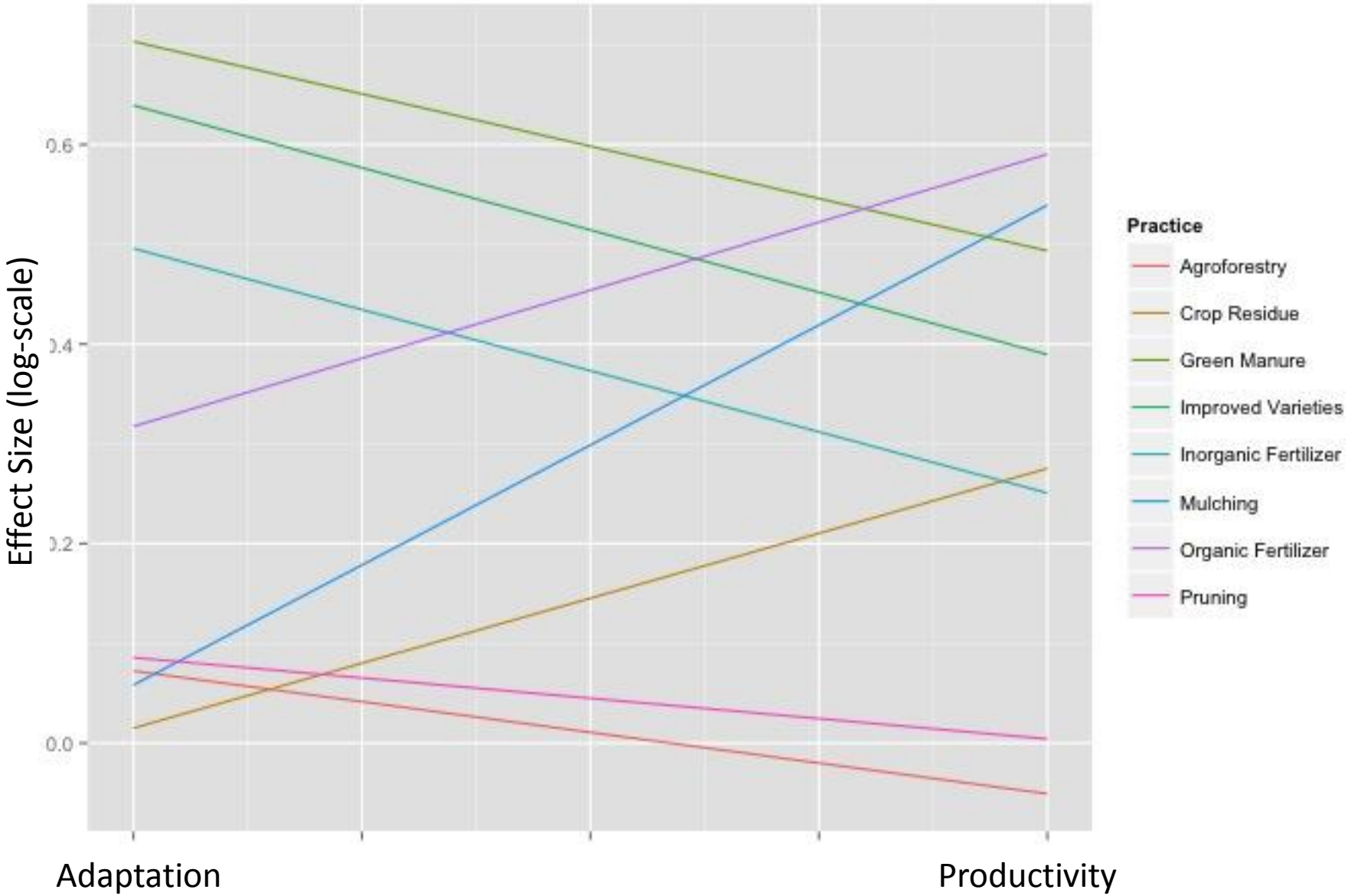
Climate change related risks –risk profiles

- Household survey data to understand climate vs. other risks (e.g. pest / disease)
- Crop-climate modelling to understand key climate vulnerability factors



Ramirez-Villegas and Challinor (in revision)

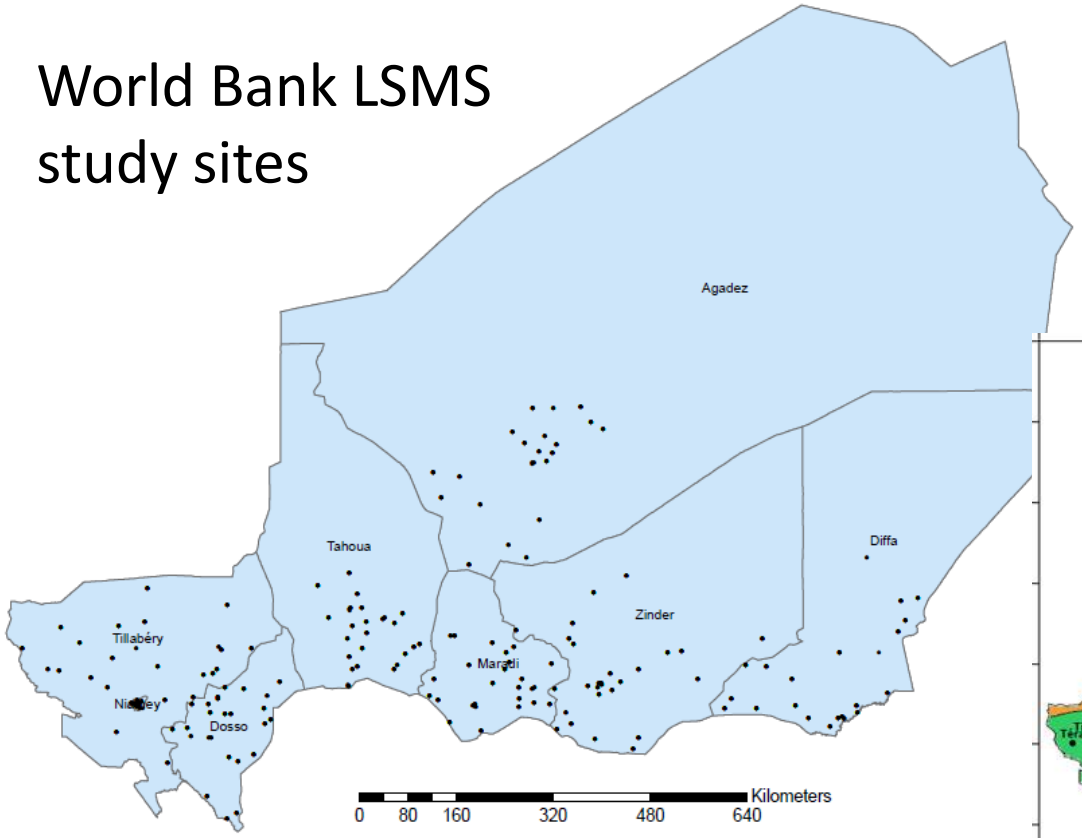
Playing out CSA practice prioritization

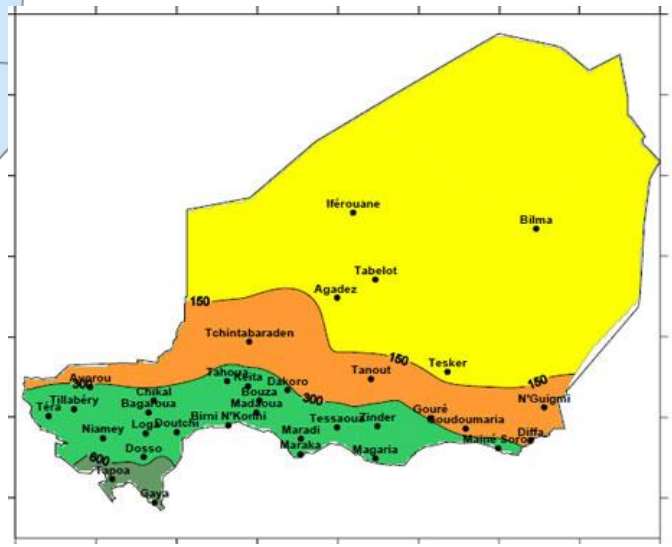


Lamanna et al. (in prep.)

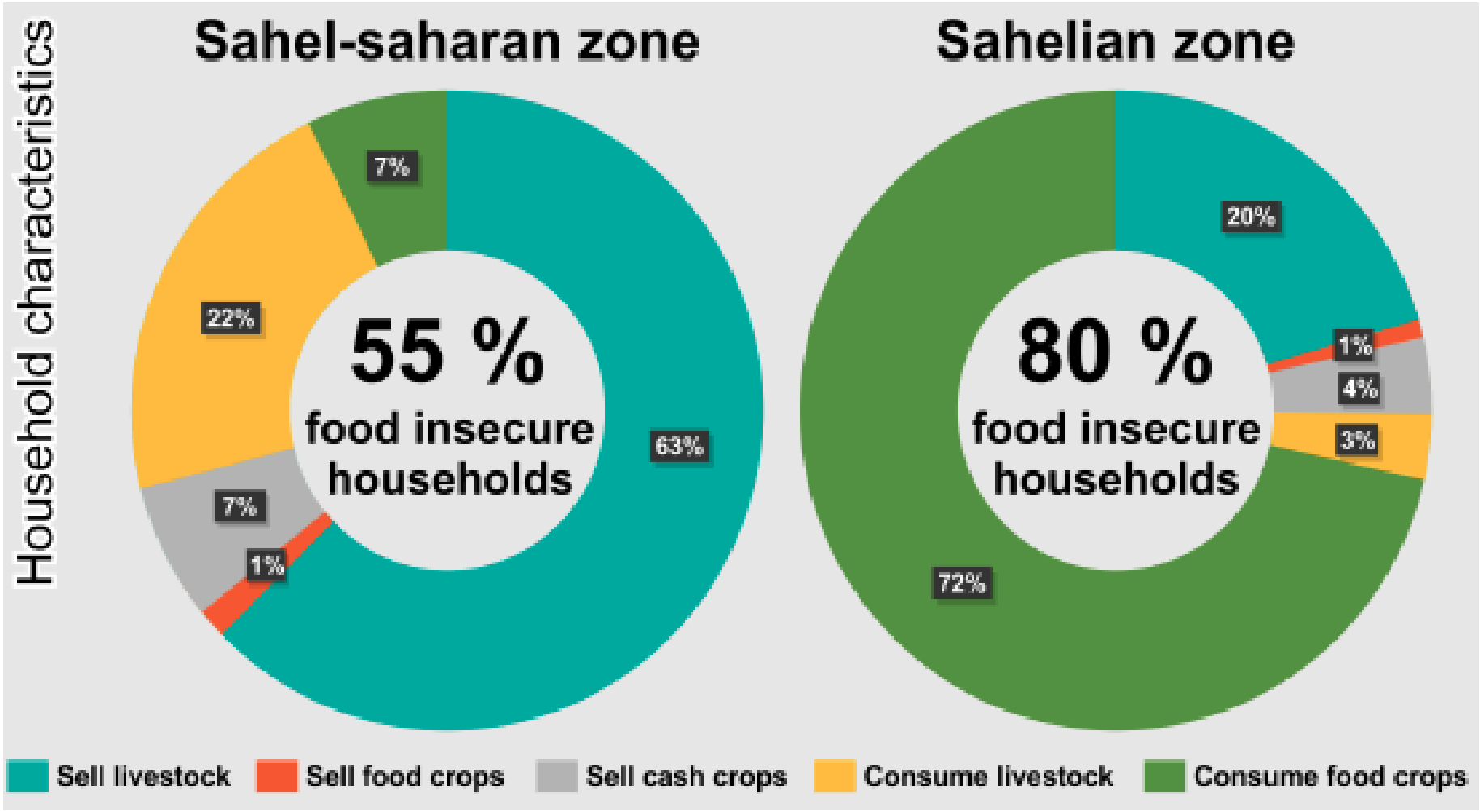
Risk-based CSA prioritization in Niger: preliminary results

World Bank LSMS study sites





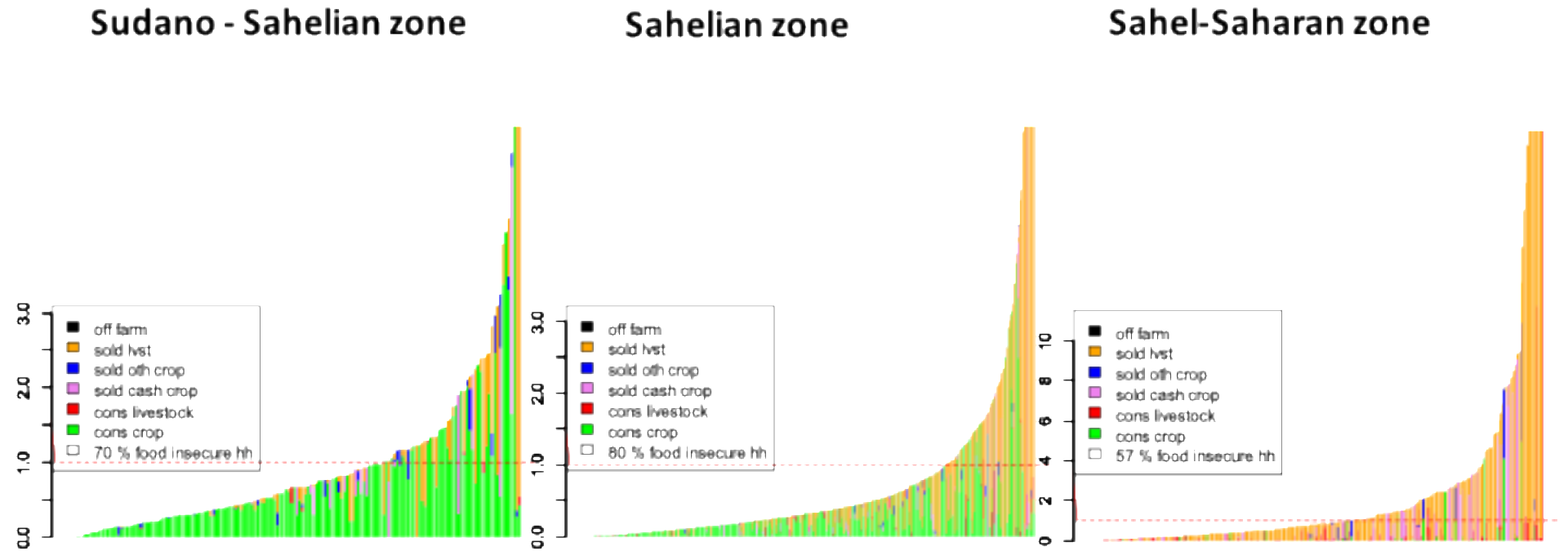
Contributors to household food availability



Lamanna, Ramirez-Villegas et al. (2015)

Household food availability in Niger

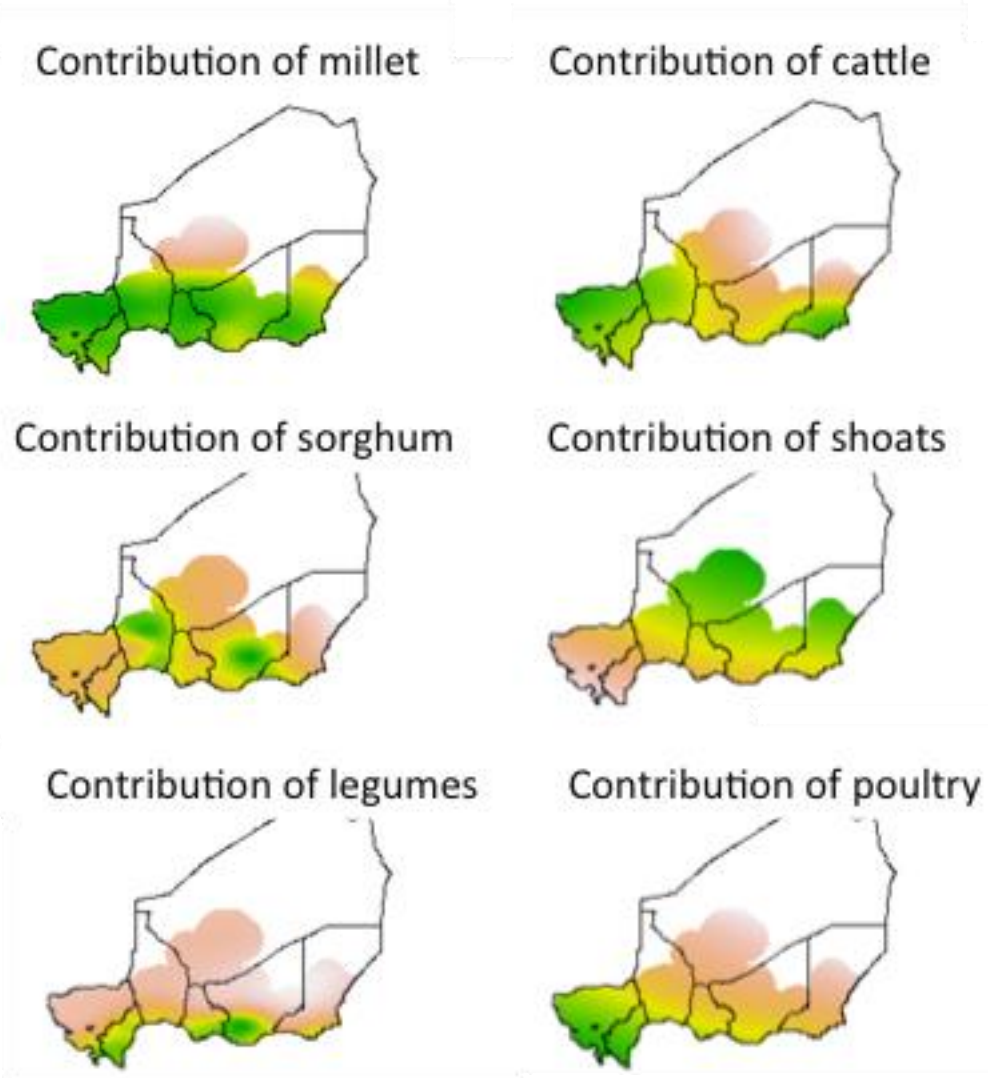
Niger –contribution to household food availability from different farming system types



Analysis: Mark van Wijk

Crop/livestock contributions to food availability vary geographically

- Marked difference between sudano-sahelian zone and sahel-saharan zone
- Millets grown ~everywhere



Analysis: Robert Hijmans, UC Davis

ILRI CGIAR

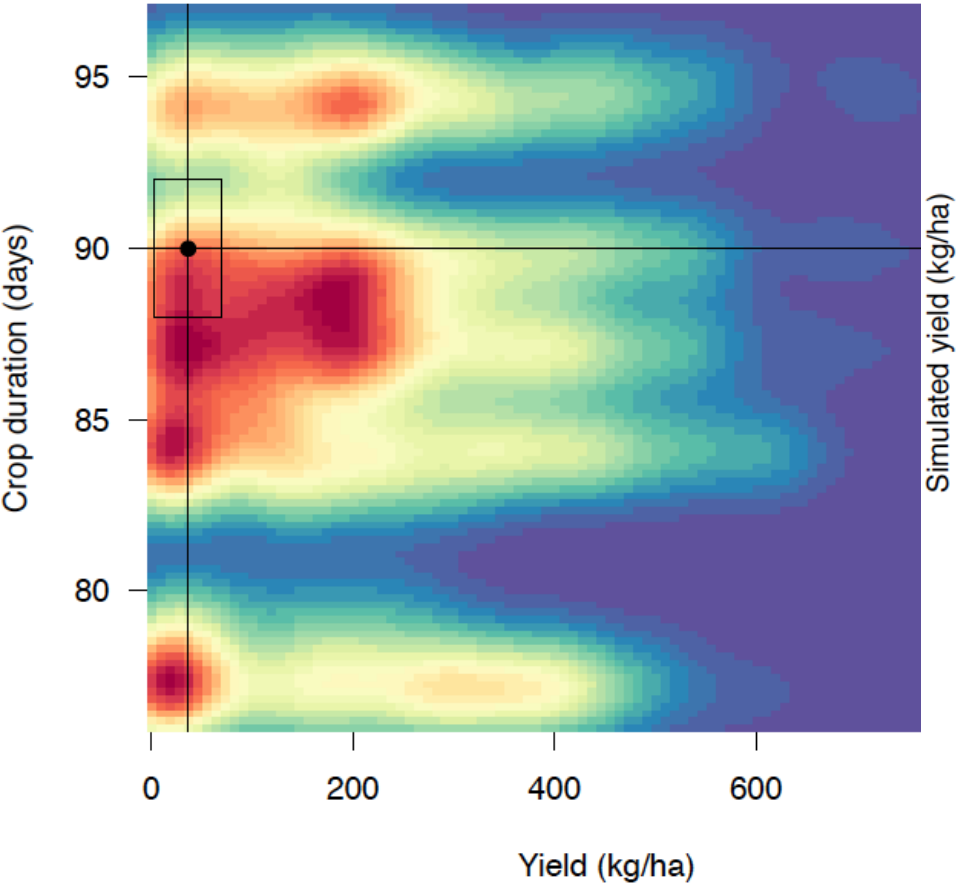
Risks amongst households

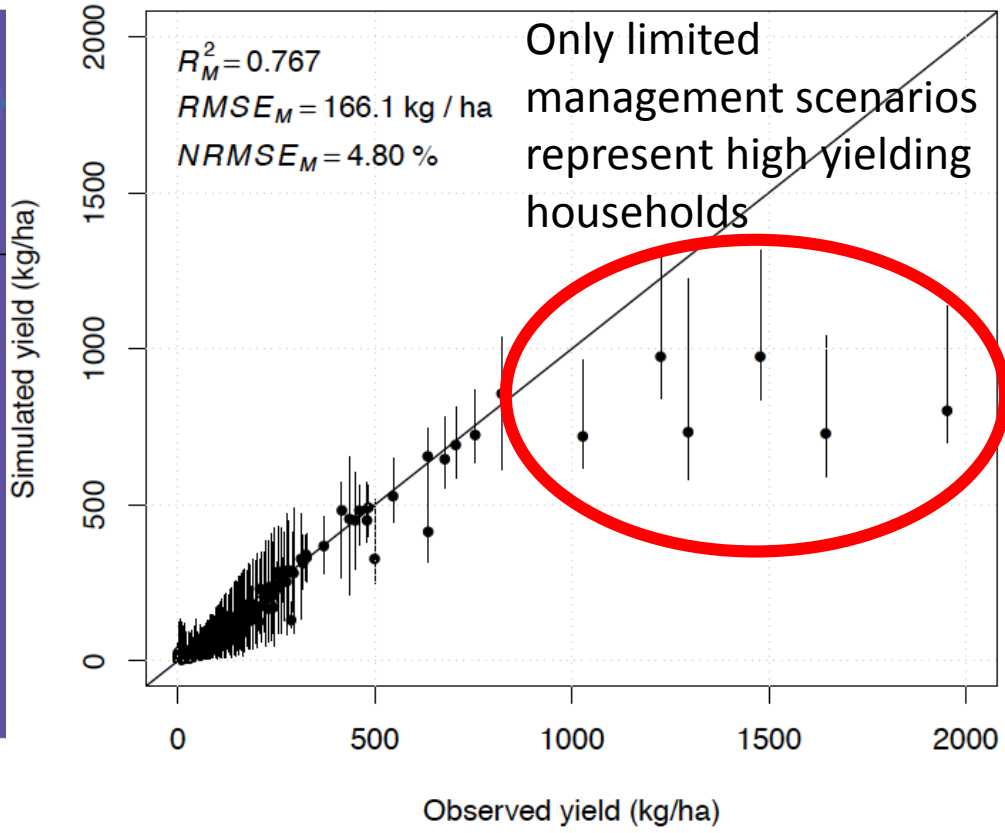
- First, used the LSMS database to characterise risks to which HHs are exposed

- 90 % HHs reported some harvest loss
- 65 % of these reported drought as the cause
- Average loss to drought was 78 %

Crop modelling: initial results (millet)

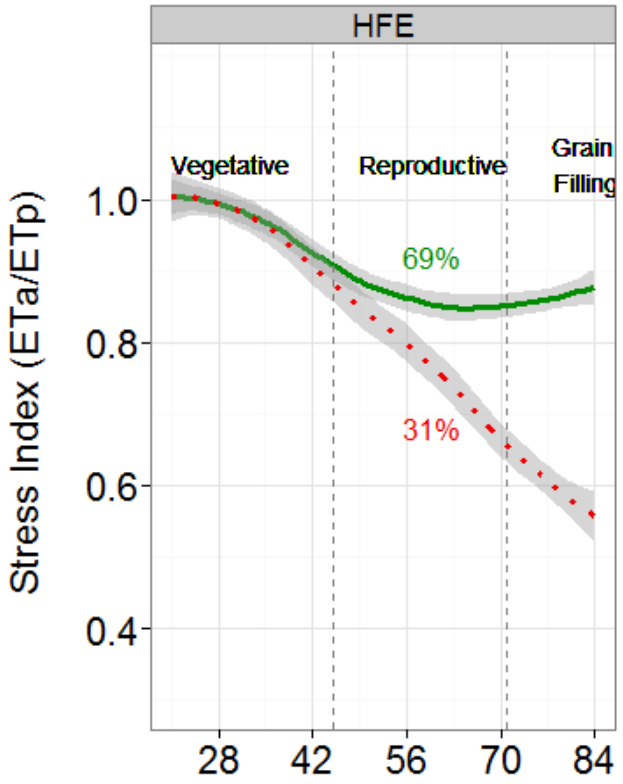
- Used a maximin latin hypercube approach to determine realistic management scenarios, based on prescribed durations and observed yields.





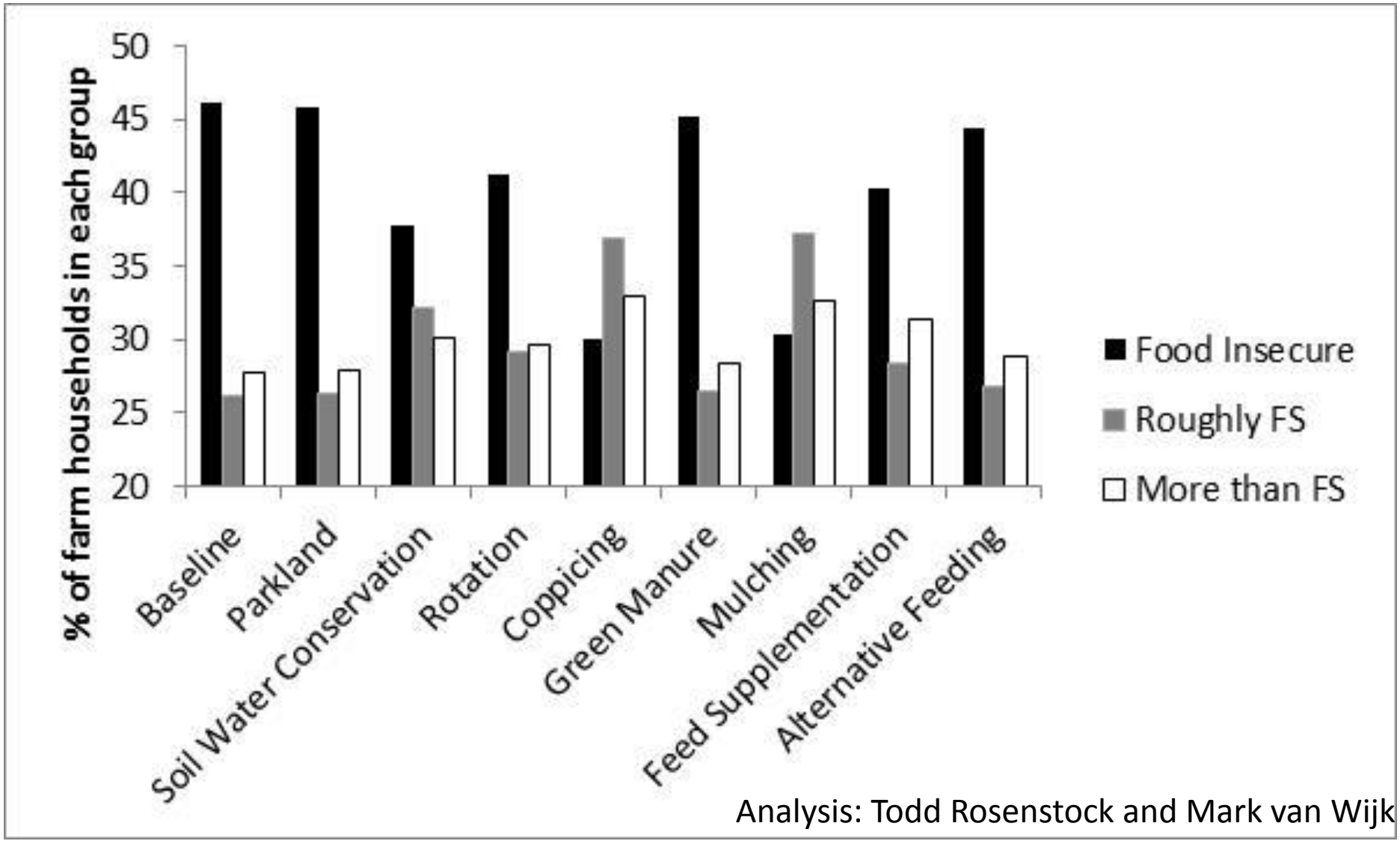
Crop modelling –next steps

- Simulate historical (1980-2010) yields for each household
- Deconstruct ”drought” through sensitivity analysis and environmental classification →
- Assess drought vs. heat stress under future climate scenarios



Heinemann et al. (2015)

CSA compendium analysis: initial results



Analysis: Todd Rosenstock and Mark van Wijk

We learned that…

- This preliminary analysis suggests priority investments need to address food insecurity with particular focus on cereal-based households across the Sahelian zone.
- There is potential in the use of a crop model to disentangle “drought” –we’ll keep working on that
- The CSA Compendium is a useful yet incomplete source of information… we need to change the way we do field experiments

Generating the field-scale evidence base that links up to modelling

Campbell et al. (under review)