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Water resources transfers through southern African food trade

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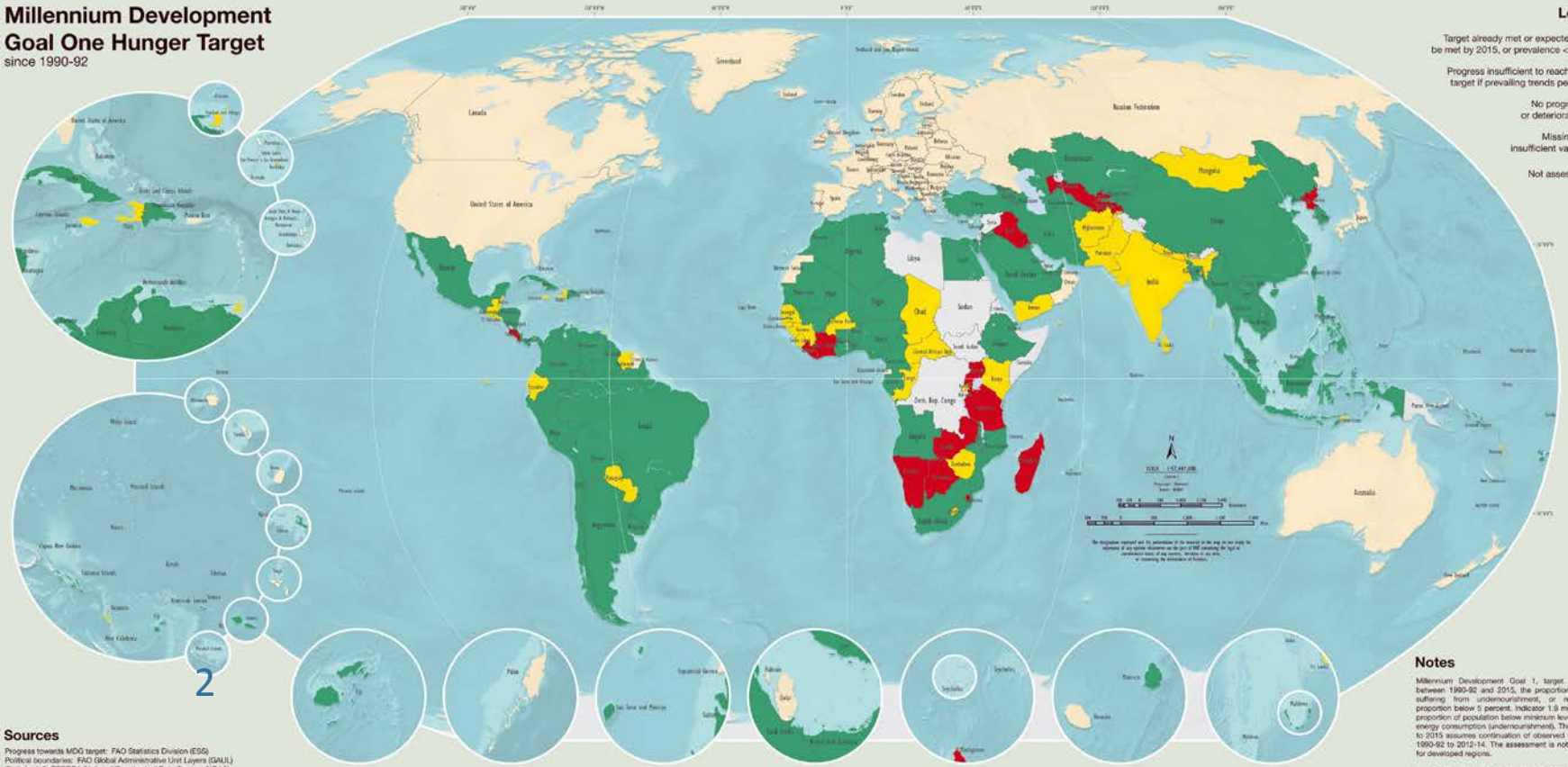
FAO HUNGER MAP 2014

- About 805 million people – one in nine of the world's population – were chronically undernourished in 2012–14, with insufficient food for an active and healthy life. This number has fallen by 100 million over the last decade, and by 209 million since 1990–92.
- The vast majority of hungry people live in developing countries, which saw a 42 percent reduction in the share of undernourished people between 1990–92 and 2012–14. Despite this progress, 13.5 percent of the overall population, or about one in eight, remain chronically undernourished in these countries, down from 23.4 percent in 1990–92.
- 63 developing countries have already met the MDG1 hunger target while 25 have reached the more stringent 1996 World Food Summit target of halving the number of undernourished persons by 2015.
- The MDG 1c hunger target – of halving, by 2015, the proportion of undernourished people in the developing world – is within reach, but only with sufficiently accelerated progress.
- Large regional differences remain. Latin America and South-Eastern Asia have been the most successful subregions, while Western Asia is the only one to actually regress. Sub-Saharan Africa, with almost one in four chronically hungry, has more than a quarter of the world's undernourished people. Southern Asia, with over half a billion, has the highest number of the chronically hungry.

produced by
Statistics Division
Food and Agriculture Organization
of the United Nations

For additional information please visit:
http://www.fao.org/economic/ess

Millennium Development Goal One Hunger Target
since 1990-92



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Sources
Progress towards MDG target: FAO Statistics Division (ESS)
Political boundaries: FAO Global Administrative Unit Layers (GAUL)

Notes
Millennium Development Goal 1, target 1C: halve, between 1990-92 and 2015, the proportion of people suffering from undernourishment, or reduce this proportion below 5 percent. Indicator 1.9 measures the proportion of population below minimum level of dietary energy consumption (undernourishment). The projection to 2015 assumes continuation of observed trends from 1990-92 to 2012-14. The assessment is not conducted for developed regions.

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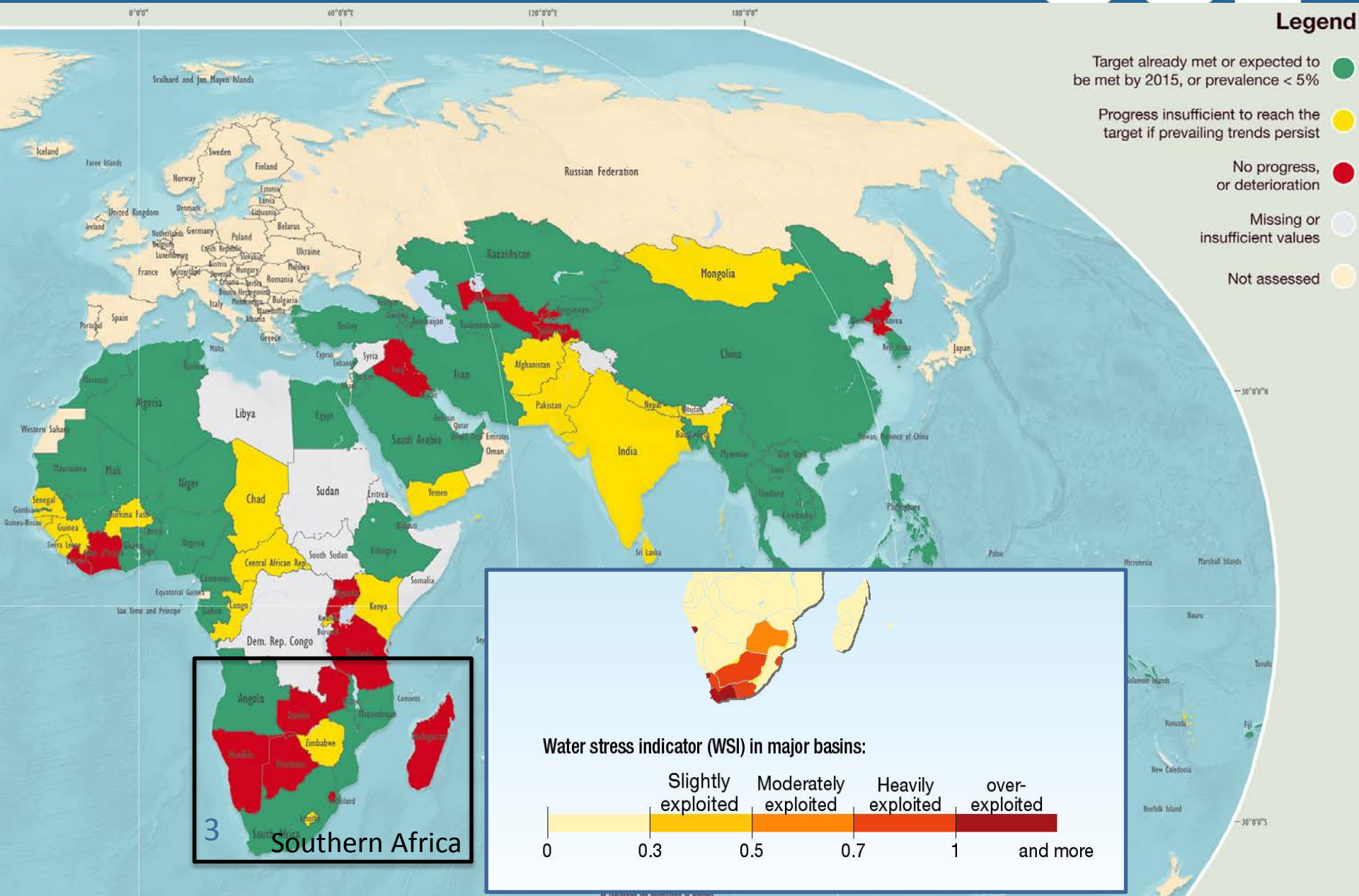
Legend
Target already met or expected to be met by 2015, or prevalence < 5%
Progress insufficient to reach the target if prevailing trends persist
No progress, or deterioration
Missing or insufficient values
Not assessed
Water stress indicator (WSI) in major basins:
Slightly exploited
Moderately exploited
Heavily exploited
over-exploited
0
0.3
0.5
0.7
1
and more
3
Southern Africa

Introduction

- High **vulnerability** of food supply & economy to **rainfall variability** and drought
  - Rainfall **highly variable** across region and seasons
  - **Agriculture** main water consumer (80%) & economic sector (30%), but mostly rainfed, with low water productivity
- Agriculture based on **maize**, but demand growing and diversifying, slow integration in world's markets; **regional integration** (SADC) promotes internal **trade**
- Potential for **water savings** through food trade due to regional **heterogeneity in water productivity**

  ➞ Global food trade shown to save 10% world irrigation withdrawal
- Implications for **sustainable development**, **food & water security**, **climate adaptation**

Objectives

1. Quantify international **trade** of staple **food** with and within **southern Africa** in the past few decades; estimate embedded water resources (**virtual water trade**)

2. Analyse **evolution** of trade connections, virtual water flows, and efficiency of trade in terms of water resources use

3. Identify **impacts** of **climate** variability; assess role of trade for mitigating **drought** effects

Data & Methods

- Southern Africa Development Community (**SADC**)
- **1986-2011** period (1991-2 and 1994-5 major dry spells)
- 8 major food products (70% total supply): **cereals & meats**

Data & Methods

- Virtual Water Content (water footprint)

$$kg_{water}/kg_{crop} \rightarrow VWC_{i,c,s} = \frac{ET_{i,c,s} \leftarrow kg_{water}/m^2}{Y_{i,c} \leftarrow kg_{crop}/m^2}$$

i: producing (exporting) province
c: crop or livestock commodity
s: source of water (blue or green)

ET, Y: Evapotranspiration and Yield from H08 hydrological model

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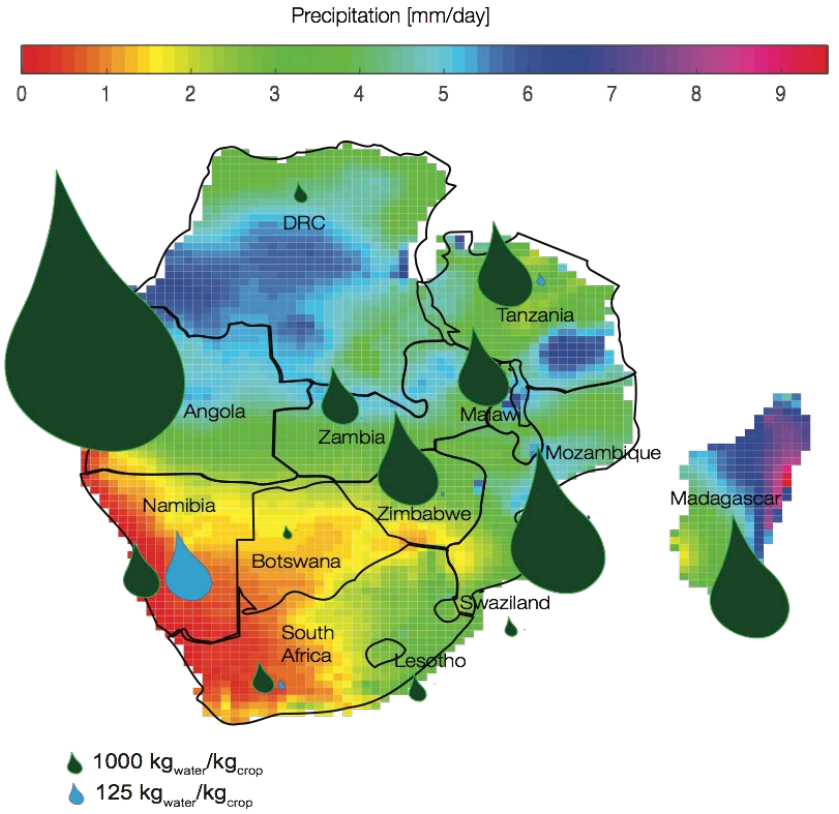
- Virtual Water Trade (embedded water in trade)

$$kg_{water} \rightarrow \quad VWT_{i,j,c,s} = VWC_{i,c,s} \cdot T_{i,j,c} \quad \leftarrow kg_{crop}$$

T: detailed international food trade (annual, per commodity) from FAOSTAT

Results I - Regional VWT

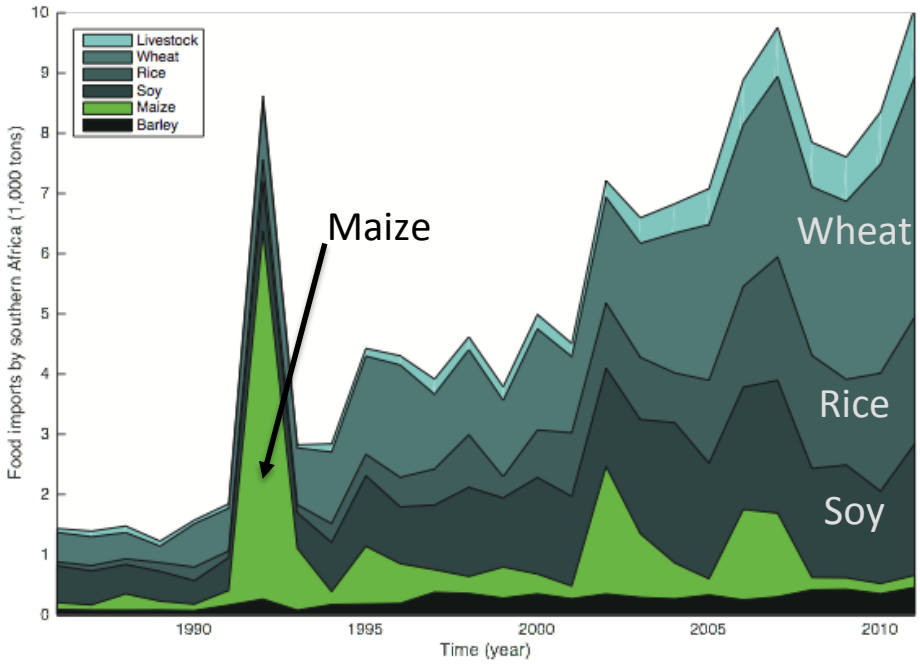
- **Low water productivity** & **yields** (water + nutrient limitations)
- **Drier areas** have much **higher yields** and thus better productivity. Trade from dry (South) to wet (North) **saves water**!… but is **unsustainable.**
- Need to develop **ag in North** and facilitate **North-South trade**



Rain and irrigation water per kg of maize

Results II - Extra-regional VWT

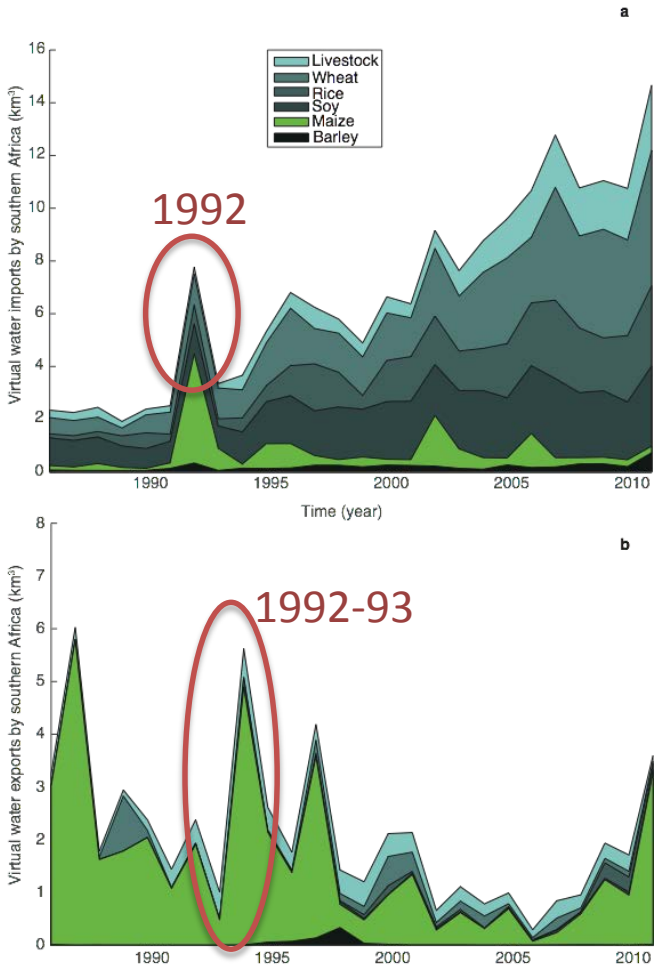
- Net importer of food from RoW, **imports x10** in 26y !
- Much higher WP in partners countries, so extra-regional imports lead to **water savings**.
- Policies: increasing trade openness; the region actually saves even more water



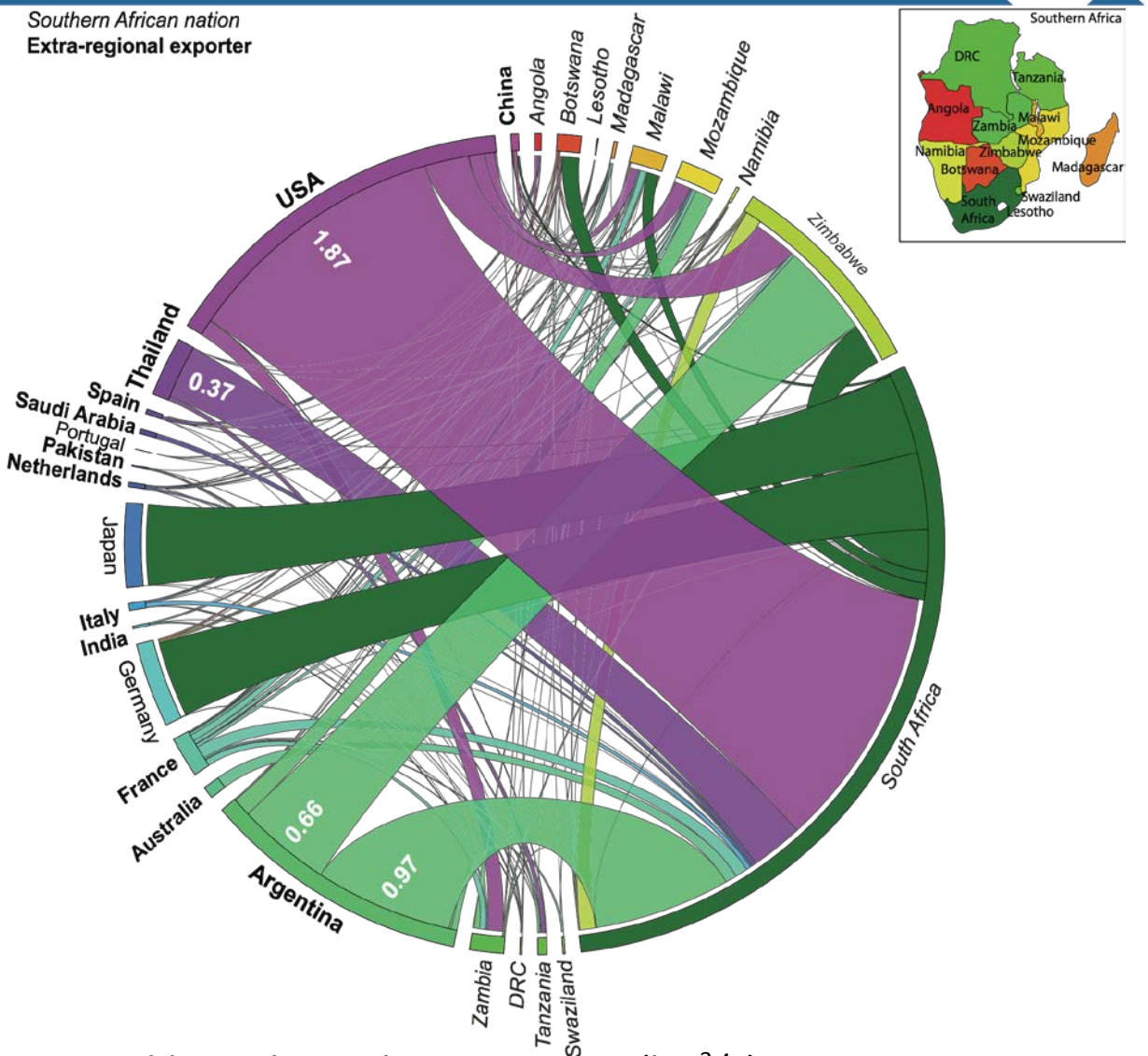
Food imports by southern Africa over time

Results III - Drought impacts & trade

- 1992 drought: maize **yields divided by 3**
- **Extra-regional imports peak** to buffer shocks (up to 350% of national maize production, usually < 25 %)
- Large **rebound of extra-regional exports** after drought: mitigate economic shock/ trade imbalance



Virtual water imports and exports over time



Additional virtual water imports (km^3/y) in 1992 vs. 1991

Conclusions

- Regional food trade **follows water productivity** patterns (water efficient), but goes **against water scarcity** patterns (risk for water and food insecurity)
- Southern Africa is **net food importer** with growing, water efficient imports, going through South Africa and Zimbabwe (hubs)
- Important role of outside partners to **buffer drought-induced production shocks** (extreme events)

Dalin C. and D. Conway, **Water resources transfers through southern African food trade: water efficiency and climate signals** (2015) *Environmental Research Letters* Focus Issue on Food, Trade and the Environment (In Review)

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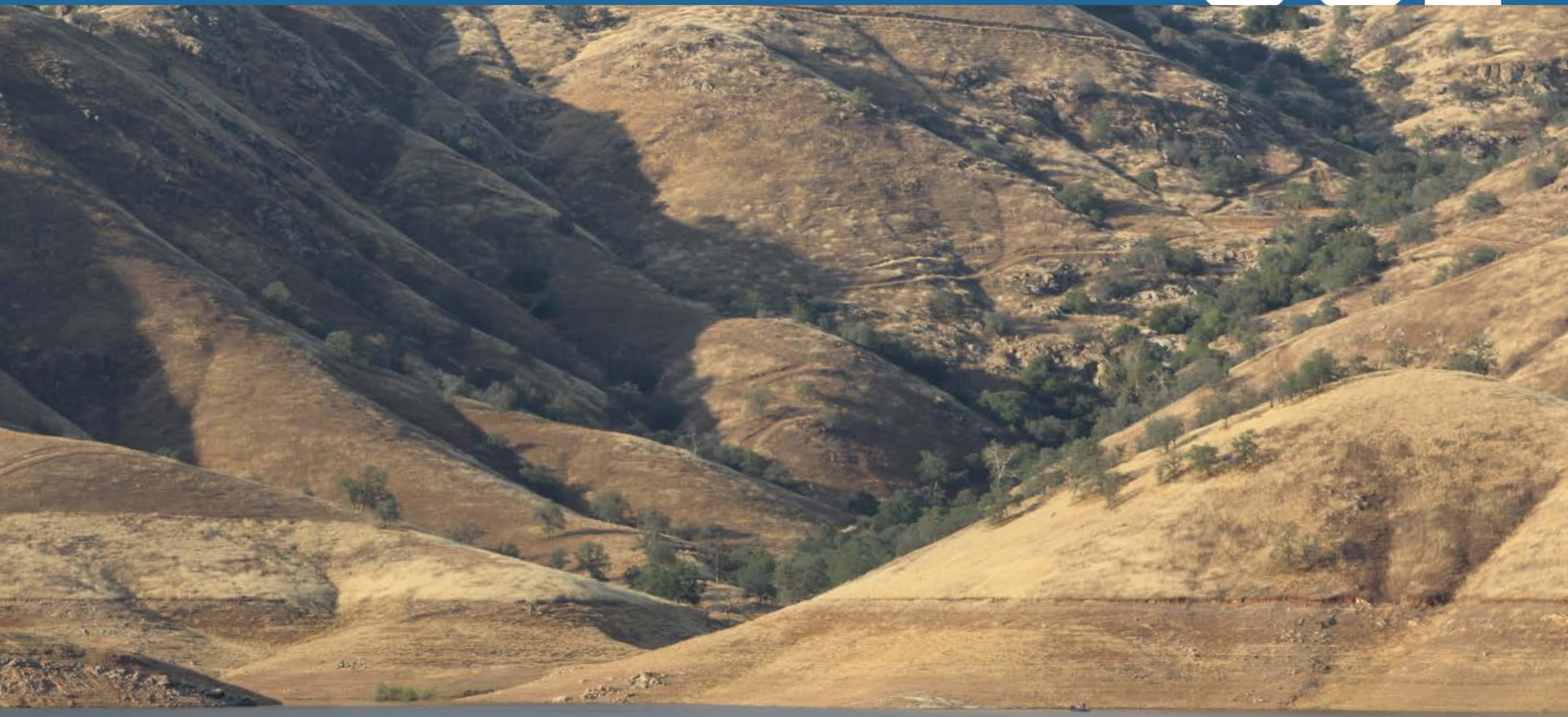

Thank you for your attention

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Back up slides

Data and Methods

Linear regressions between climate influences and measures of agricultural productivity and trade

- Seasonal **precipitation** and **drought index** (October to May) obtained from 0.5 daily datasets (PDSI and cumulative rainfall, average weighted by proportion of cropland).
- Crop **yield**: 1.125 annual datasets from 1982-2006, for maize, soy, rice, and wheat.