

Impact of climate variability on global hunger and food production systems



RESEARCH PROGRAM ON
**Climate Change,
Agriculture and
Food Security**

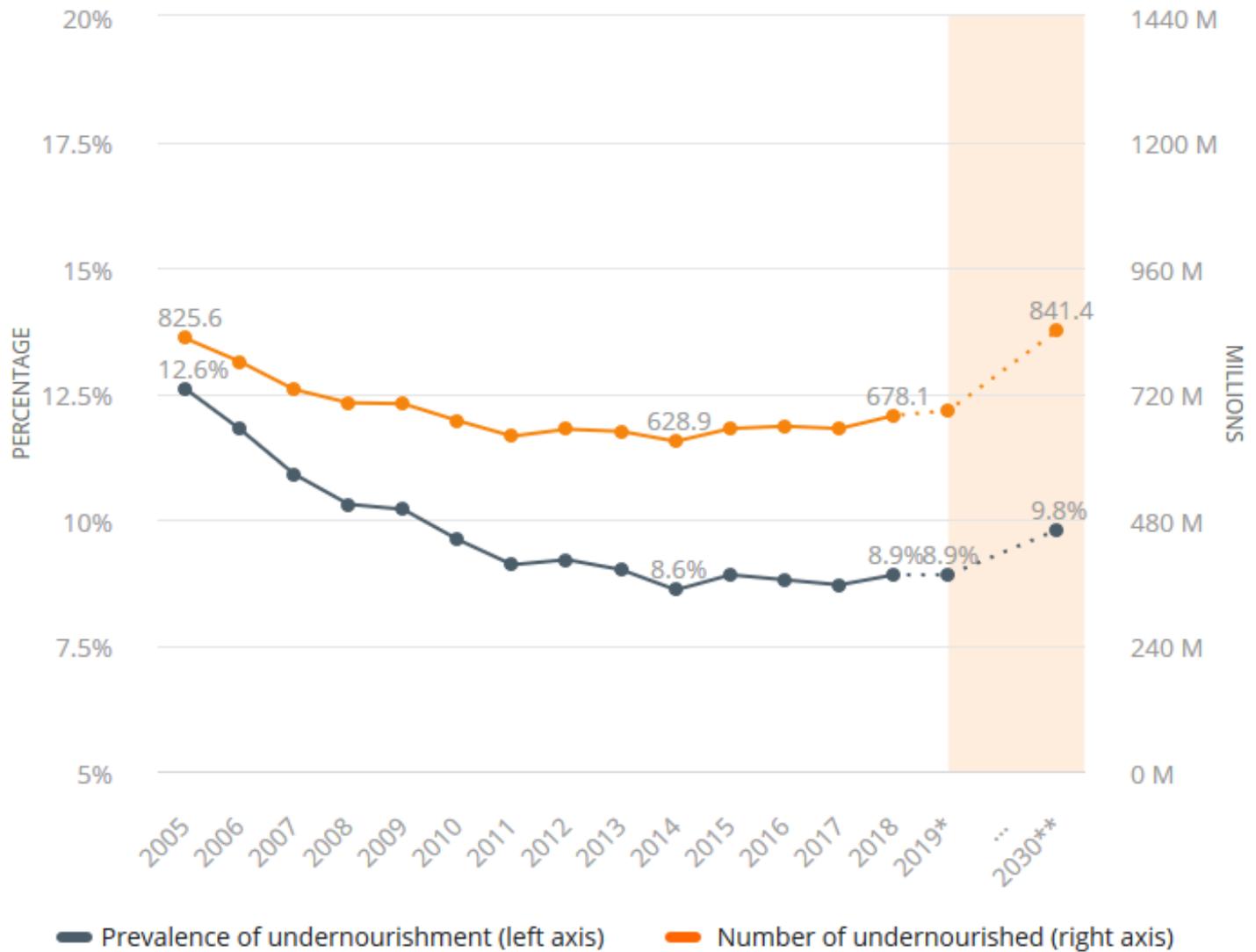


Philip Thornton

Global Food Security Cluster Partners Meeting

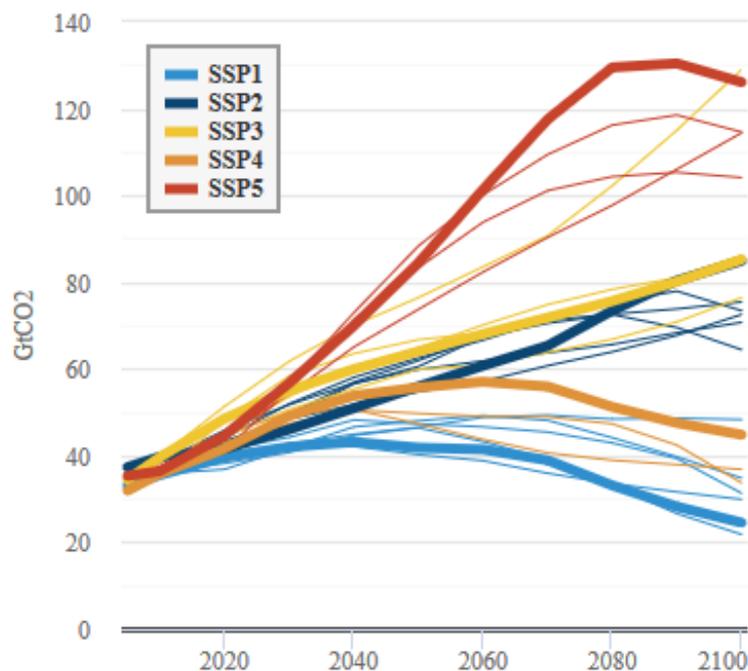
11 November 2020

How are we doing in relation to SDG2?

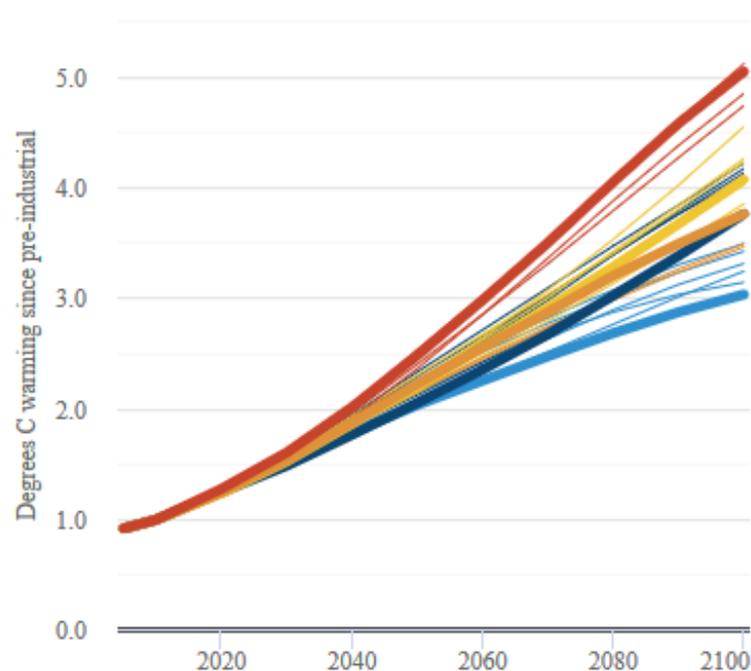


Why is progress towards SDG 2 going to get much harder?

CO₂ emissions for SSP baselines



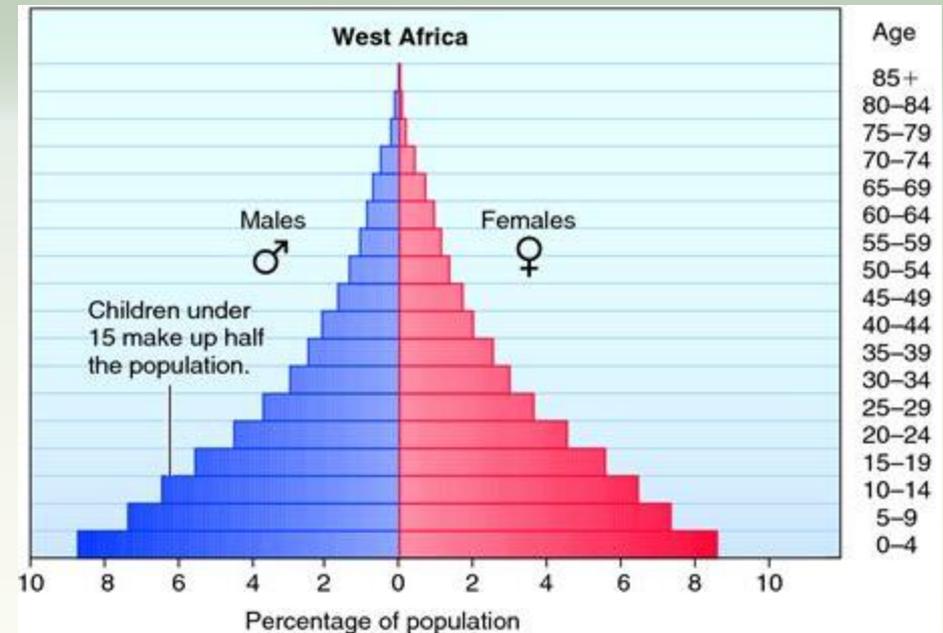
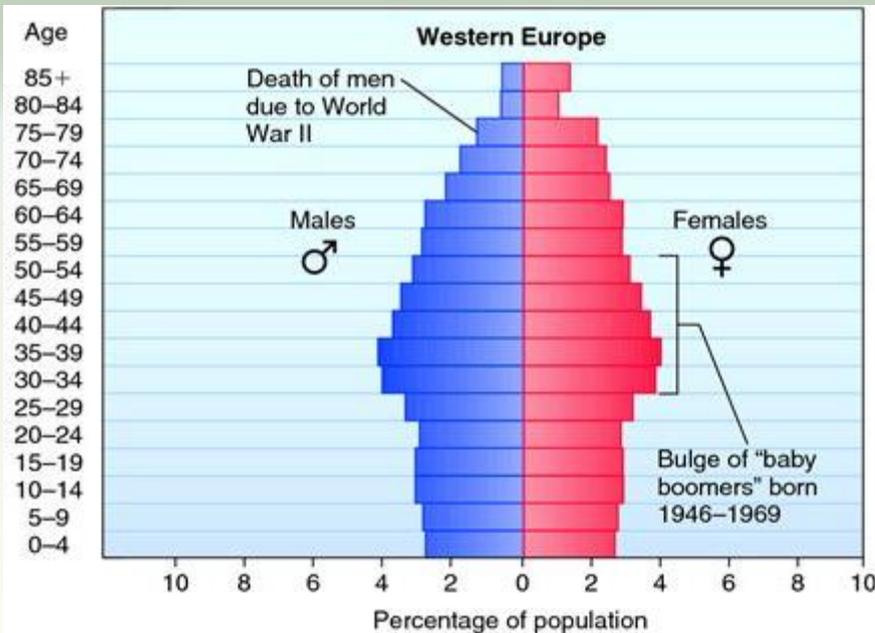
Global mean temperature



Even with a low-emissions future, which includes drawing down already-emitted CO₂ later this century, we still have baked in +2°C of warming by 2050 and nearly +3°C by 2100

What will things look like by mid-century?

Demographics



Population growth

- Sub-Saharan Africa: 800 million → 2.1 billion by 2050, 3.8 billion by 2100

Urbanisation

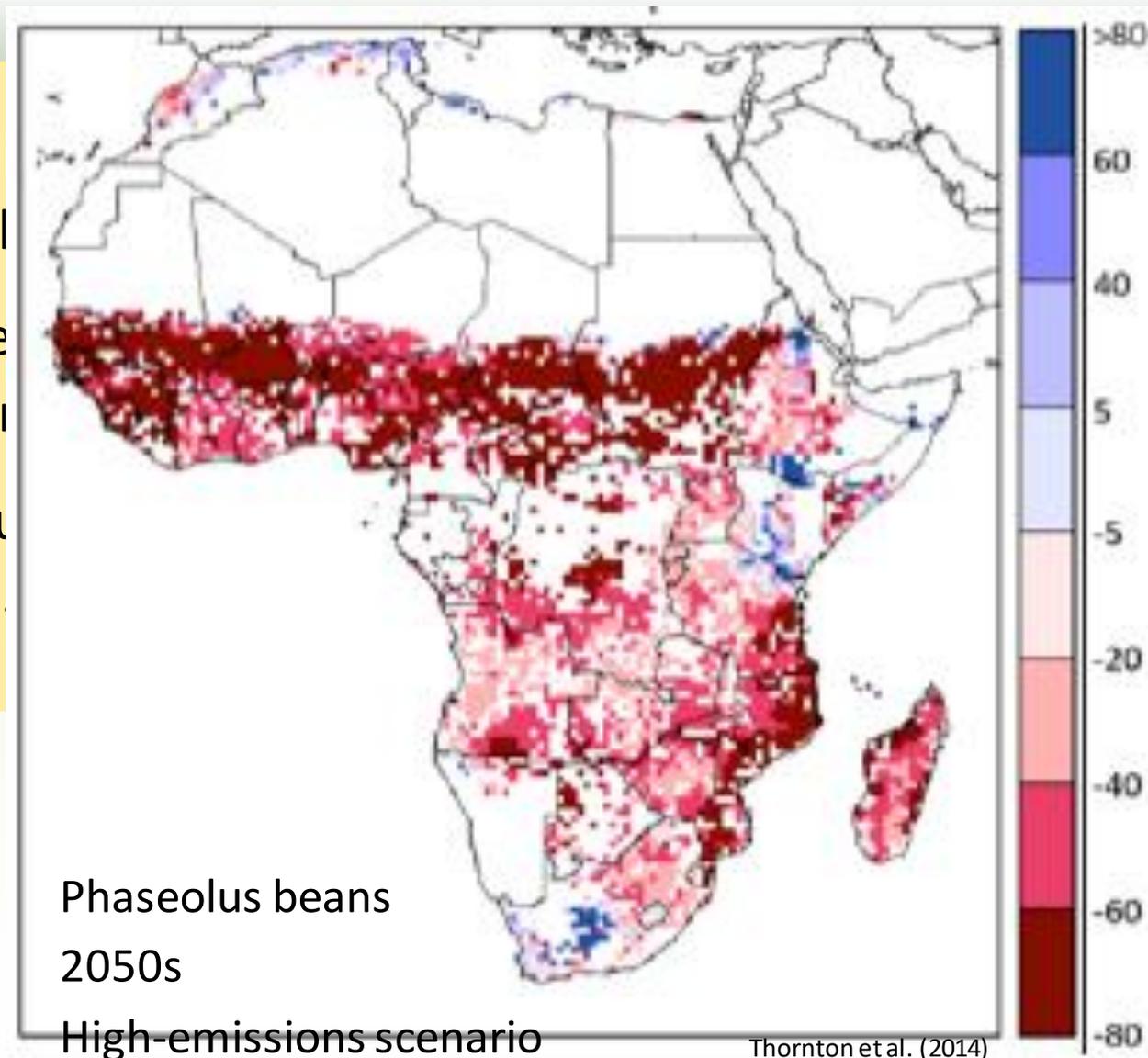
- Africa: 36% urban now, 50% by 2030

→ Huge implications for economies, labour supply, food systems

What will things look like by mid-century?

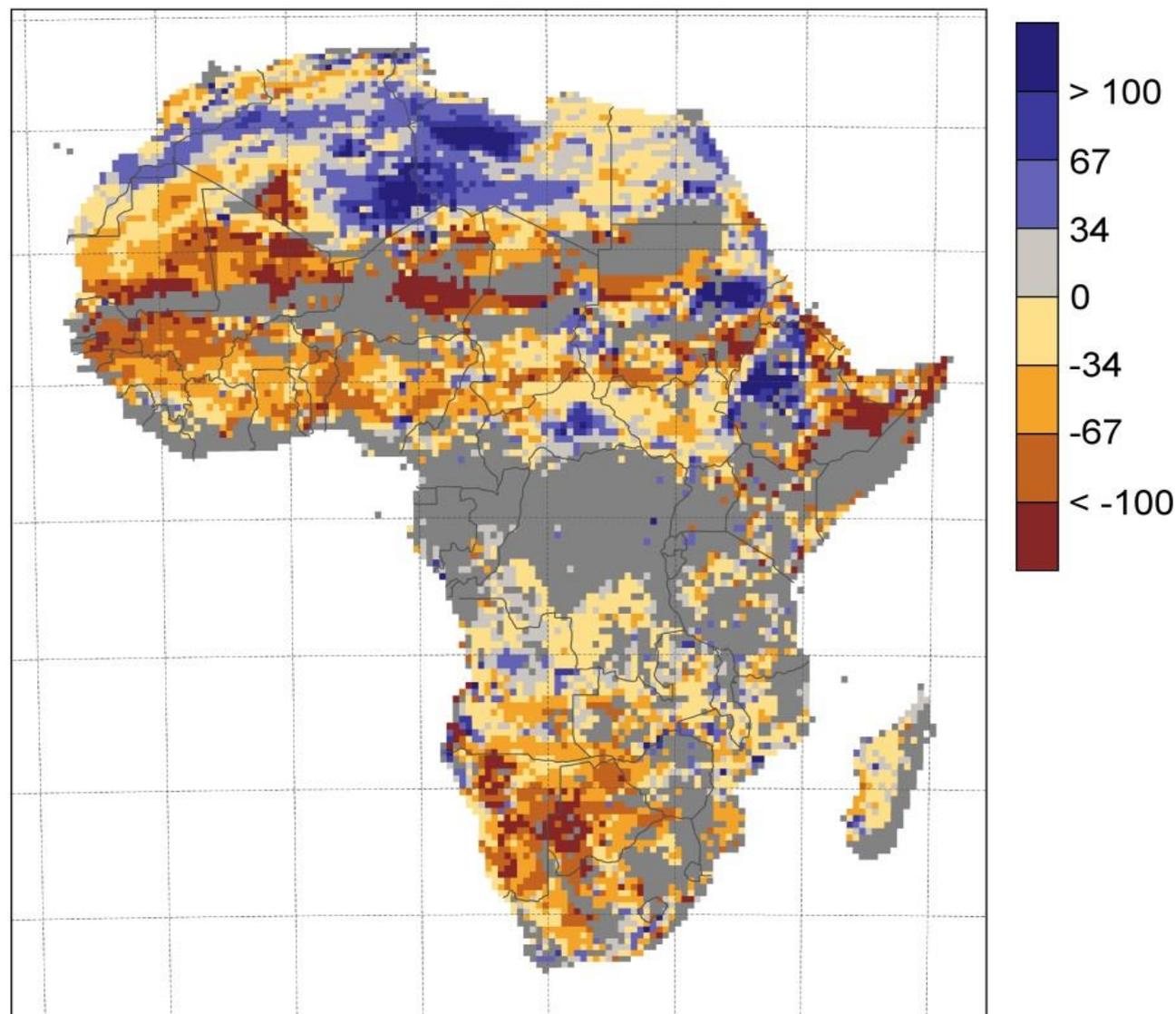
Crop production

- Climate change is already here; we've already seen it
- Tropics are more vulnerable than temperate regions
- Poor are more vulnerable than rich
- Impacts are getting worse



What will things look like by mid-century?

Livestock production



Projected changes
in Aboveground
Net Primary
Productivity
(ANPP) in Africa's
rangelands

2050s, high
emissions
scenario,
compared with
1971-1980

What will things look like by mid-century?

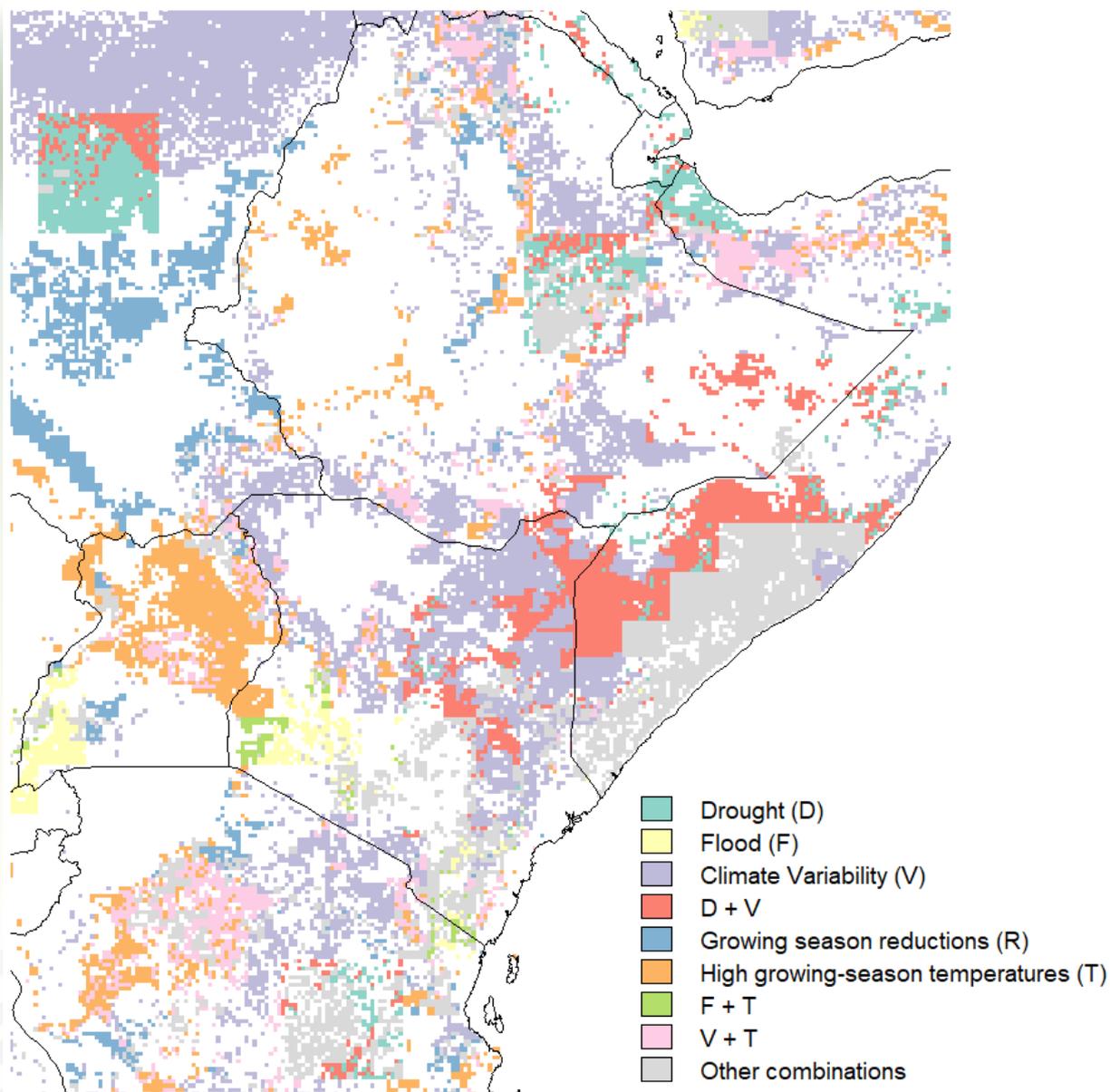
Natural disasters worldwide – trending upwards?

-  Climatological events (extreme temperature, drought, forest fire)
-  Hydrological events (flood, mass movement)
-  Meteorological events (storm)
-  Geophysical events (earthquake, tsunami)



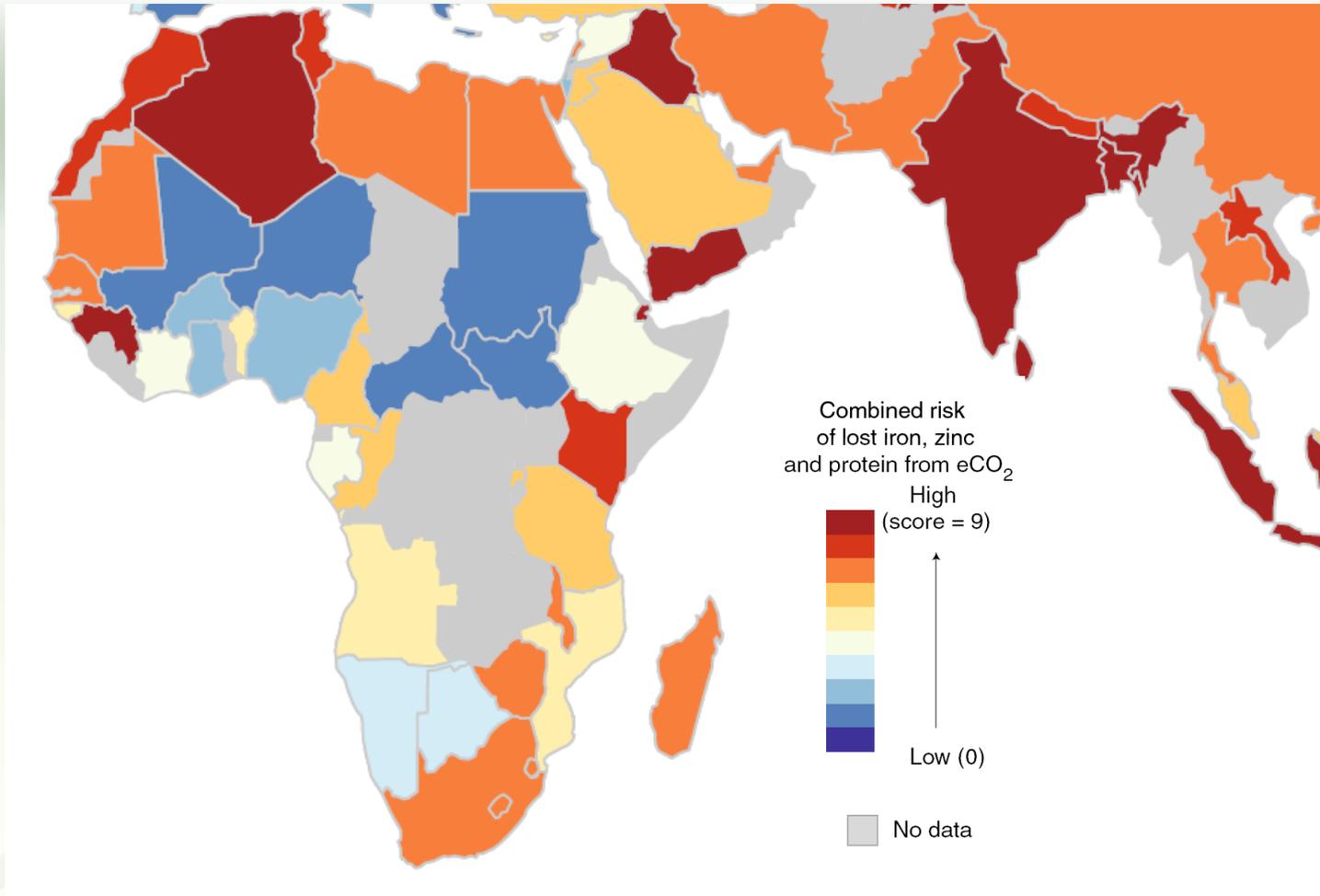
What will things look like by mid-century?

More climate hazards affecting agriculture



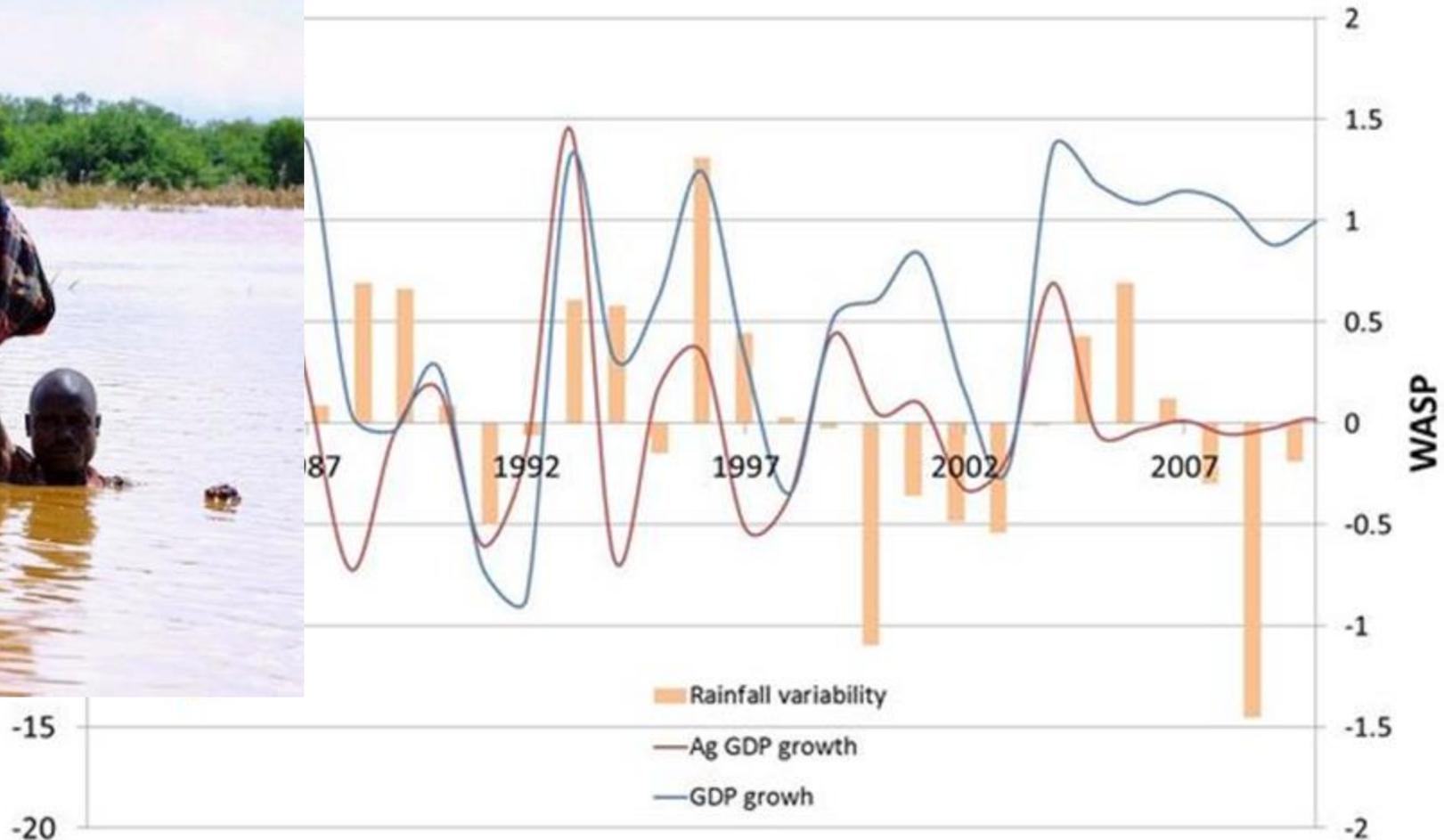
What will things look like by mid-century?

People's nutrition at risk



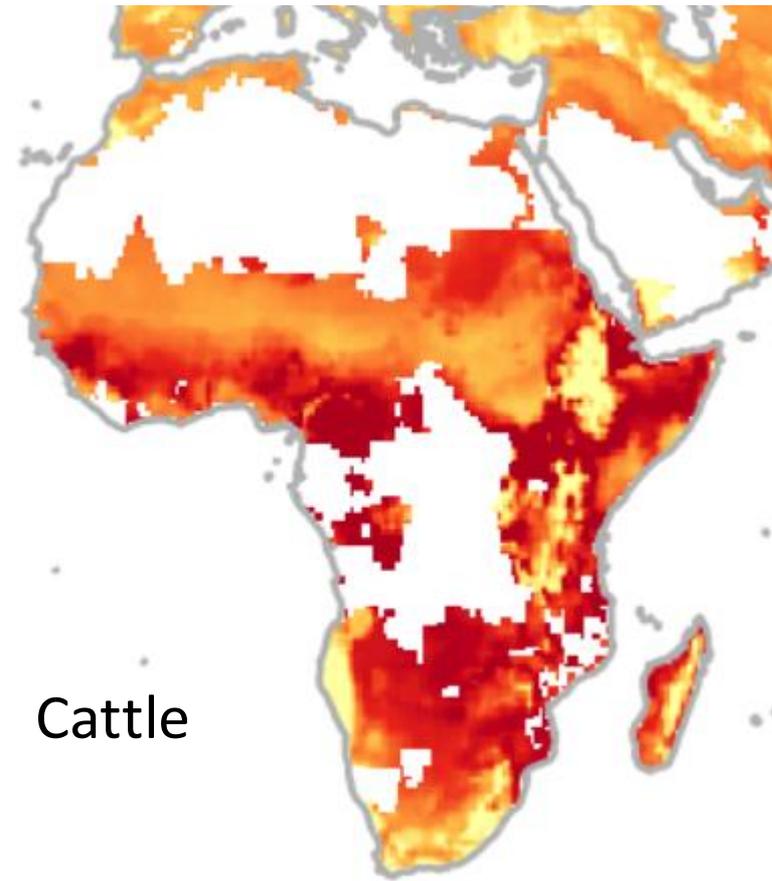
- CO₂ fertilisation in C3 crops: more carbohydrates produced at the expense of other nutrients
- 175 million more people zinc deficient (122 million protein deficient) by 2050 owing to 550 ppm CO₂
- Similar for forages: 60% of grasses globally are C3 and susceptible to CO₂ effects on nutritional quality

Climate variability matters at different scales

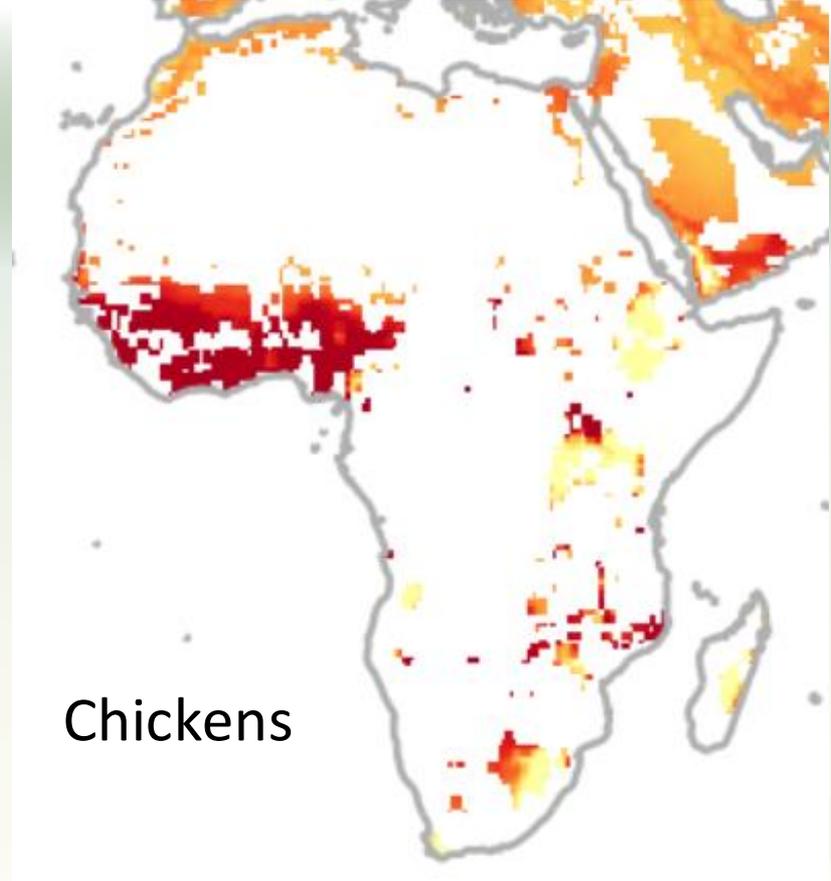
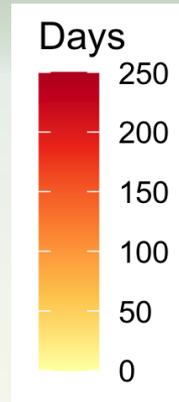


12-month Weighted Anomaly of Standardized Precipitation (WASP) and growth in GDP and agricultural GDP (data from data.worldbank.org/indicator and the IRI data library, iridl.ldeo.columbia.edu/)

Climate variability matters at different scales



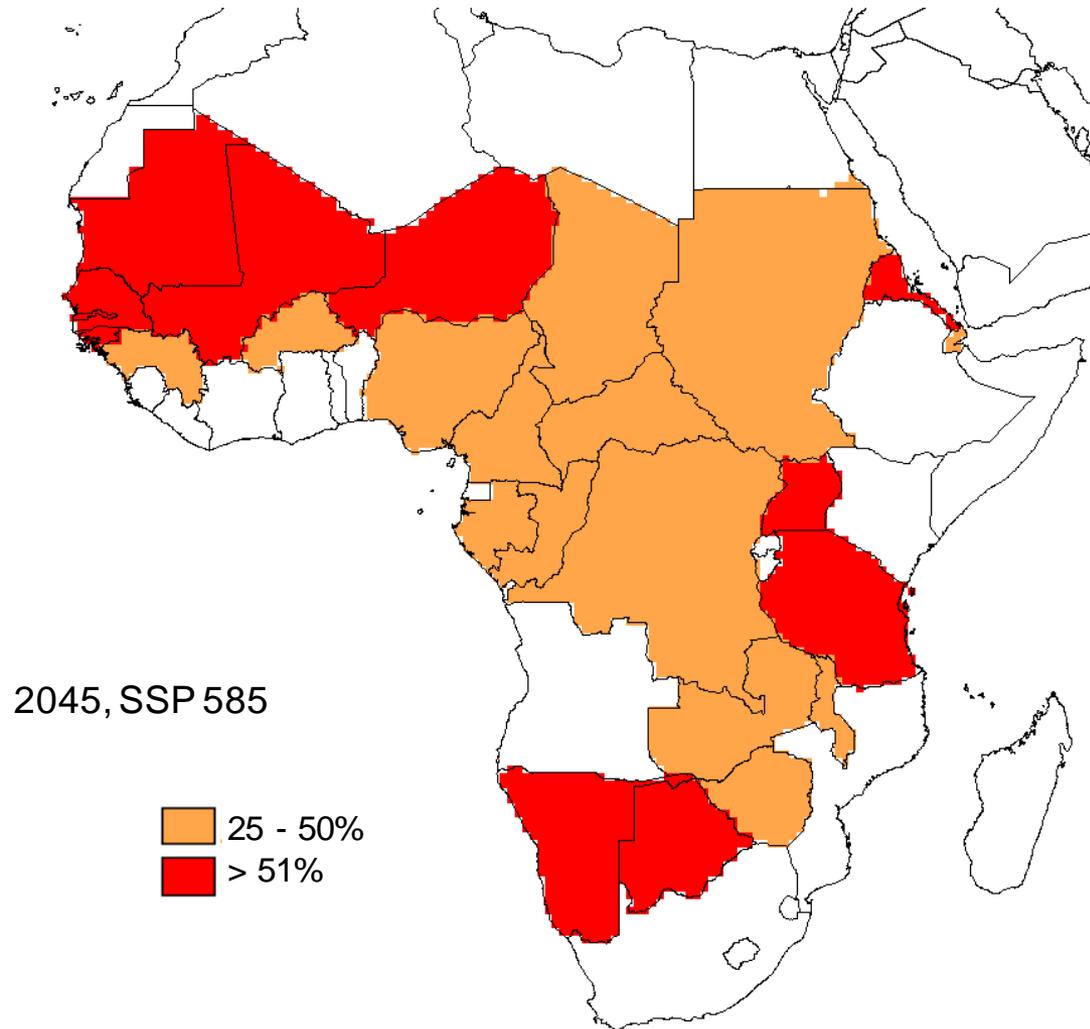
Cattle



Chickens

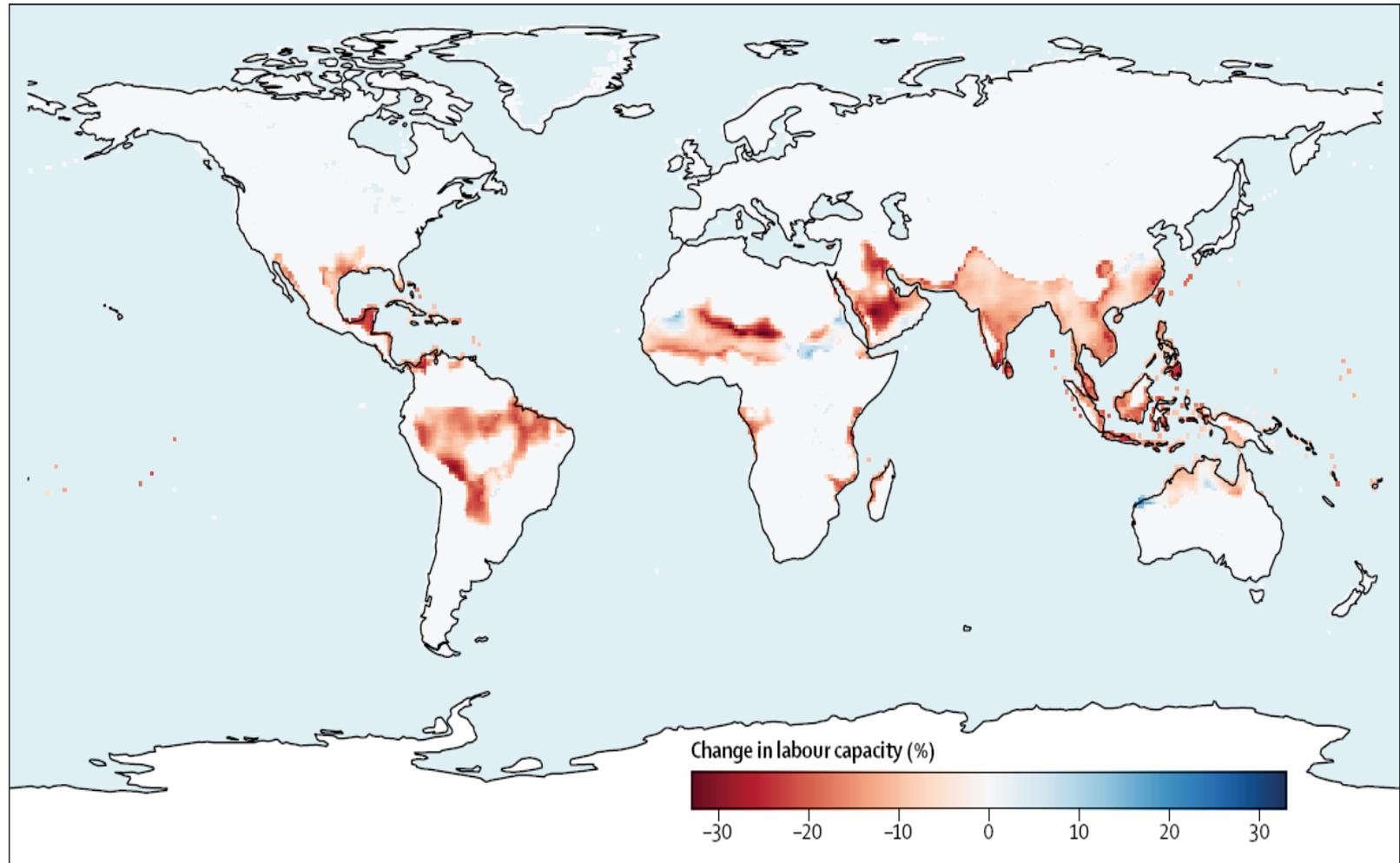
Change in the number of days per year above “extreme stress” values from 2000 to end-century (high emissions scenario)

Climate variability matters at different scales



Country hotspots of value of milk production loss due to dairy cattle heat stress compared with 2005

Rural labour capacity loss due to extreme, seasonal heat exposure: change in 2006-2016 relative to the 1986–2008 average



What will things look like by mid-century?

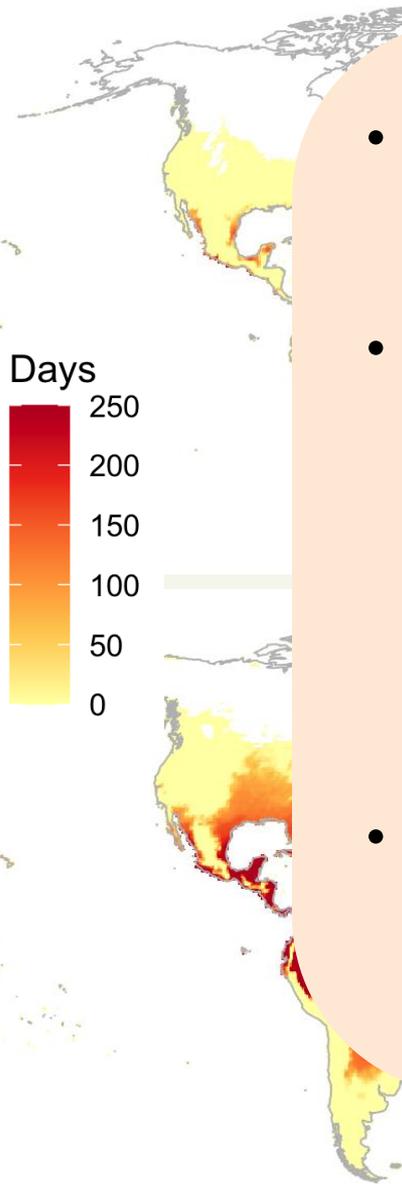
People's ability to work outside in the fields

- Increased human morbidity and mortality associated with heat stress
- Increased incidences of chronic kidney disease in agricultural populations (already being seen in Central America, southern Africa), due to heat stress / dehydration, possibly compounded by exposure to toxic agrochemicals
- Impacts of heat stress on human health not that well understood

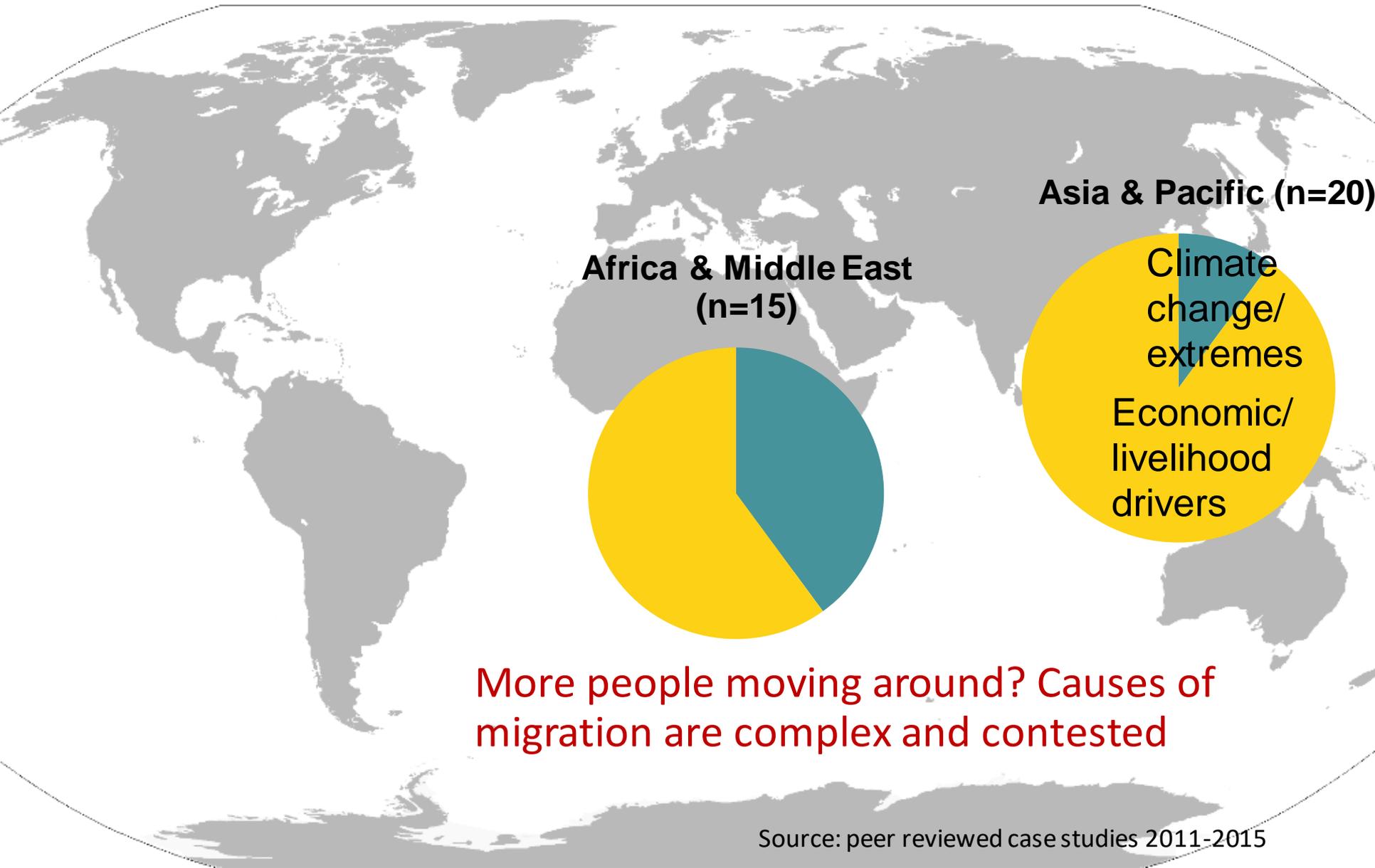
Number of days per year where physical capacity is <50%

Maximum physical output from someone under moderate-heavy work conditions.

High CO2 emission scenario



What will things look like by mid-century?



Asia & Pacific (n=20)

Climate change/ extremes

Economic/ livelihood drivers

Africa & Middle East (n=15)

More people moving around? Causes of migration are complex and contested

What will things look like by mid-century?

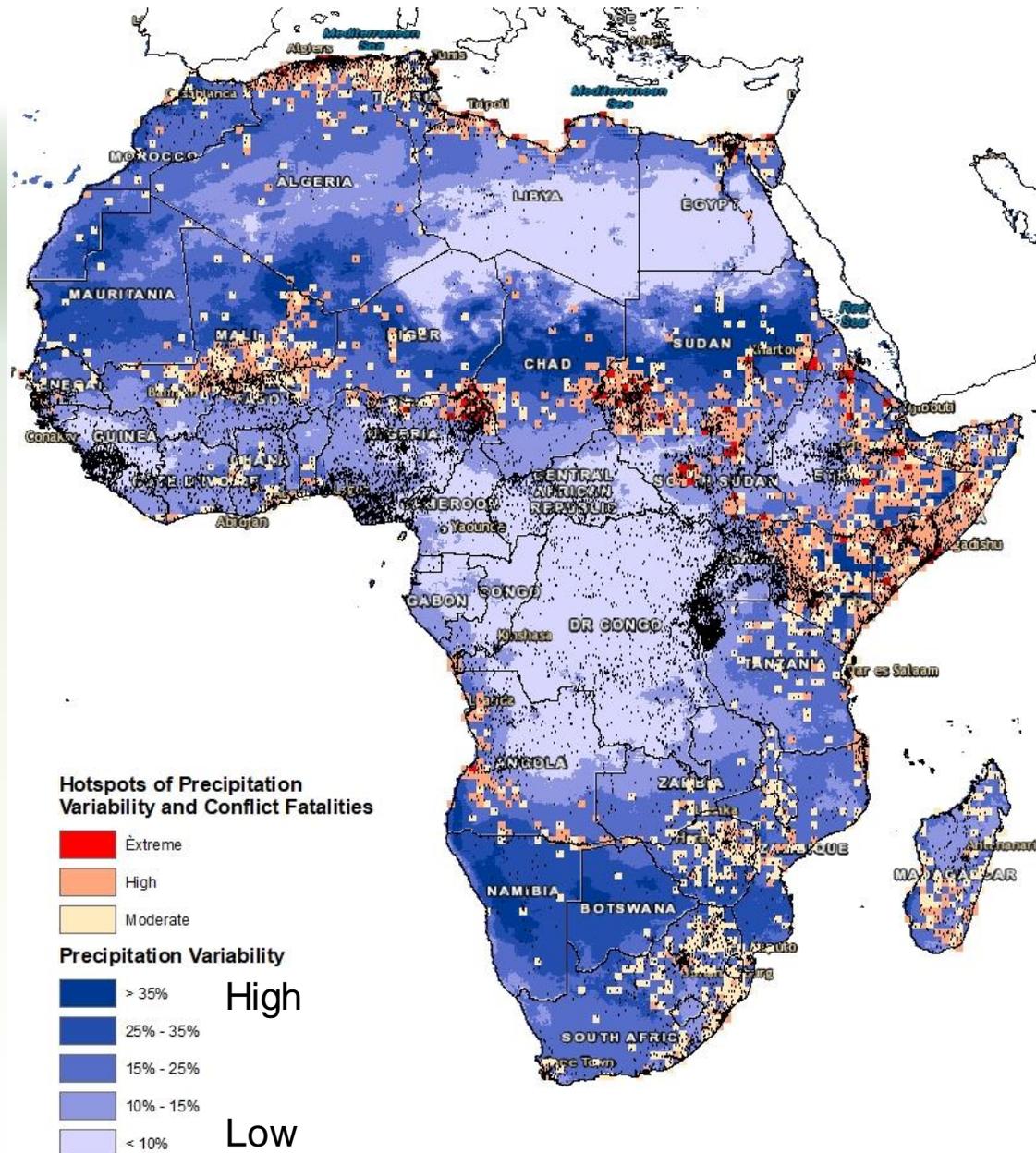
Rainfall variability: annual CV% (CHIRPS v2.0 data between 1981 and 2018)

Fatality data: Armed Conflict Location & Event Data Project (ACLED) database and subset for events in Africa

“Hotspots”: areas where fatalities coincide with >15% rainfall CV

What about future rainfall CV?

Precipitation Variability and Loss of Life due to Violence



What will things look like by mid-century?

If things don't change, for vulnerable people in the lower latitudes:

- Poorly-performing crops and livestock – some staple crops in some places will not be able to be grown
- More year-to-year variability in yields and household income, more frequent “bad years”
- Less nutrient-dense crops in people's diets
- Less field work possible because of heat stress, fewer workers anyway because of urbanization and an aging rural population

→ More movement of people, more hunger, more conflict over natural resources seem inevitable ...

Major challenges if SDG2 is to be achieved by 2030

- How best to identify appropriate short-term and long-term interventions in complex food systems
- Effects of interventions not easy to envisage: socioeconomic and environmental outcomes interact in complex ways
- Dealing with a wide range of power, vested interests, fragmented governance
- Avoiding marginalisation of the poorest
- 2030 is only 10 years away

But opportunities too

Our understanding is increasing all the time of:

- likely effects of short-term, long-term climate change
- where they will be felt

Making incremental, beneficial changes:

- Do better targeting of interventions
- New crops, different varieties
- Different livestock species
- Encourage “mixed” systems – crops, livestock, fish, trees, ...
- Put in place early warning systems for early action
- Provide weather forecasts, seasonal forecasts
- Insurance products bundled with crop and other inputs

When incremental changes won't be sufficient, food system transformation may be needed ...

Tigray, Ethiopia: Semi-arid conditions and high rainfall variability contributed to significant waves of famine in the past. Drastic positive change—irrigated land area increased from 40 hectares to 40,000—achieved through collective action and local leadership

Langui, Peru: Changes in climate and markets have reduced farmers' harvests. Communities shifted from growing traditional staple crops to planting improved varieties of grasses for dairy production, opening access to a whole new dairy market

Vietnam: Dietary patterns in Vietnam have experienced dramatic changes during the last few years. This transition aligns with the national nutrition strategy, for which the 2012 goal was for 50% of Vietnamese households to achieve a dietary balance by 2015. By 2014, half of the population had a diet balance close to the ideal

Addressing the challenges

- Better links between the disaster risk community and the agricultural research-4-development community – use “climate-resilient development pathways” as a common framework?

“... continuing processes for managing climate and other driving forces that affect development, combining flexibility, innovativeness, and participative problem solving” (IPCC, 2014)

- Better targeting of interventions – and what are the “limits to adaptation” in any place, that may increase migration, conflict?
- More effective use of early warning systems, “next-gen” seasonal & weather forecasts, and other risk management tools
- Use some of the pipeline of novel and near-ready technologies (e.g. ICT, drones, big data approaches to monitoring and forecasting)
- Effective communication with farmers about using stress-tolerant interventions, using mobile phone apps, radio, TV

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