



Societies are getting older – developing countries more urbanized and planet earth hotter!  
What is the future role of international agricultural trade?

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'Food security, safety and sovereignty'

24th Annual Conference of the

Austrian Society of Agricultural Economics, Vienna,  
September 26-26, 2014



# Content

- Major challenges
  - Ageing societies
    - ,Societies are getting older'
  - Urbanization
    - ,Developing more urbanized'
  - Growing population
    - not mentioned in the title!
  - Climate Change
    - ,Planet earth is heating up'
  - Food security, safety and sovereignty





# Content

- Research question:

What is the future role of international agricultural trade?

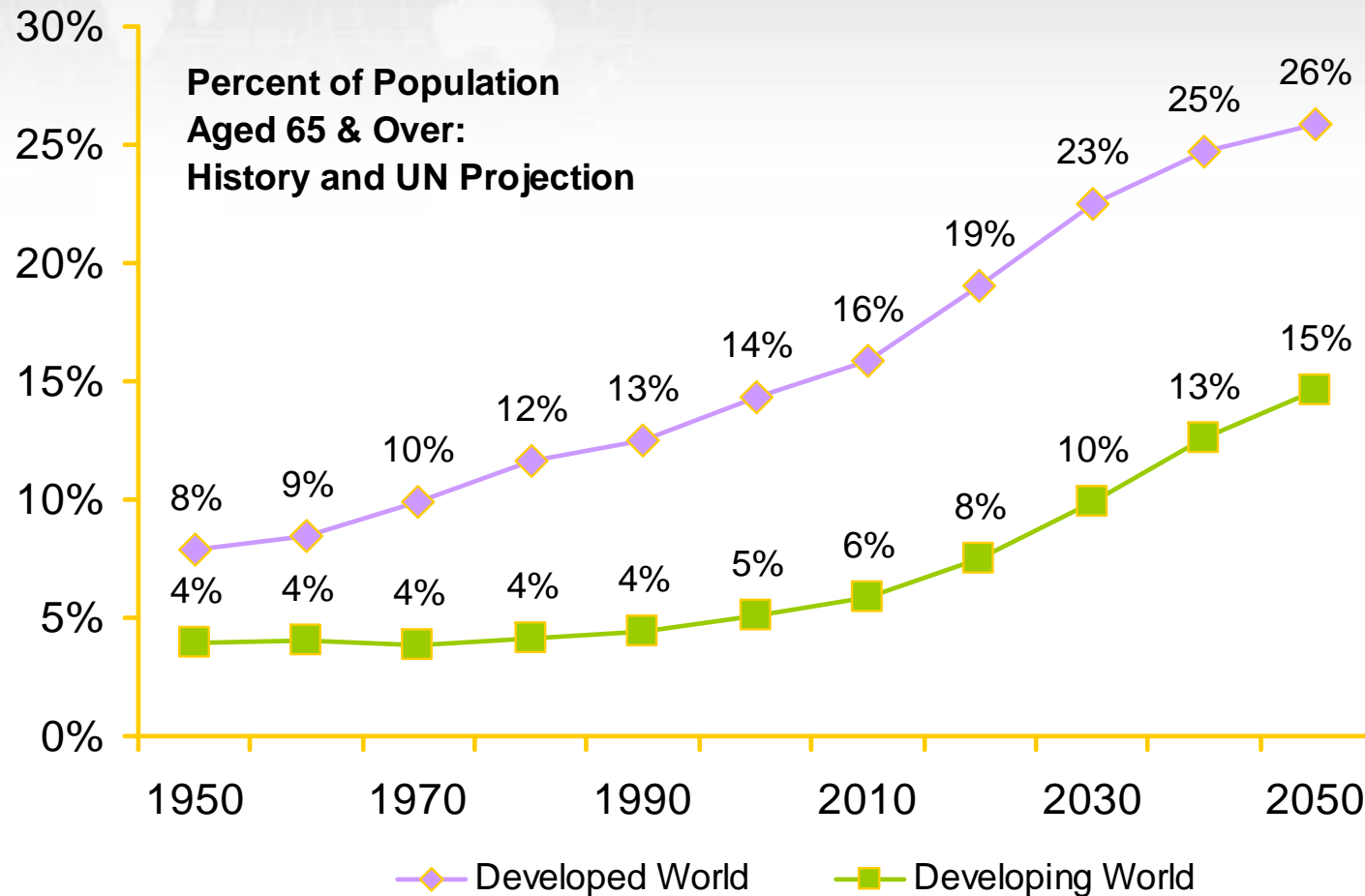




# Ageing

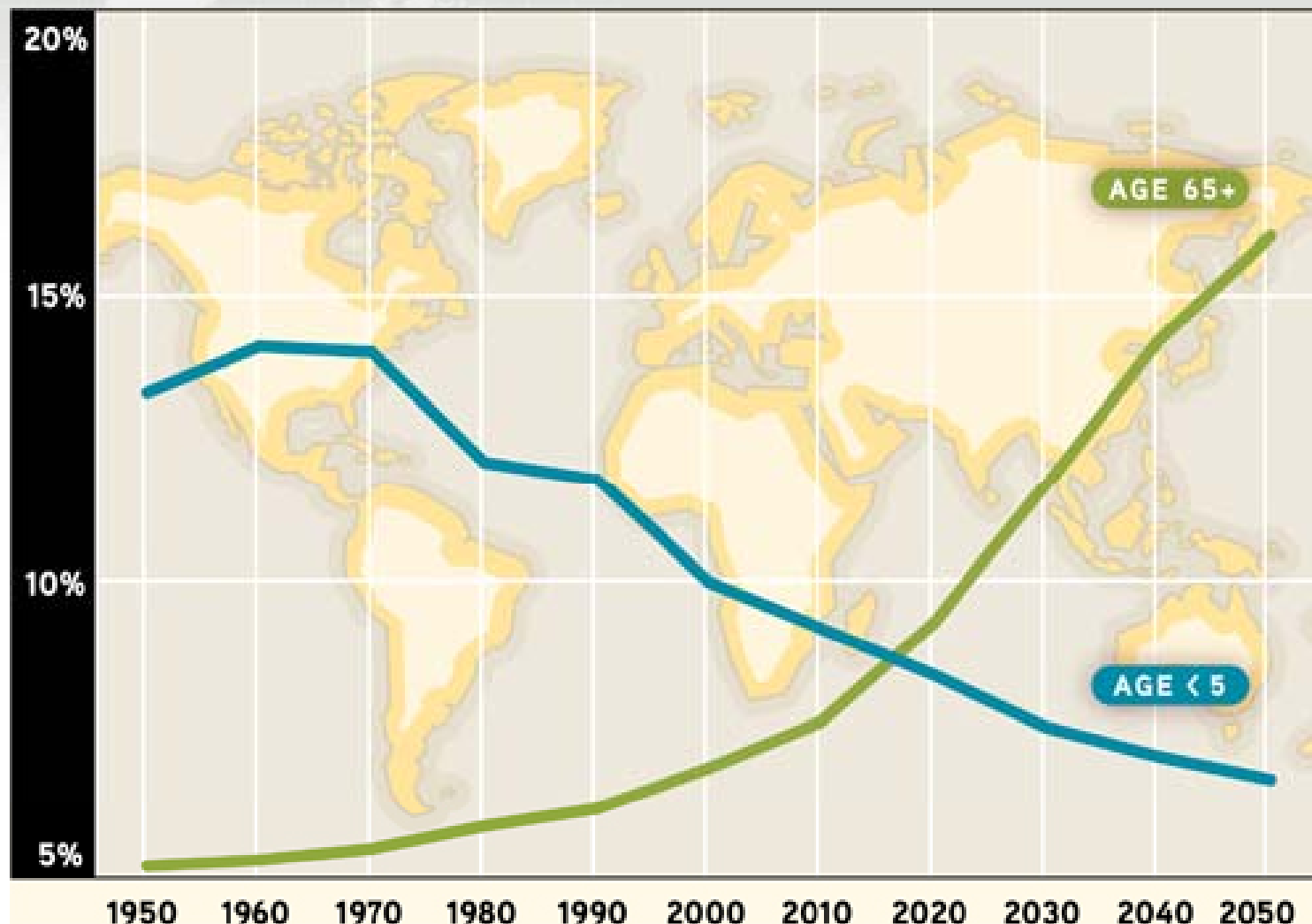


# Trends in Global Ageing



Source: UN (2005)

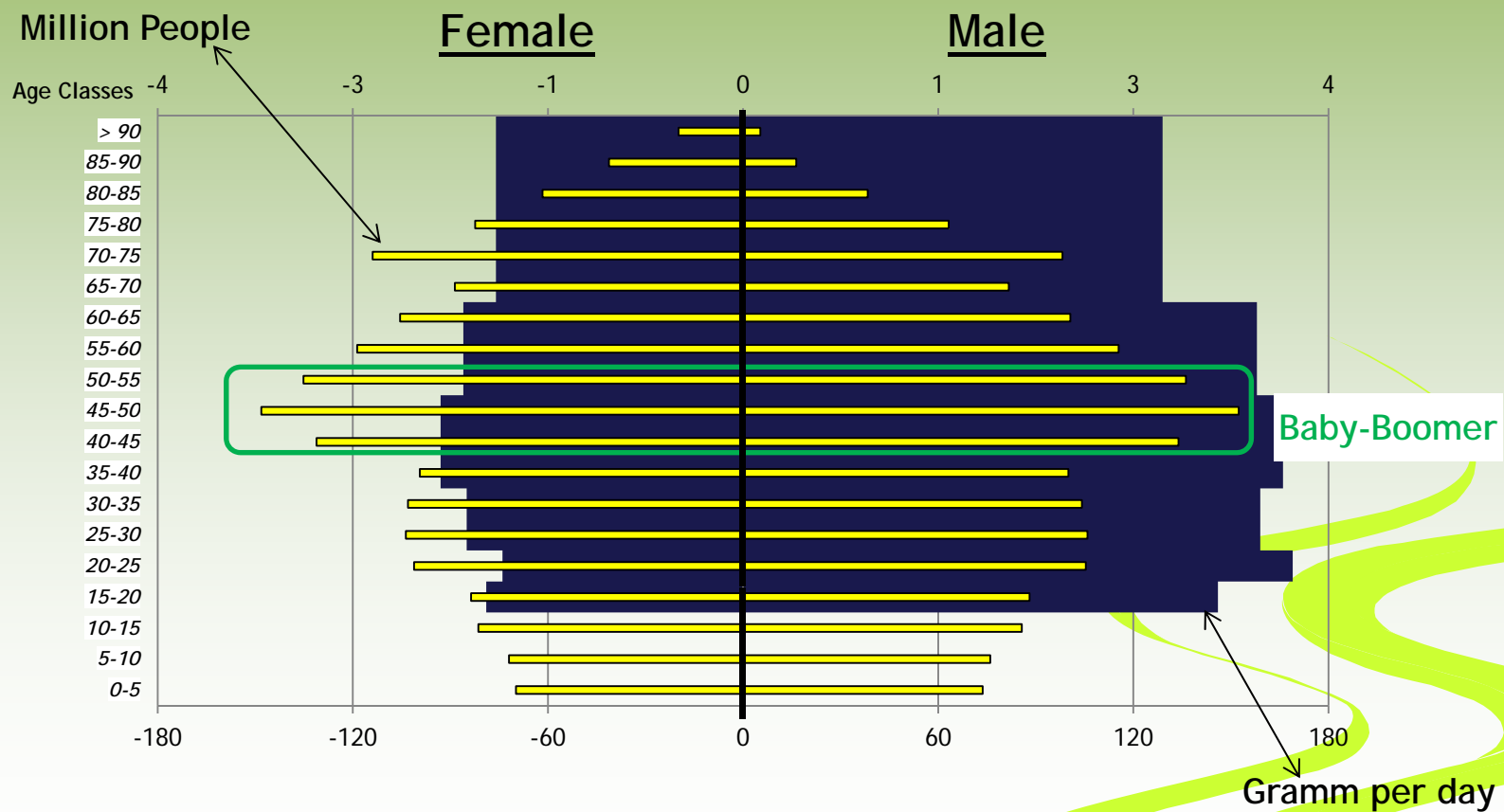
# Young vs. Old – trends in global ageing



Source: United Nations Department of Economic and Social Affairs, Population Division. *World Population Prospects. The 2004 Revision*. New York: United Nations, 2005.



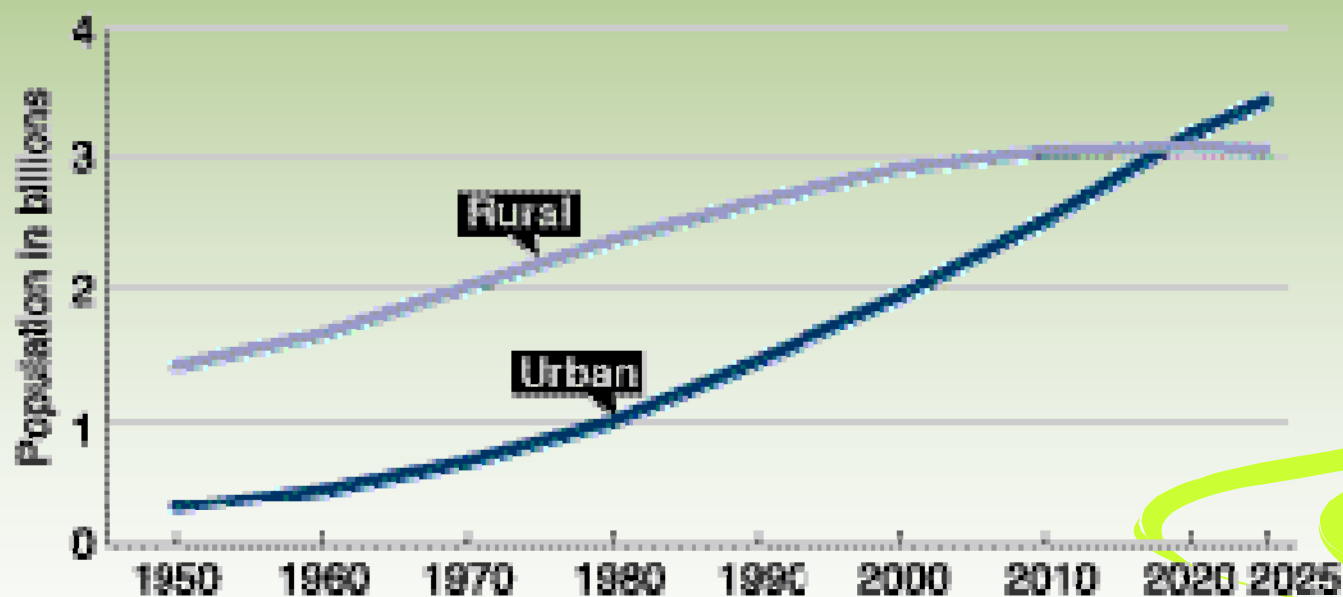
# Meat Demand, Germany 2013



Source: Efken (2014).



# Urban and Rural Population, Less Developed Countries 1950 to 2025

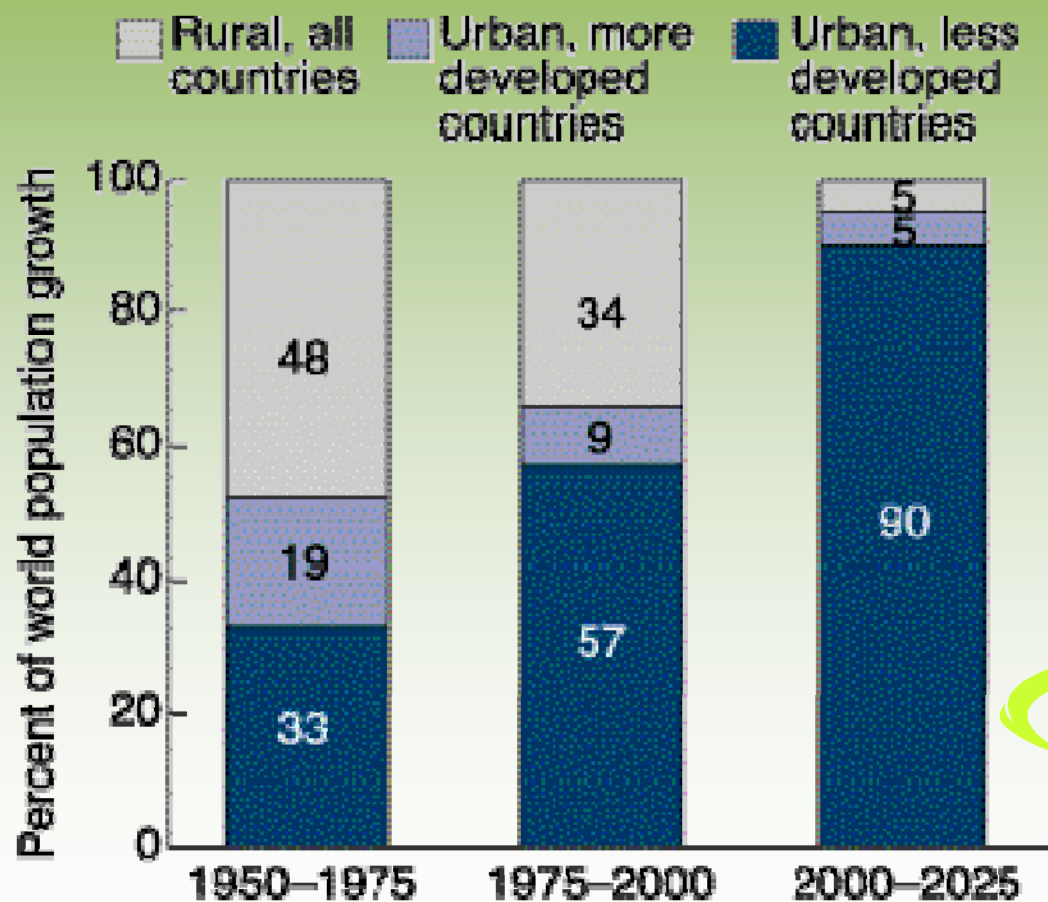


Source: United Nations





## Share of World Population Growth Urban and Rural Areas LDCs and MDCs 1950 to 2025



- Over the next quarter century, increases in urbanization will be almost entirely attributable to sub-Saharan Africa and Asia

Source: United Nations

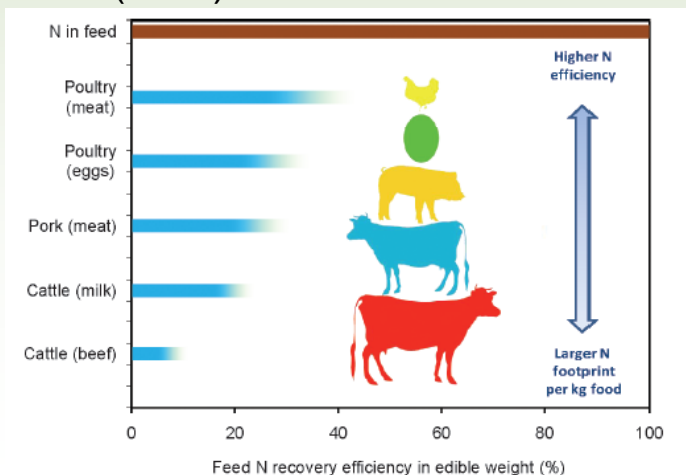


# Growth in global food demand

This is a good thing!

- 35% more mouths by 2050
  - Mainly in Asia, Africa and S. Am
- Richer people eat more:
  - ~5bn people in middle class by 2030 (~1.8bn now),
  - with associated higher consumption
  - Mainly in Asia
- 70% urbanised
  - Understanding of food systems
- All add up to increased global food demand (FAO estimate 60% more)

Animal protein expensive in resources to produce (ENA)



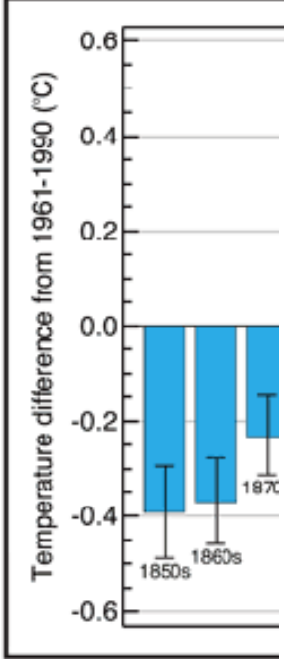


# Climate Change

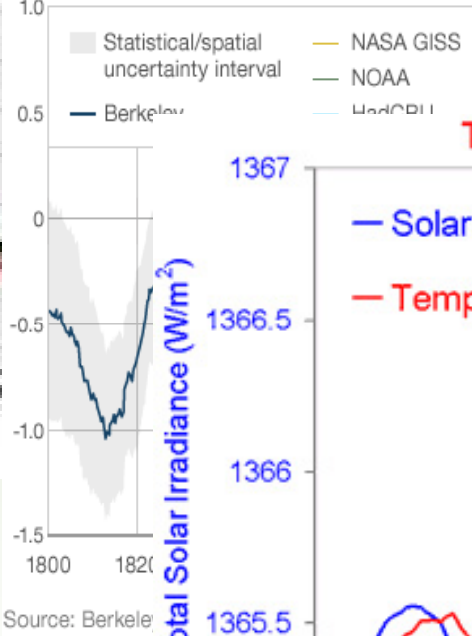
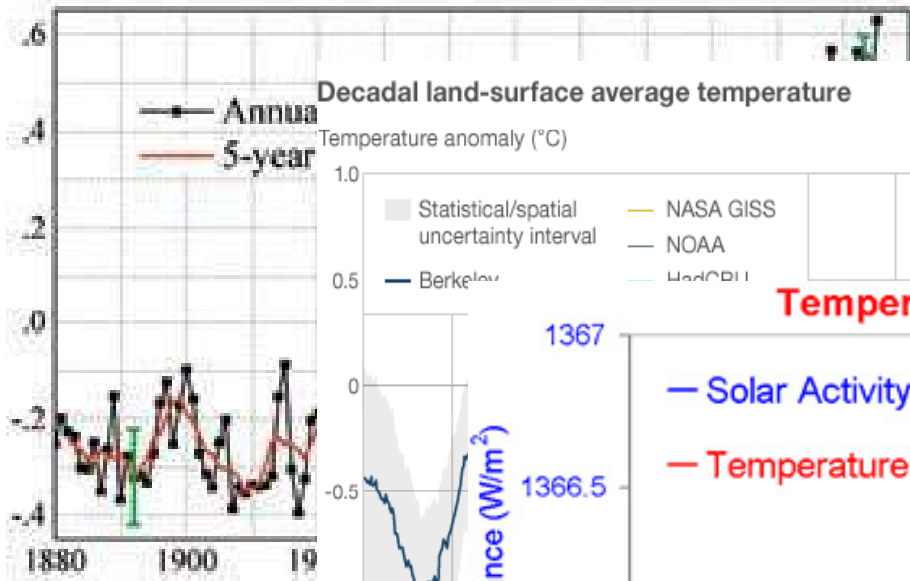




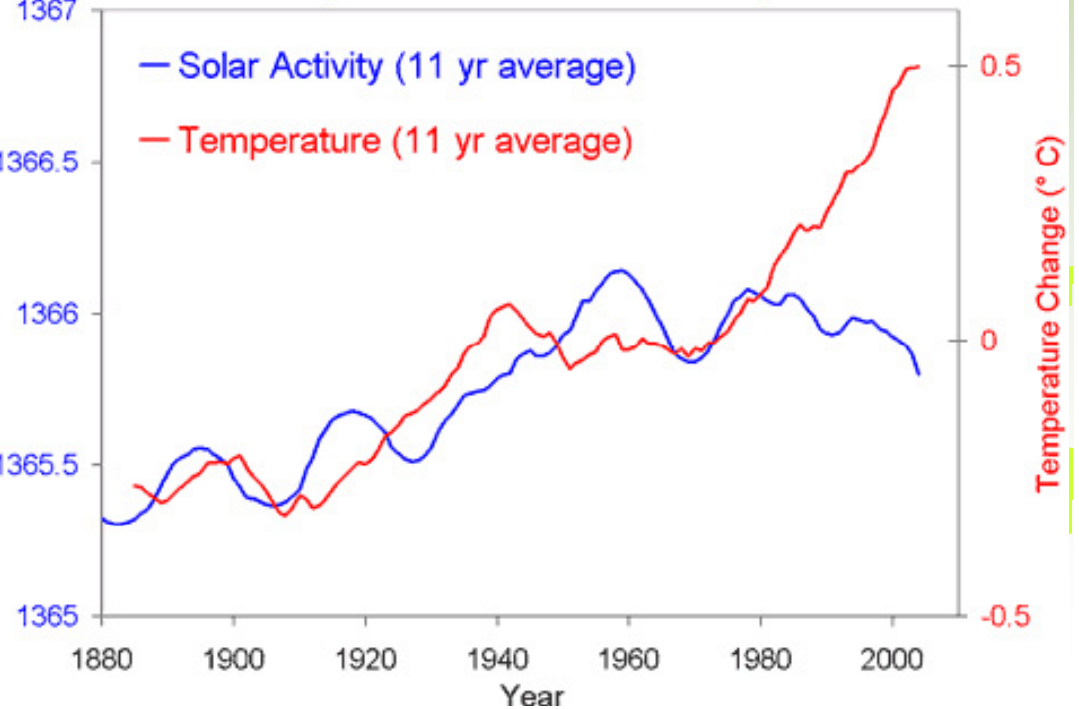
**Met Office** Global average temperature 1850-2009  
2000s warmest decade



### A Global Land-Ocean Temperature Anomaly (°C)



### Temperature vs Solar Activity

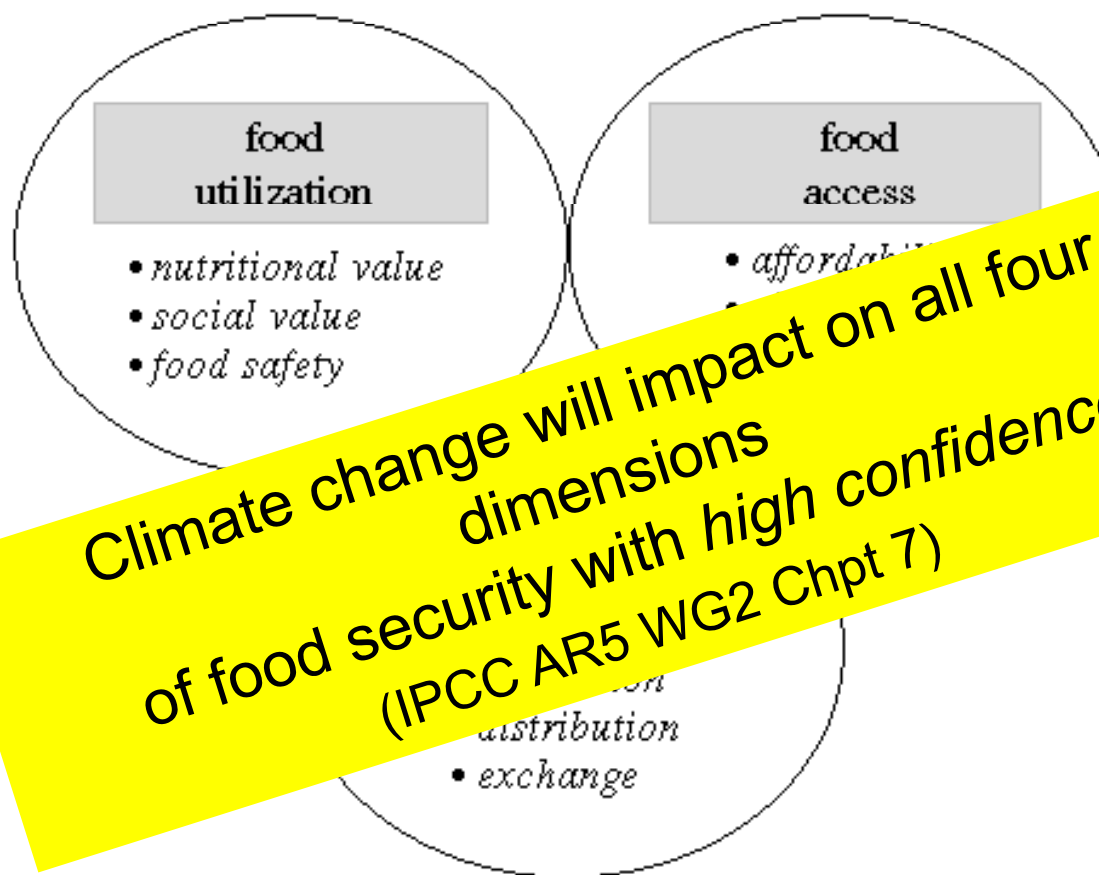




# Broad features of climate change impacts on agriculture

- Climate variability and change
- Global changes and local detail
- Change in areas of production and productivity
- Opportunities and challenges
- Uncertainty in projections
- Climate is only one driver of change in agricultural and food systems



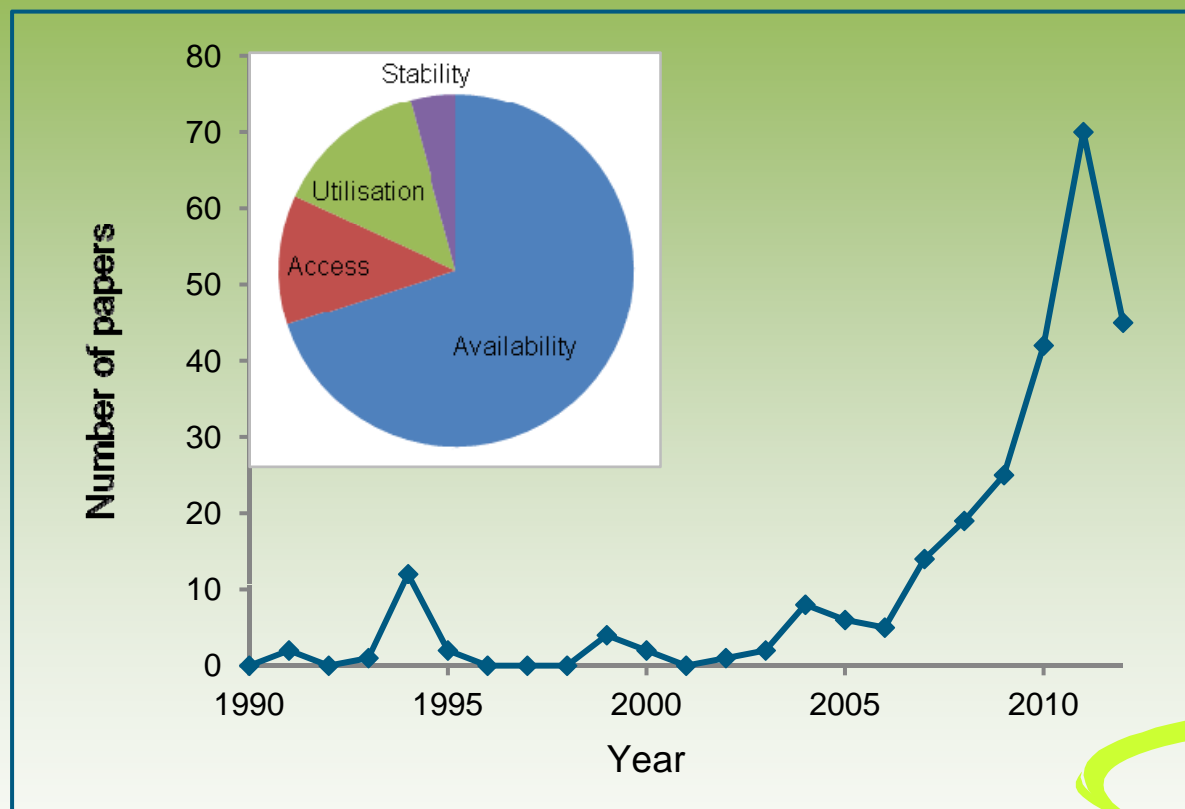


Food systems underpin food security

Adaptation of food systems possible through interventions in food availability, utilization and access



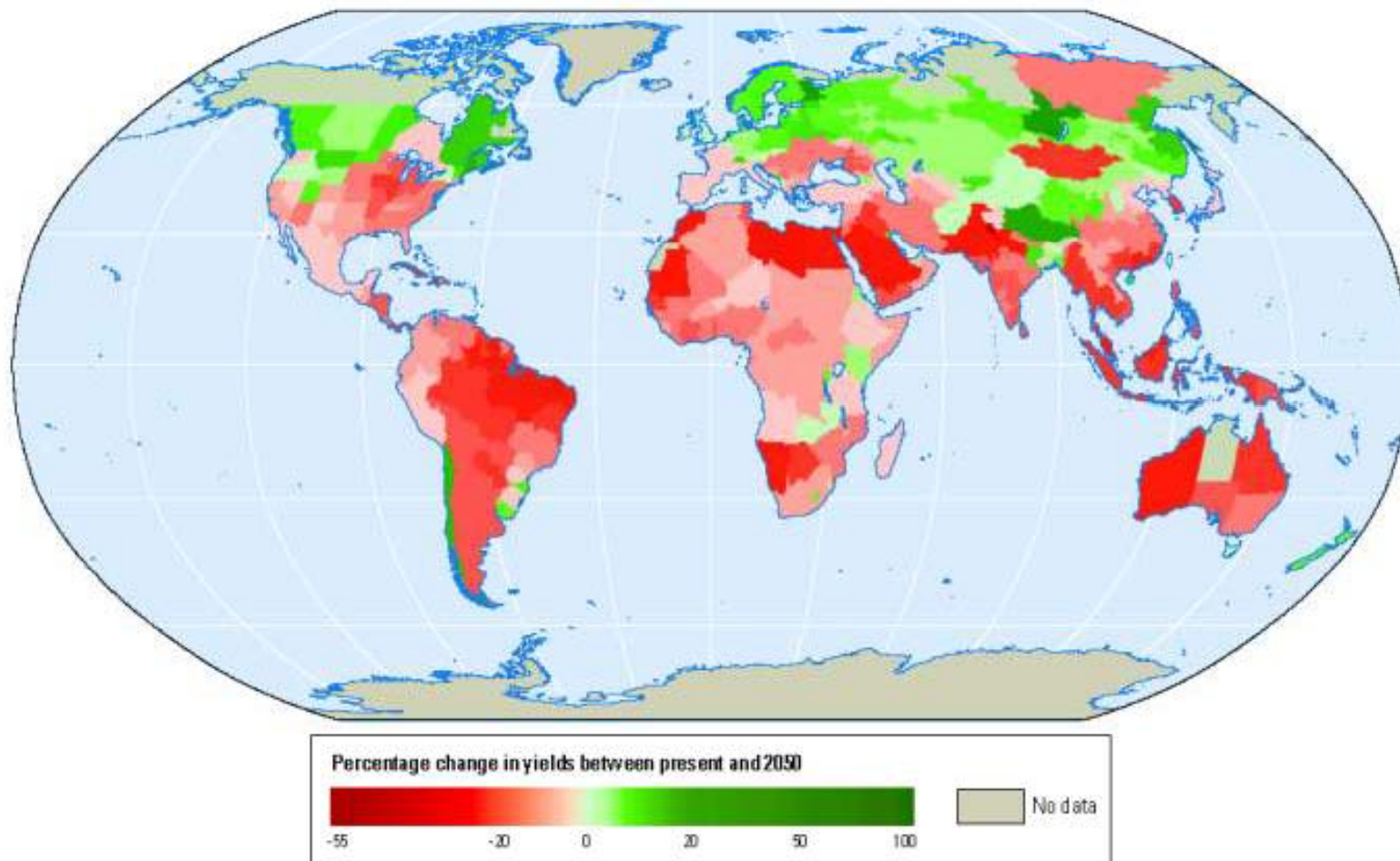
## Evidence base for climate change impacts on global food security stresses food availability...



...with serious gaps on the broader aspects of food security



Map 1 Climate change will depress agricultural yields in most countries in 2050, given current agricultural practices and crop varieties



## Broad-scale impacts on crop production

Potential change in crop yield World Bank Development Report 2010





## Summary of % change in yield under climate change by crop

Across Africa

- 17% wheat
- 5% maize
- 15% sorghum
- 10% millet

Across South Asia

- 16% maize
- 11% sorghum

No change in yield was detected for rice

Systematic review of climate change impacts across Africa and Asia  
Meta analysis of data in 52 publications from an initial screen of 1144  
studies

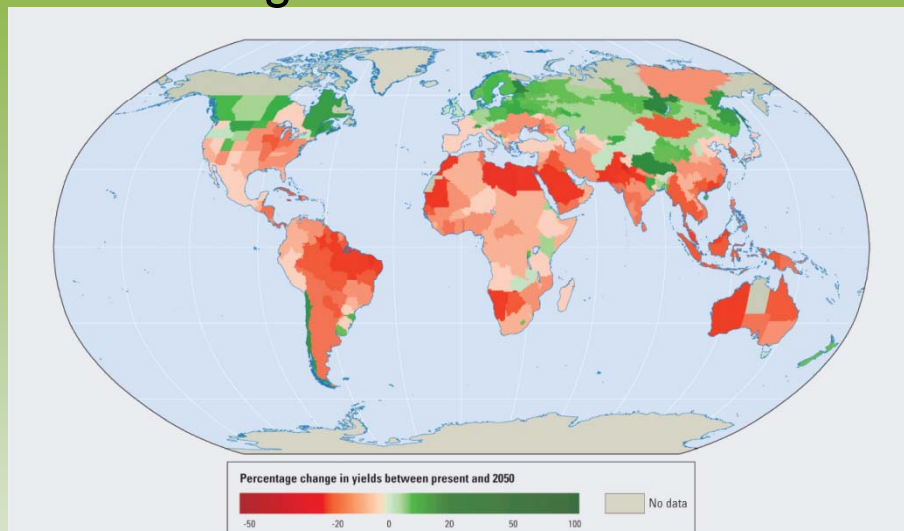
Knox et al *Env Res Letters* 2012 vol 7



## Climate variability and change will exacerbate food insecurity in areas currently vulnerable to hunger and under-nutrition

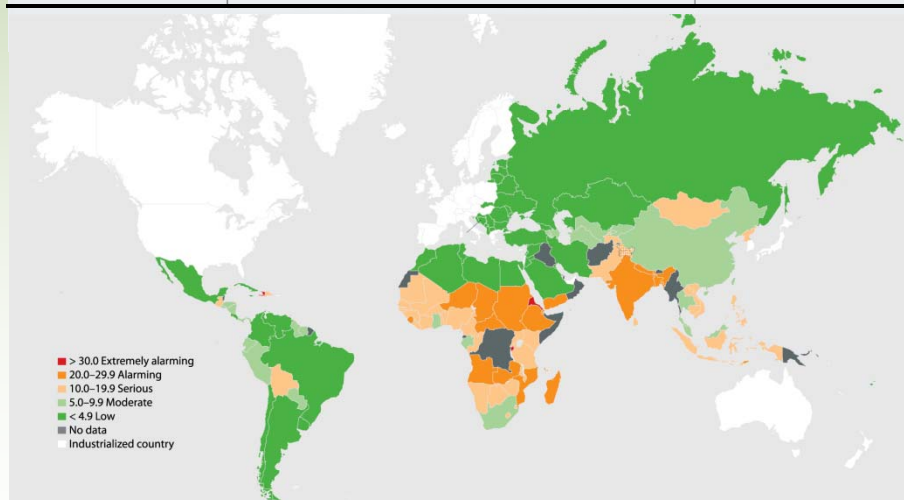
Impacts of climate change on the productivity of food crops in 2050

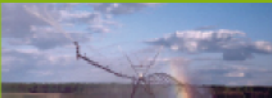
World Bank Publishers  
World bank Development report 2010  
<http://wdronline.worldbank.org/>



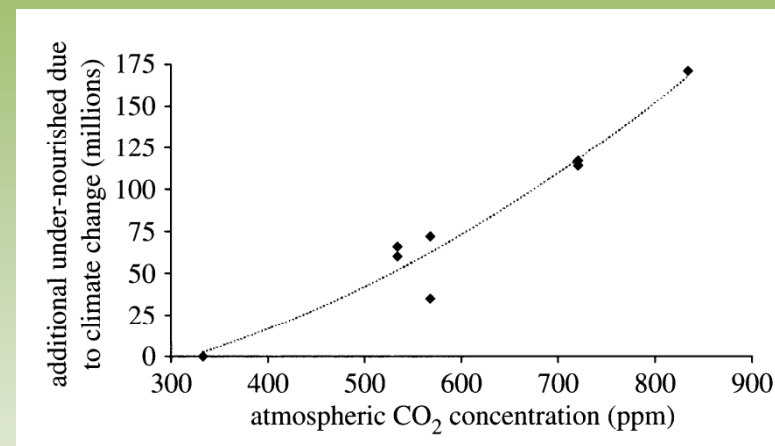
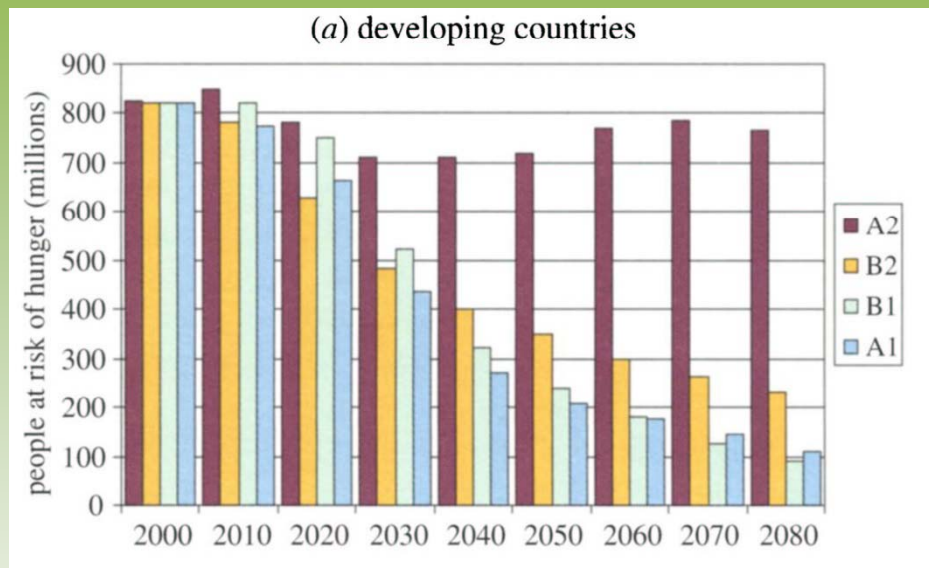
2012 Global Hunger Index

Welthungerhilfe, IFPRI and Concern  
Worldwide  
K von Grebmer et al 2012  
<http://www.ifpri.org/ghi/2012>





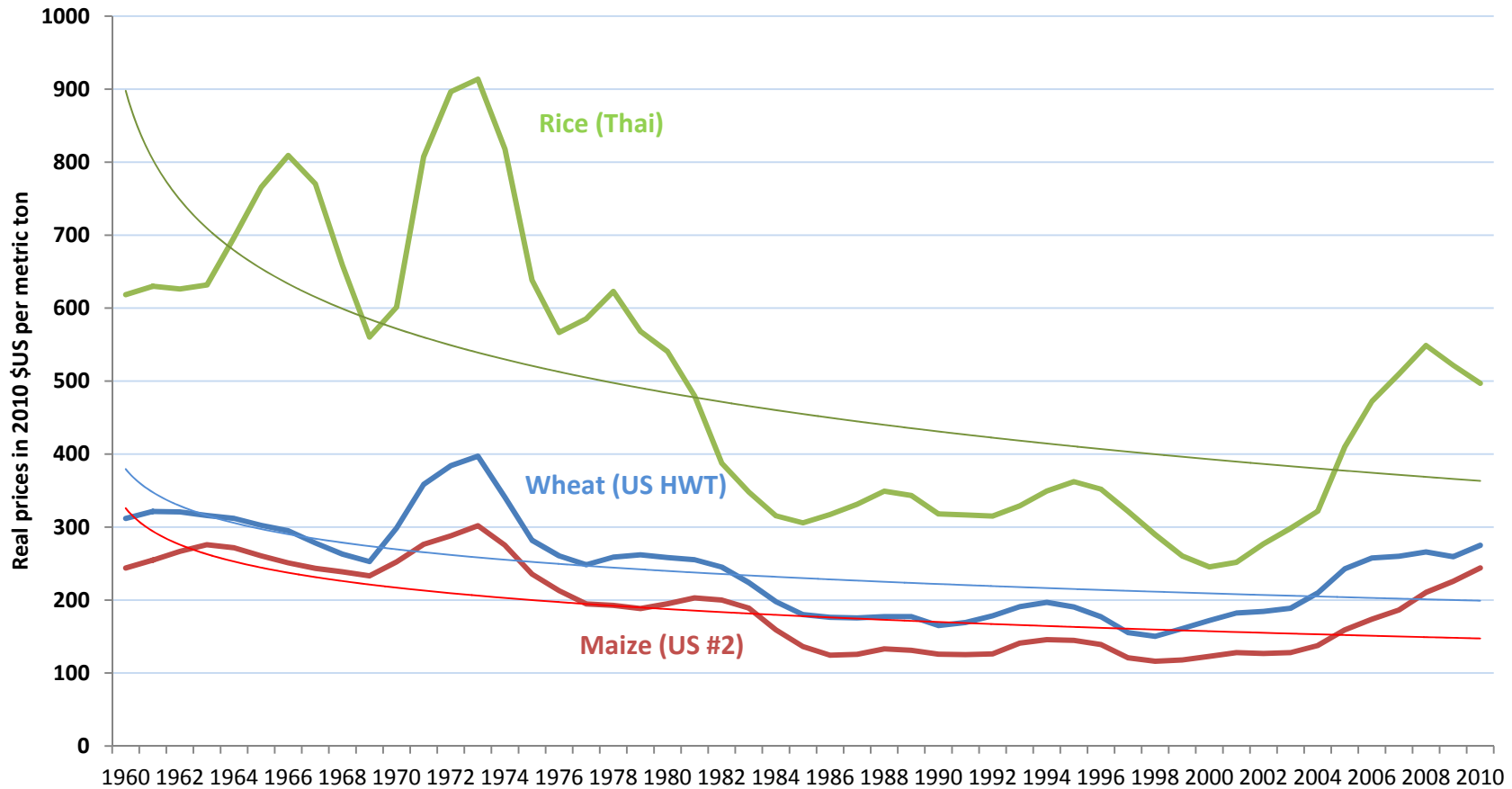
## Additional under-nourished under climate change



- Linked agro-ecological model to socio-economic scenarios and trade model
- Under nourished related to index of food supply / food requirement
- High population growth under A2 keeps millions at risk high
- Climate change progressively adds more under-nourished

*Fischer et al., Phil Trans Royal Soc B (2005)*

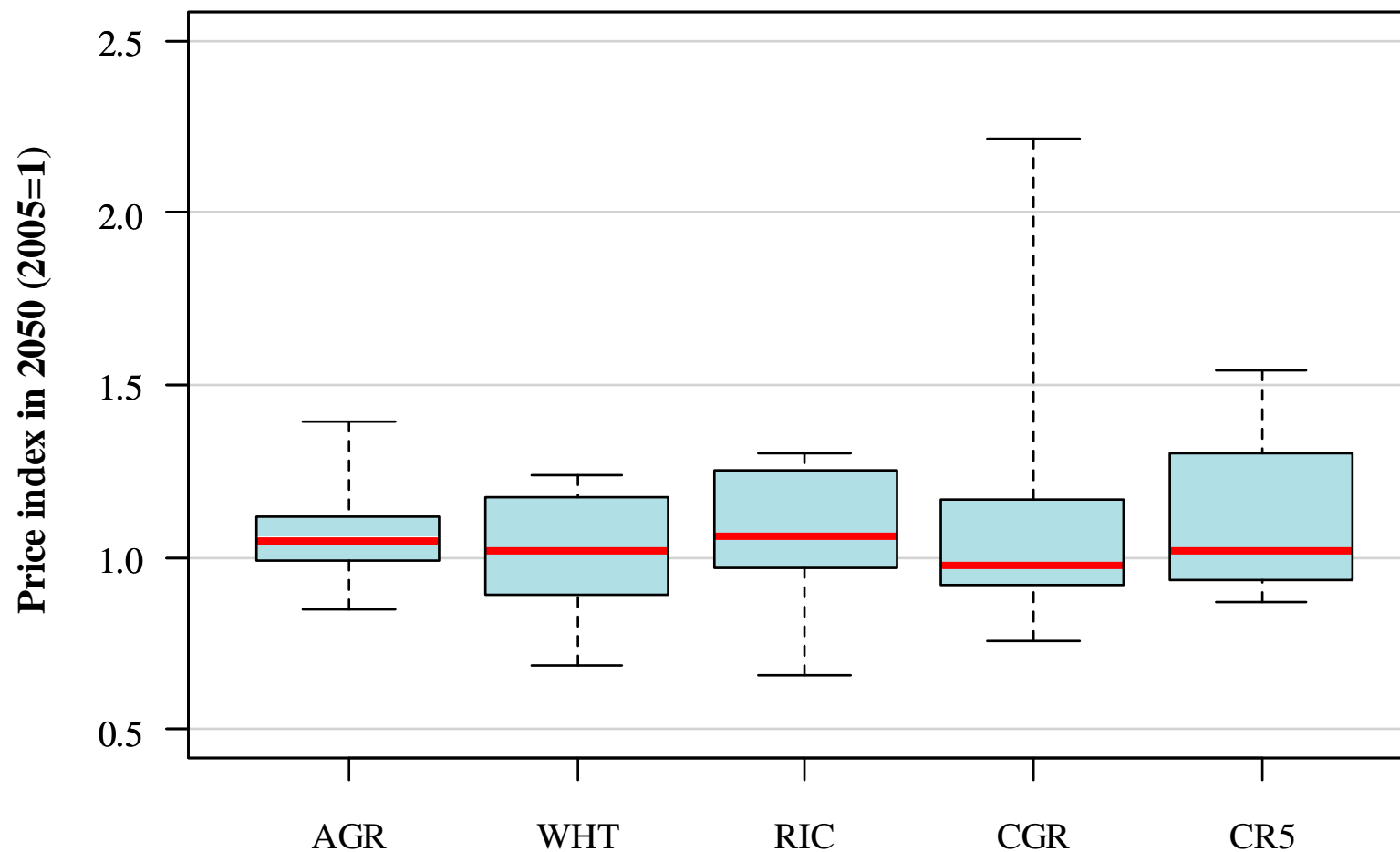
# Long-term downward trend in real agricultural prices though-out the 20<sup>th</sup> century



Source: World Bank pink sheet (<http://go.worldbank.org/4ROCCIEQ50>, accessed 7-Jan-2014) and own calculations

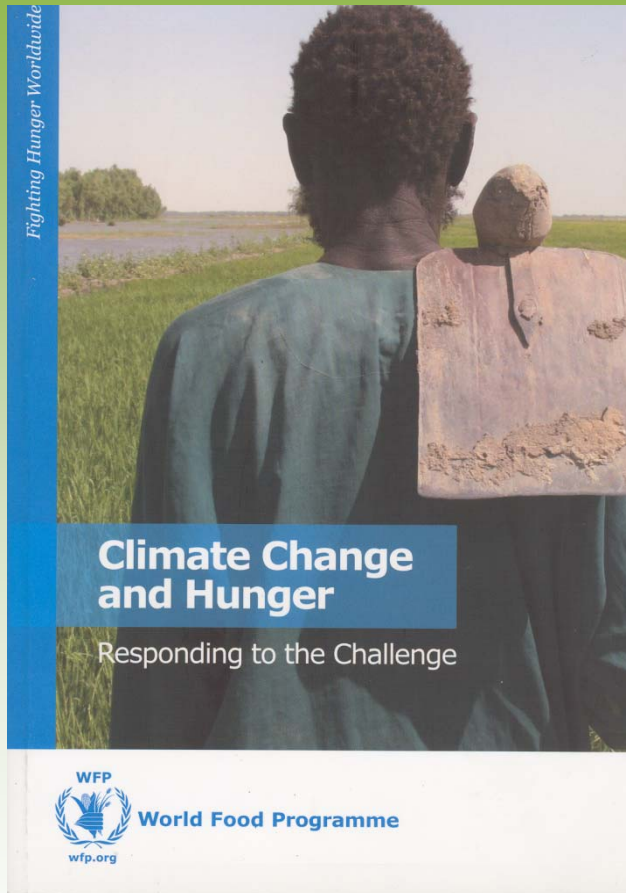
Note: 4-year leading moving average (last year available = 2013).

# Variation of world prices across commodities in 2050



Note: All agriculture (AGR), wheat (WHT), rice (RIC), coarse grains (CGR), index for wheat, rice, coarse grains, oil seeds and sugar (CR5).

Source: AgMIP global economic runs, February 2013 and own calculations.



## First Summary: Climate Change and Hunger



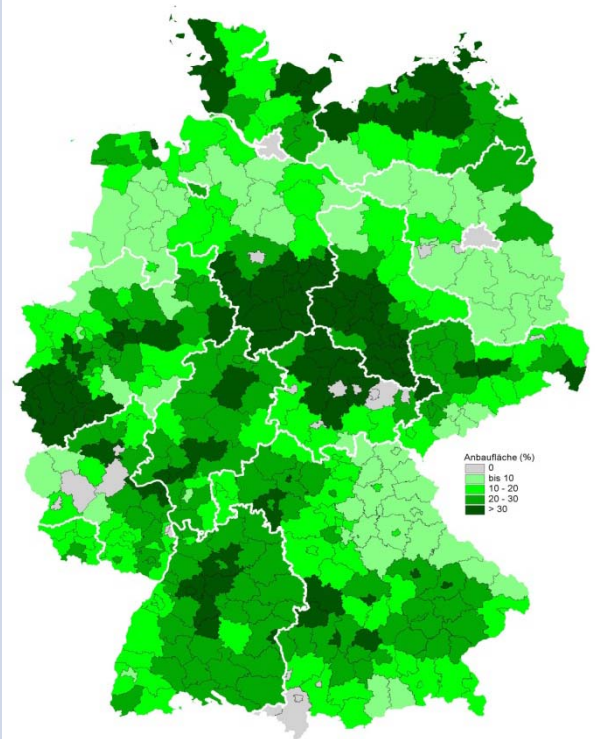
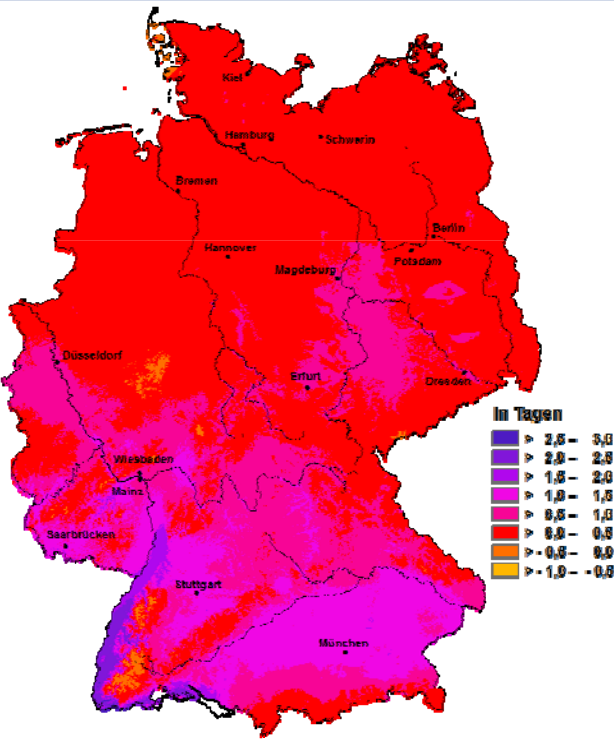
- The numbers at risk of hunger as a result of climate change are projected to increase by 5-20% by the year 2050
- About 65% of the global total is projected to occur in Africa
- In sub-Saharan Africa, 10 million more children are projected to be malnourished by 2050 due to climate change



# Extreme Weather Events



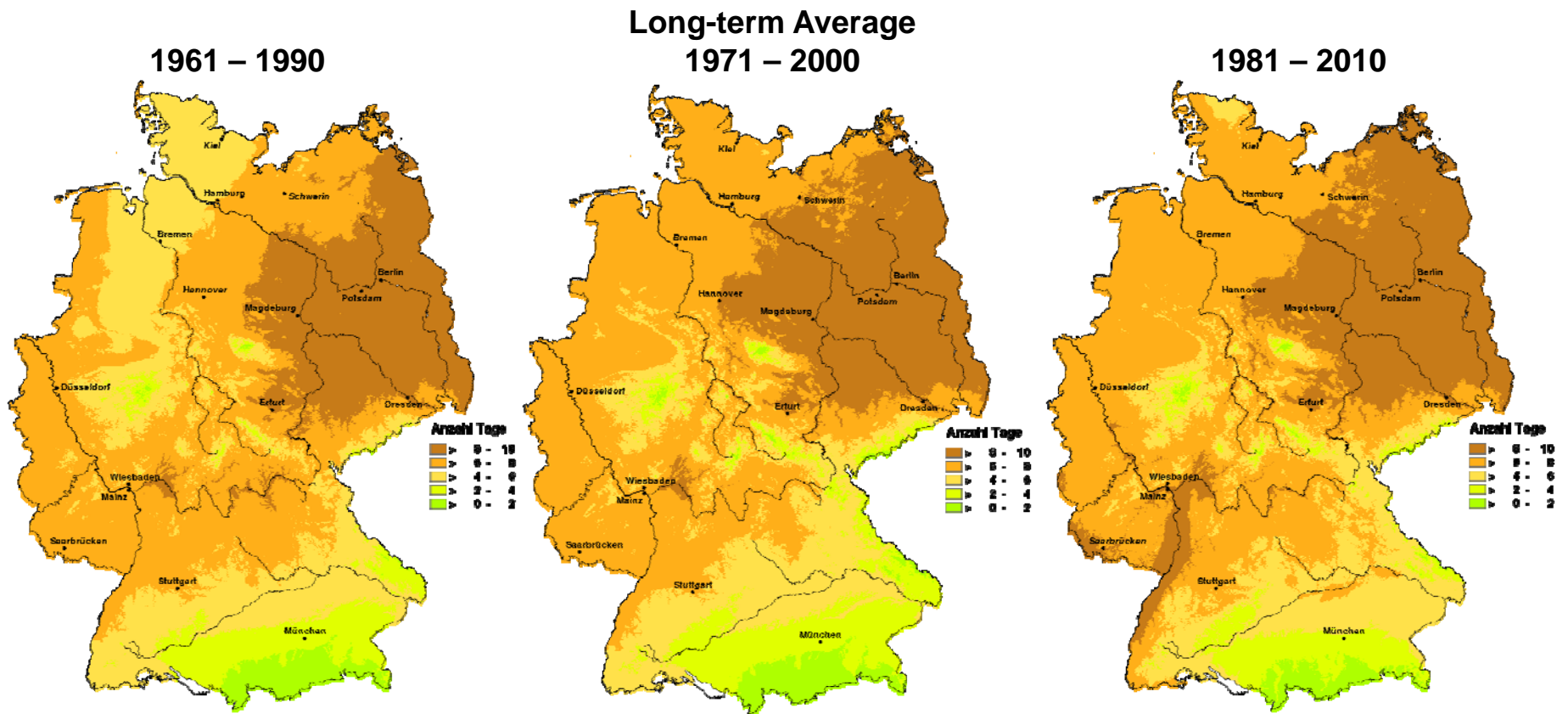
# Identification of extreme Weather Events in Crop Production

| Potential Risk   | Local Risk   | Expected Risk  |
|--|--|--|
| <p data-bbox="174 459 365 496">Cropping risks</p>  <p data-bbox="174 826 557 850">Quelle: Thüringer Allgemeine vom 8.6.2012</p> <p data-bbox="174 903 353 940">Technical risk</p>  <p data-bbox="174 1265 598 1289">Quelle: <a href="http://www.agrartechnik-im-einsatz.de/">http://www.agrartechnik-im-einsatz.de/</a></p> | <p data-bbox="880 464 1370 501">Areas of Wheat Production, Germany</p>  | <p data-bbox="1559 443 1944 520"><math>T_{max} &gt; 30^{\circ}\text{C}</math> at wheat blossom<br/>Winter Wheat ; June 5 – 19</p>  |



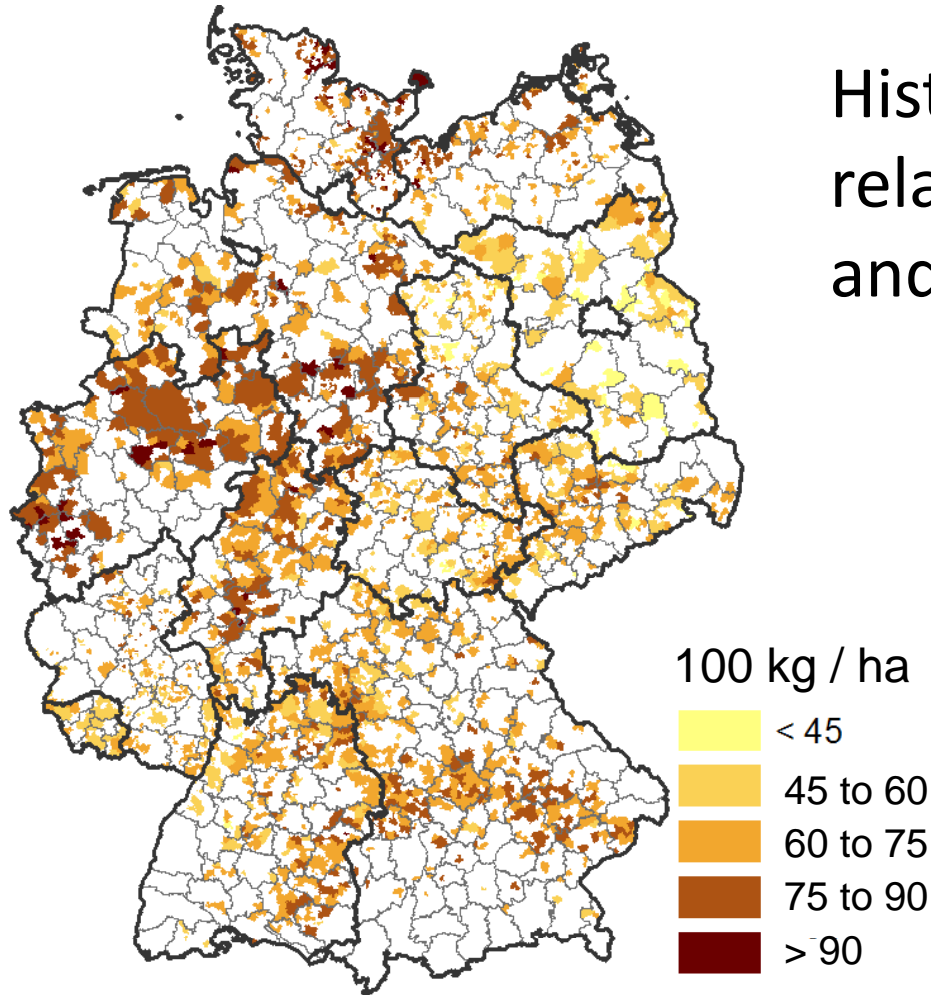
# Soil Moisture

**Number of day with a soil moisture < 50 %nFC**  
**Crop: Winter wheat, sandy soil**  
**Periode: July 21-31**



# Regional Wheat Yields (1995 - 2012) (Farms in FADN: ca. 11500)

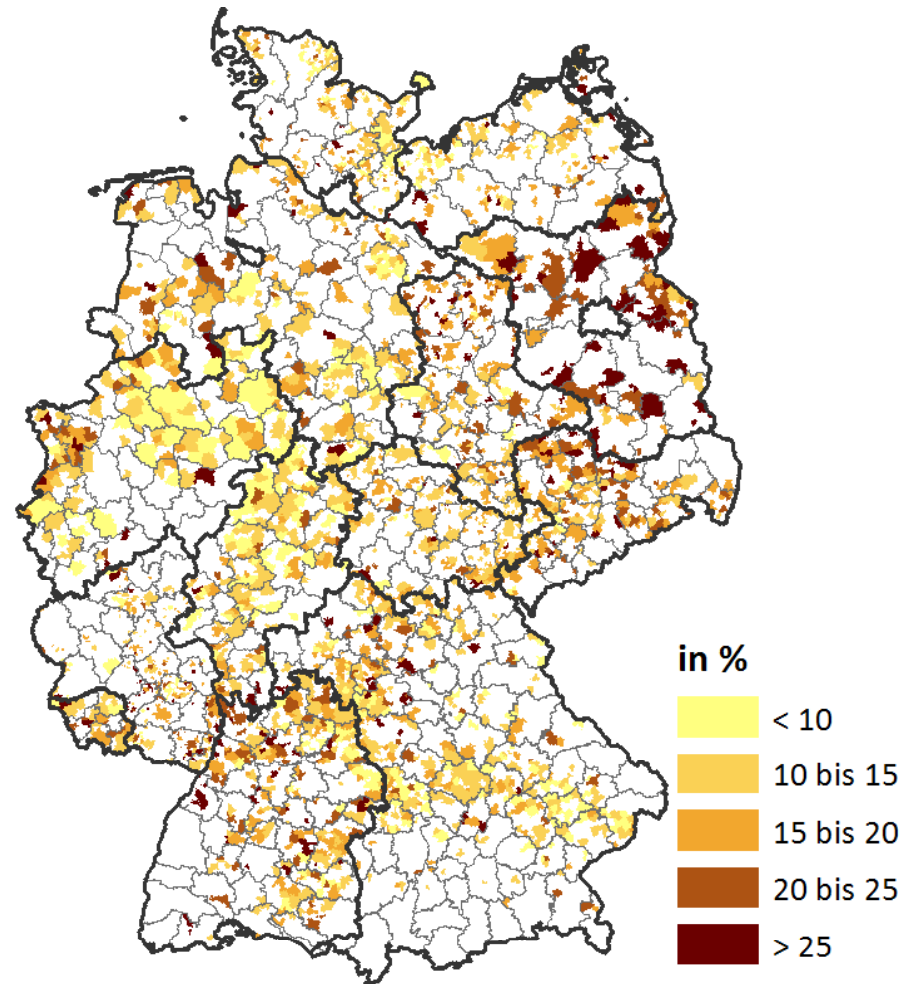
## Average Yield



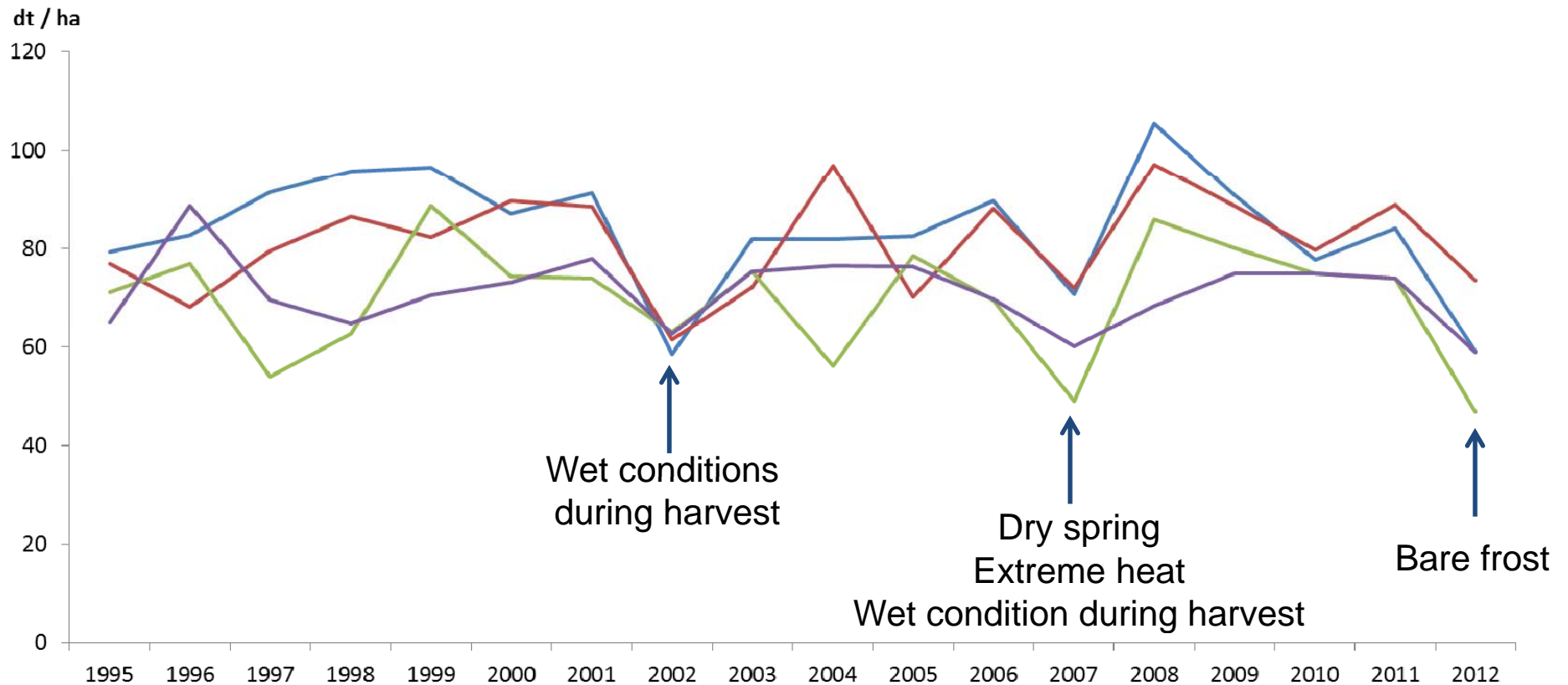
Historical Analysis of  
relation between weather  
and harvest

# Regional Wheat Yields (1995 - 2012) (Farms in FADN: ca. 11500)

## Coefficient of Variation



# Wheat Yields Lower Saxony Data of selected farms (1995 – 2012)





# Challenges - Agricultural Trade

- Agricultural is not only driven by CC
  - Strong impact on production side
  - Demand is also driven by population growth, change in consumption pattern, socio-demographic trends
- Food systems are closely coupled with global trade in agri-food commodities
- Comparative advantage will be altered with implications on international trade



# How to address?

- Bringing together researches from the area of modeling crop, livestock and economic systems
- One example: European-wide network of excellence:

**MACSUR** - **M**odelling European  
**A**griculture with **C**limate Change for  
Food **S**ecurity



# MACSUR's aims

- To analyse the effects of climate change for **farming conditions** in European regions
- To identify **risks for farmers**, to jointly develop mitigation and adaptation options
- To analyse consequences of mitigation and adaptation for farming **competitiveness**, the **environment** and **rural development**



# MACSUR's mission

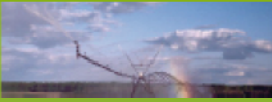
- **improve and integrate** models - crop and livestock production, farms, and national & international agri-food markets
- **demonstrate** integration and links - models for selected farming systems and regions
- provide **hands-on training** - young and experienced researchers in integrative modeling



Linked models







# Mostviertel - Austria



- Farmers may benefit from climate change in several regions of Austria, although effects seem to be mixed for farmers specialised in crop production
- Climate change induced intensification of land by removing landscape elements and increasing use of fertilizers. Benefits result from participation in agri-environmental programs
- Benefits of climate change (through productivity gains) will increase opportunity costs for participation in AEP. Payments may have to increase for such farmers



## *The way forward: Policy evidence messages*

Six precepts for decision-makers developing policy responses to climate change impacts on food security

1. Climate change impacts on food security will be **worst** in countries already suffering high levels of hunger and will worsen over time
2. The consequences for global under-nutrition and malnutrition of **doing nothing** in response to climate change are potentially large, and will increase over time
3. There is a commitment to climate change of **20-30 years into the future** as a result of past emissions of greenhouse gases that requires immediate adaptation actions to address global food insecurity over the next two to three decades
4. **Food inequalities will increase**, from local to global levels, because the degree of climate change and the extent of its effects on people will differ from one part of the world to another, from one community to the next and between rural and urban areas
5. People and communities who are vulnerable to the effects of **extreme weather** now will become more vulnerable in the future and less resilient to climate shocks
6. **Extreme weather events** are likely to become **more frequent** in the future and will increase risks and uncertainties within the global food system



a FACCE JPI  Knowledge Hub

For further information  
please visit: [www.macsur.eu](http://www.macsur.eu)