



PBL Netherlands Environmental  
Assessment Agency

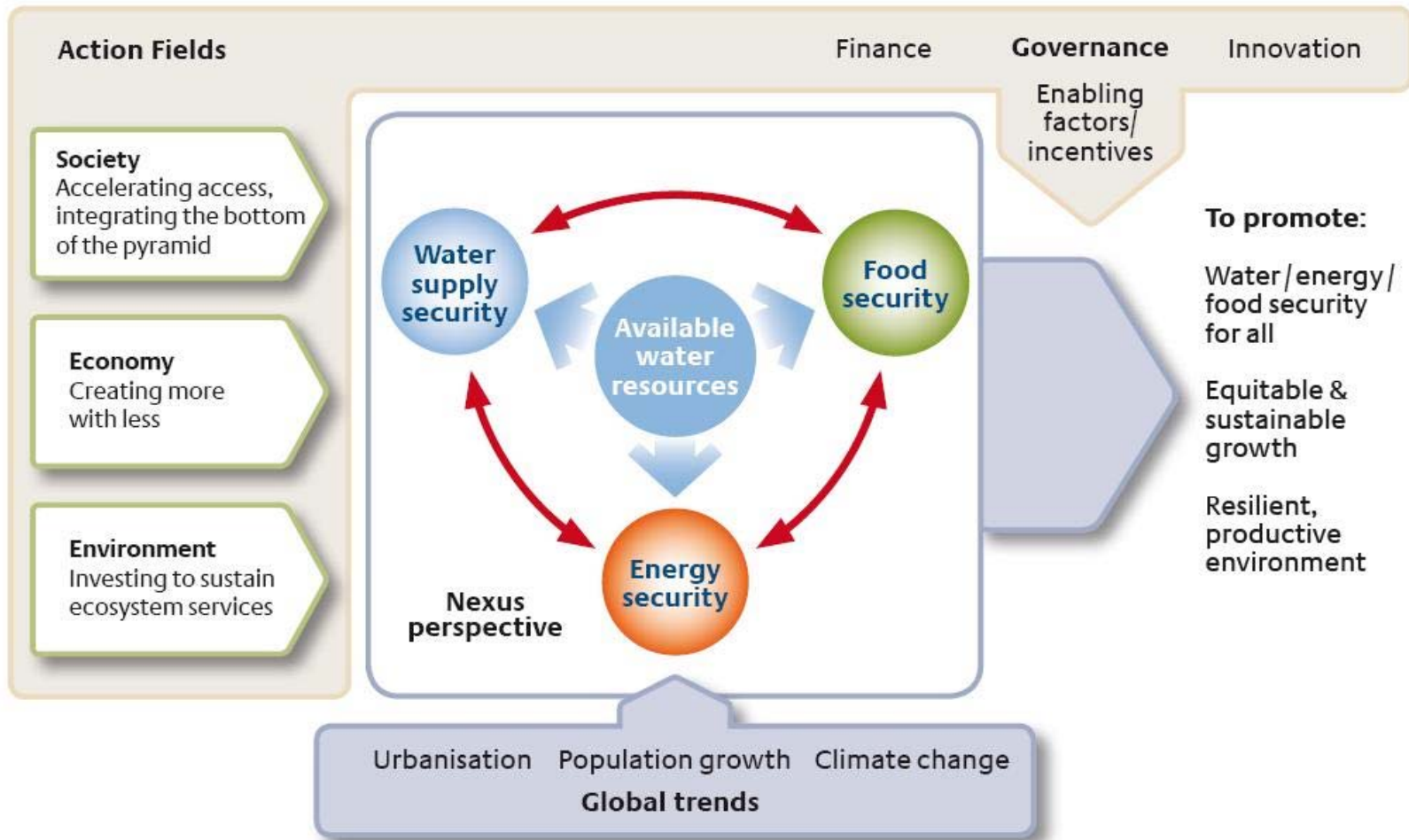
# Nexus Water Food Energy

Global and local challenges

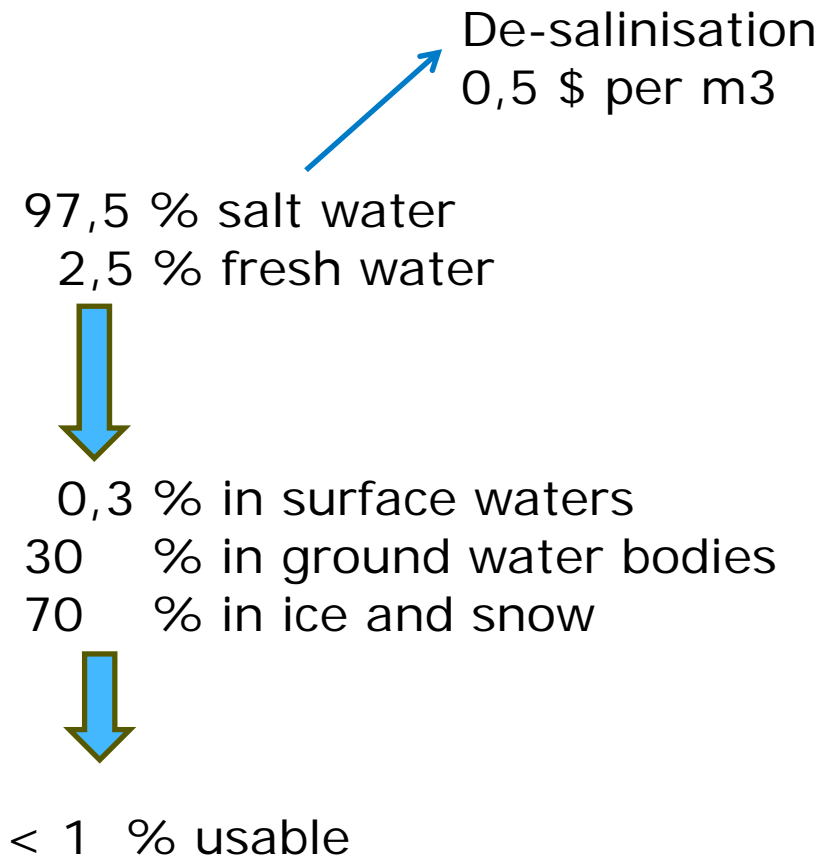
Willem Ligtvoet

16 October 2013  
Vijverberg

# Nexus Water - Food - Energy



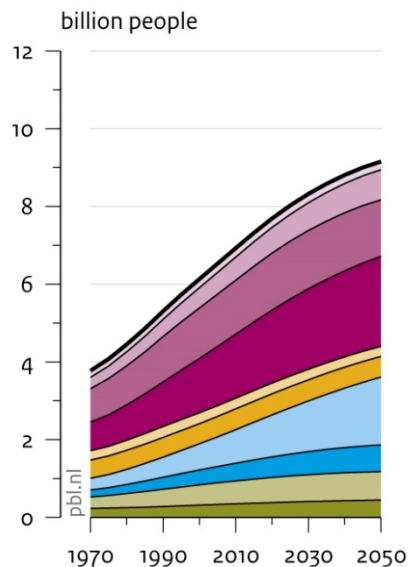
## Water: abundantly available



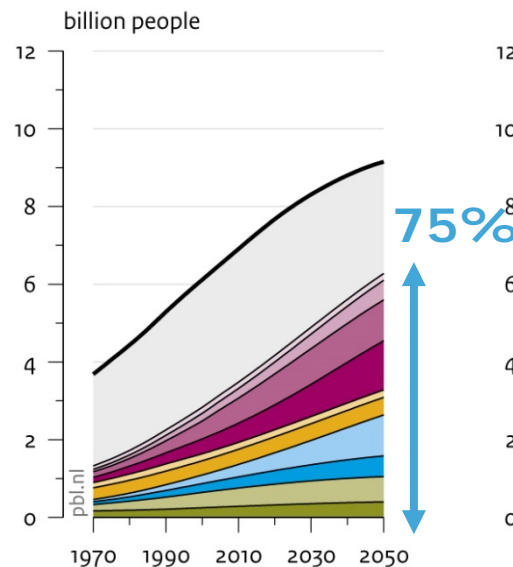
# Growing and urbanizing population

## Global demographics in the Trend scenario

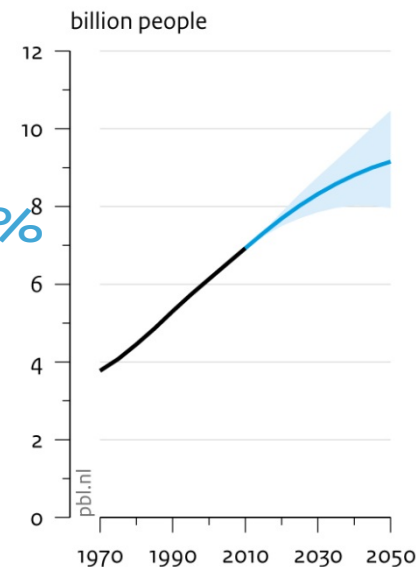
Population per region



Urban population per region



Range from literature



Japan, Korea and Oceania  
Southeast Asia  
China region  
South Asia

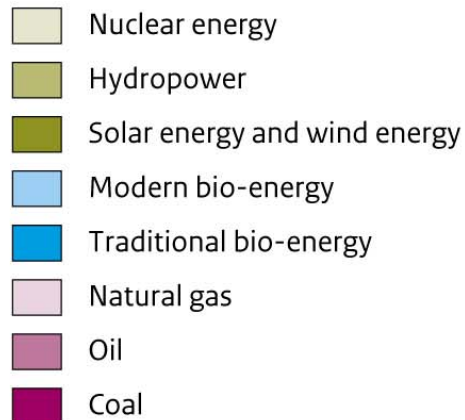
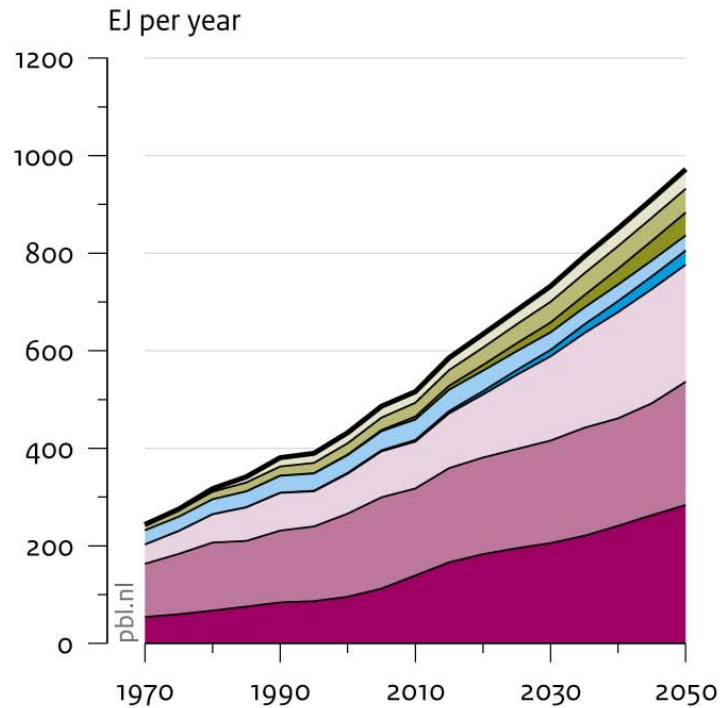
Russian region and Central Asia  
West and Central Europe  
Sub-Saharan Africa  
Middle East and North Africa

Central and South America  
North America  
Rural population

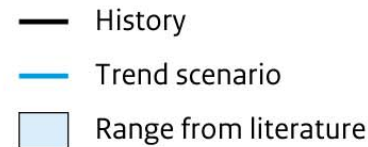
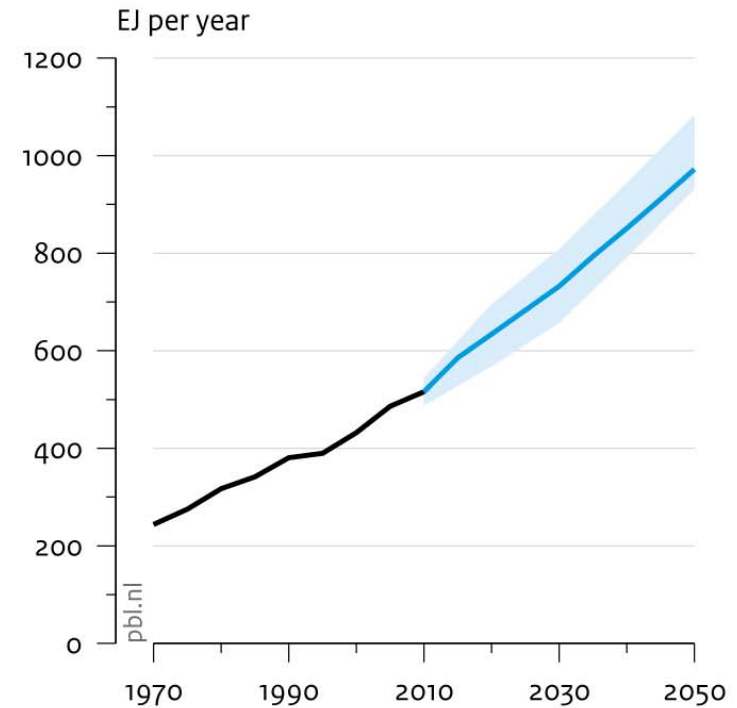
History  
Trend scenario  
Range from literature

# Energy demand doubles

Per energy carrier



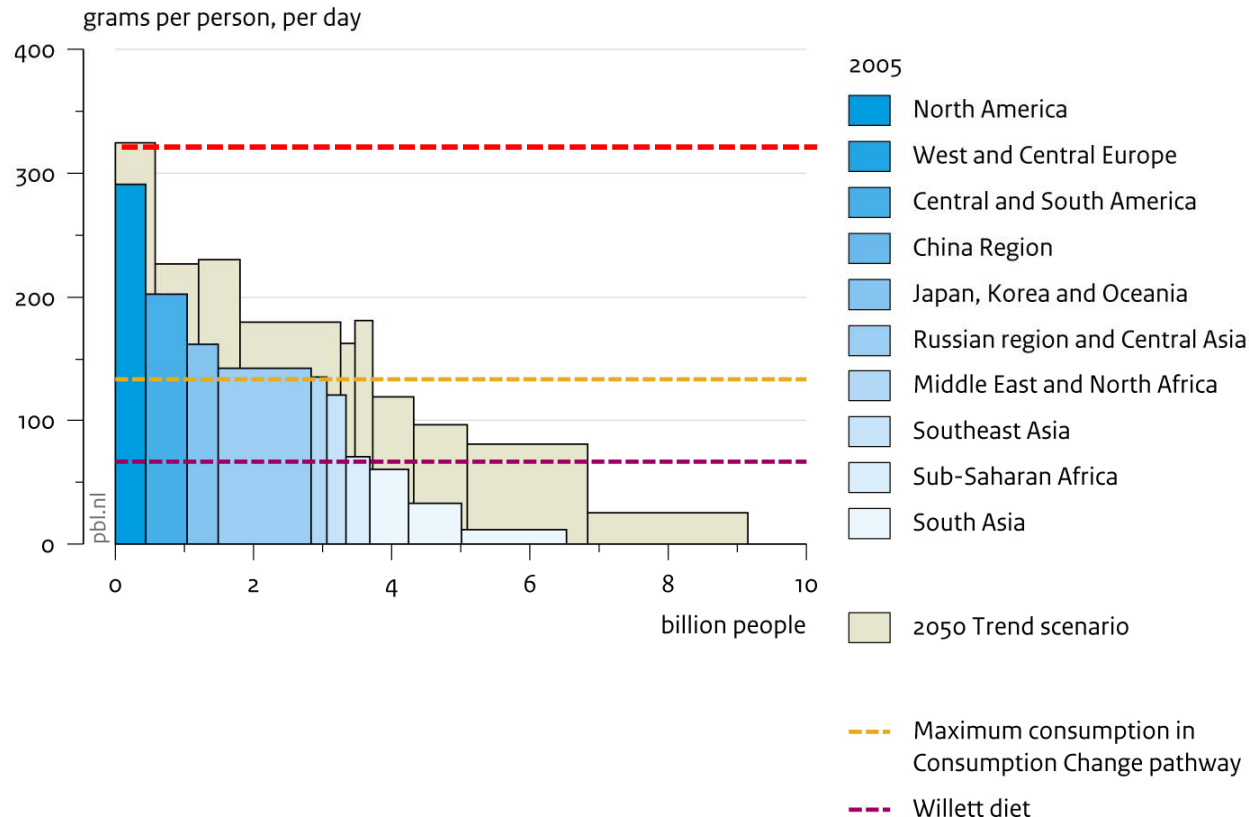
Range from literature





# Strong increase in protein consumption

## Consumption of meat and eggs, per region



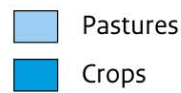
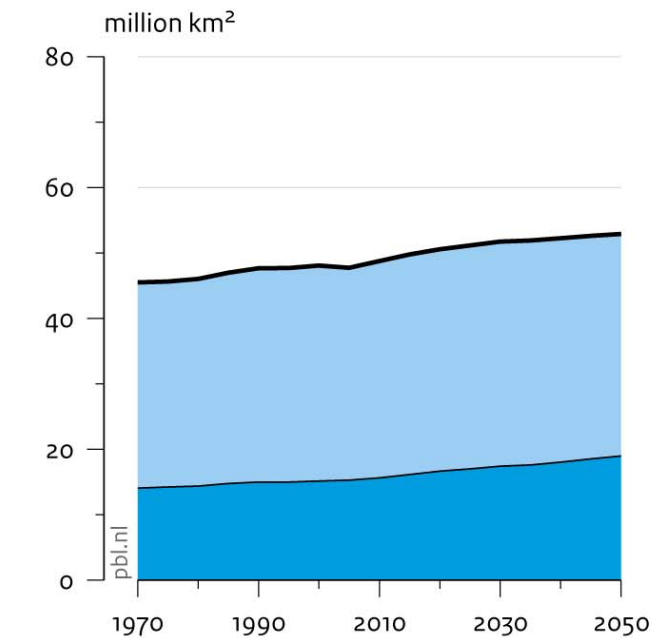
## Water use/kg

	m <sup>3</sup>
Cows	15
Sheep	10
Poultry	6
Rice	3
Grains	1,5

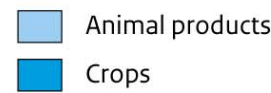
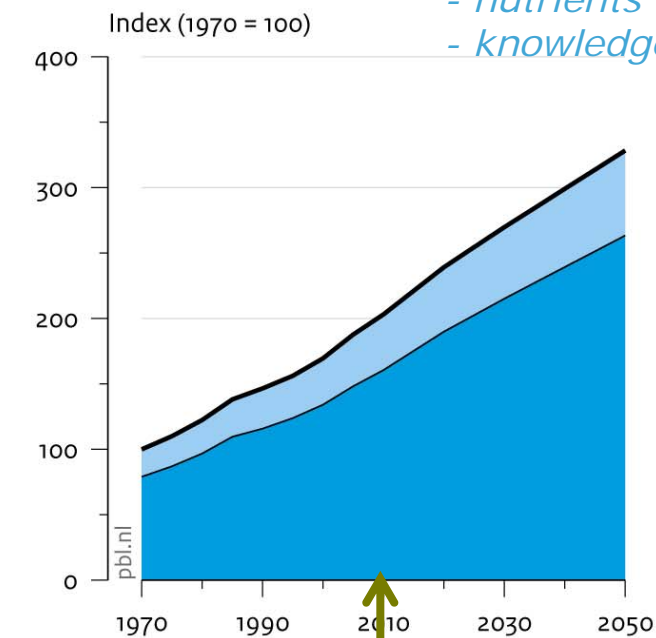
## Global agricultural area and production in the Trend scenario

*Growth rate realistic?*

Agricultural area



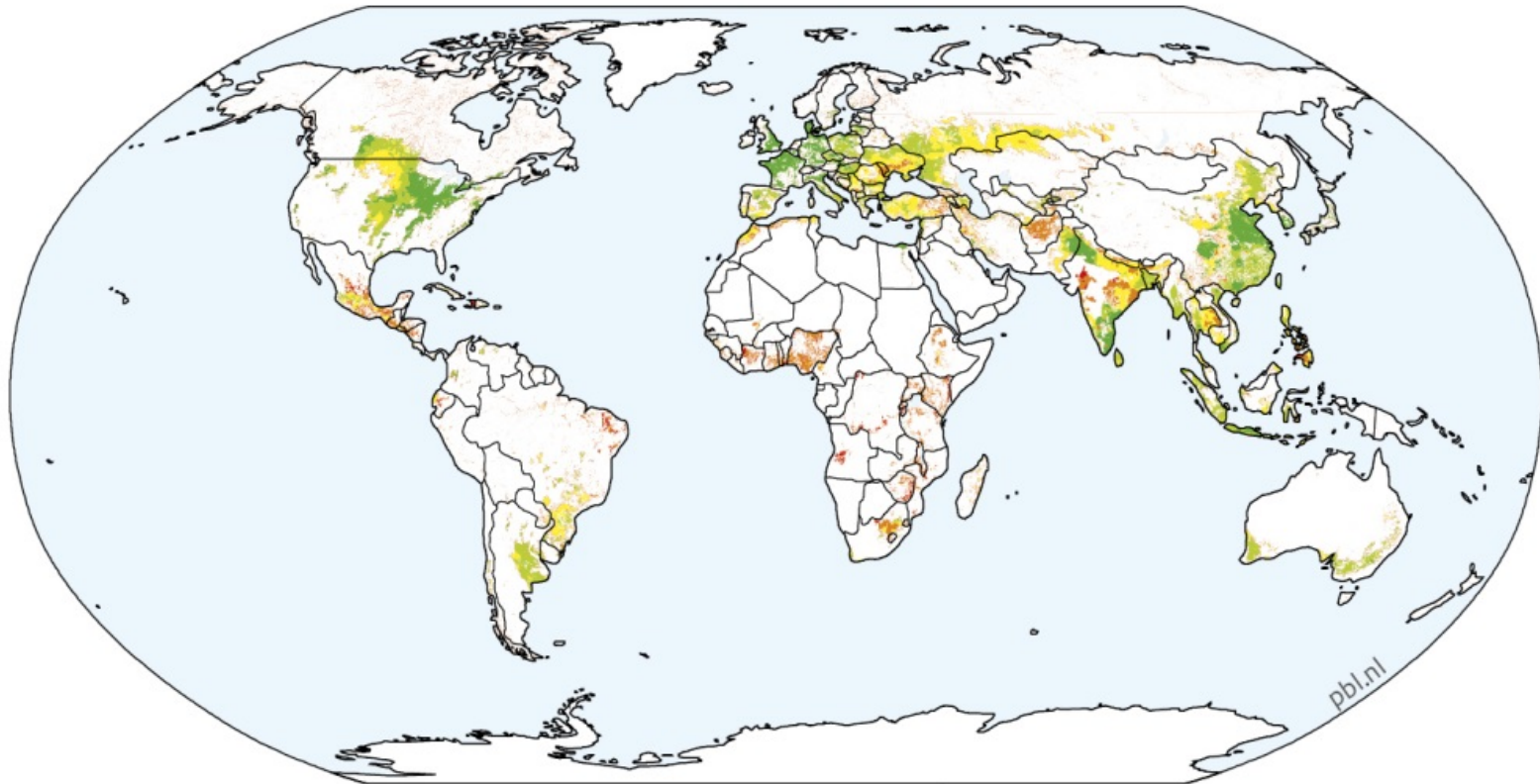
Agricultural production



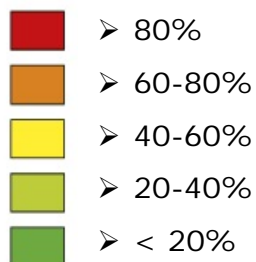
- water  
- nutrients  
- knowledge

- 20% irrigated
- with irrigation 2-5x increase in production

# Yield gaps for wheat, maize and rice



## Yield gap



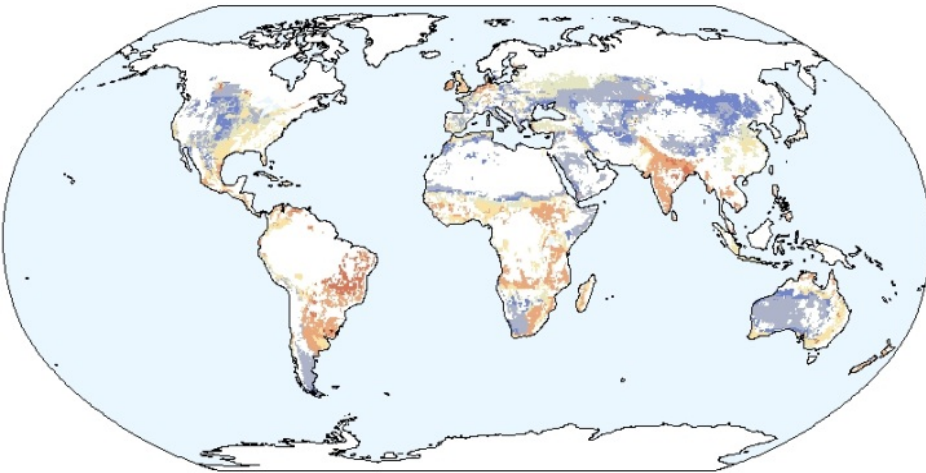
## Closing yield gaps:

- water/irrigation
- nutrients
- knowledge

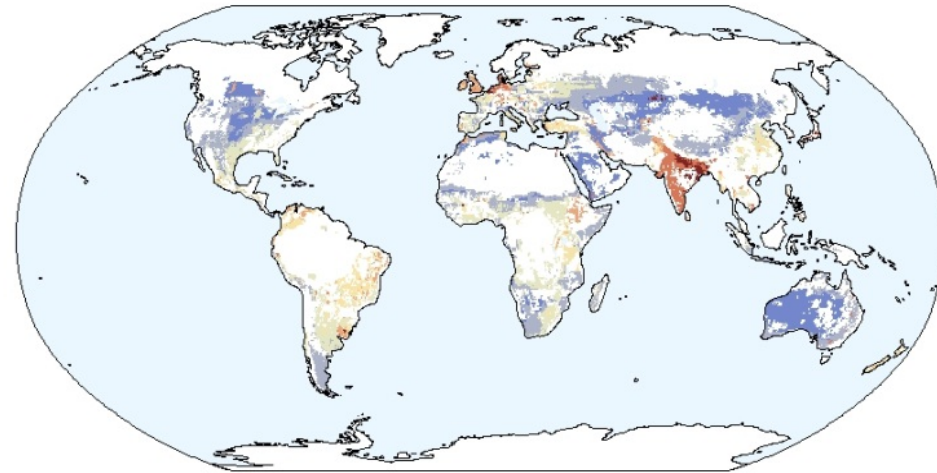


# Increased use of fertilizers

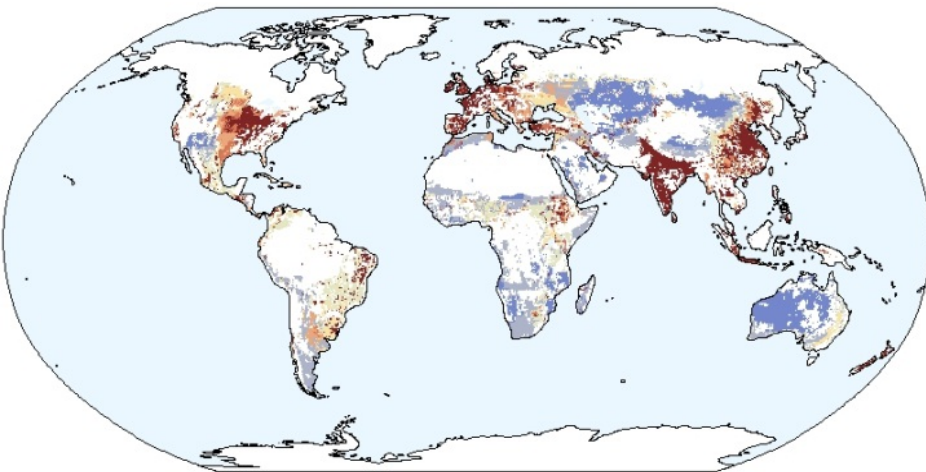
1900



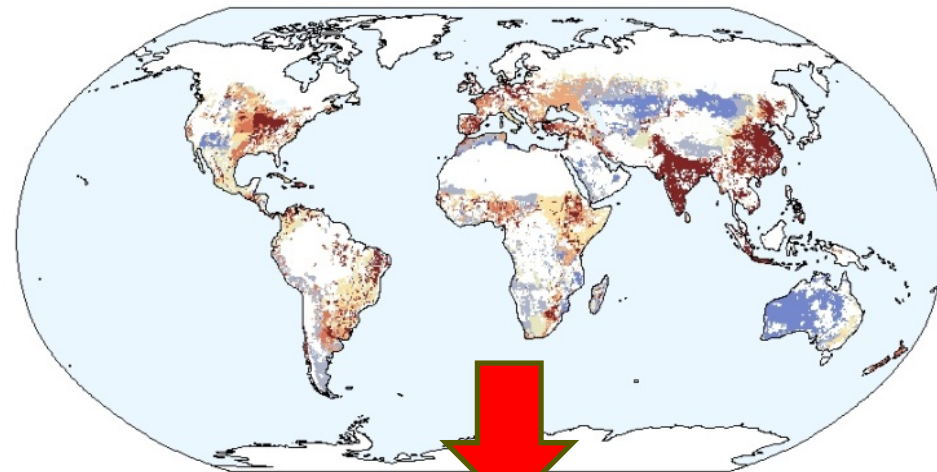
1950



2000



2050



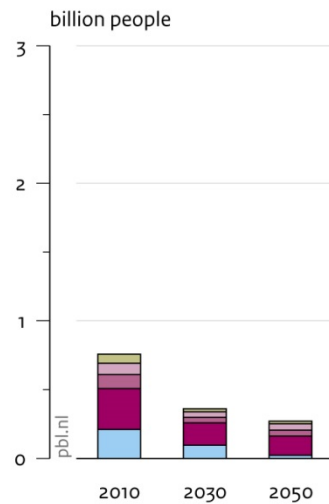
kg N km<sup>2</sup> yr<sup>-1</sup>



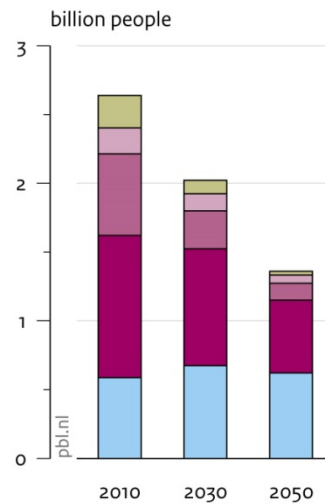
Pollution of fresh water ecosystems  
and coastal seas

### Human development indicators in the Trend scenario

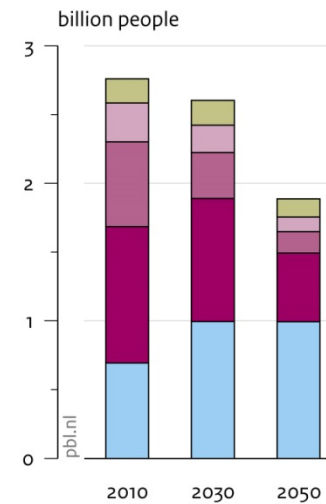
People suffering from hunger



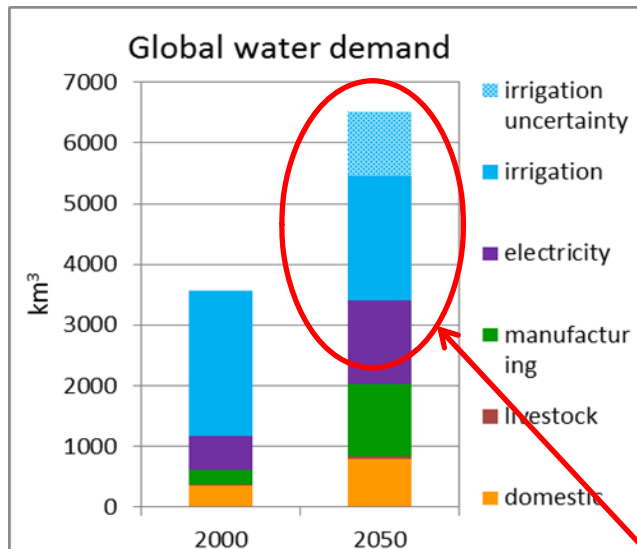
People without access to safe drinking water or basic sanitation



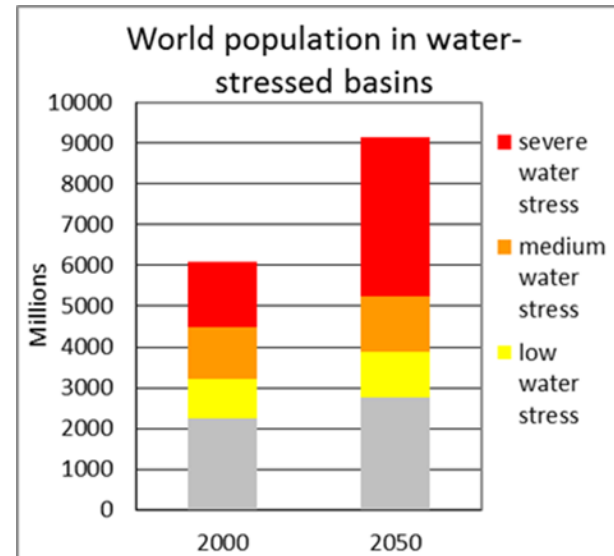
People using traditional energy for cooking and heating



## Trend scenario 2050 – water related challenges



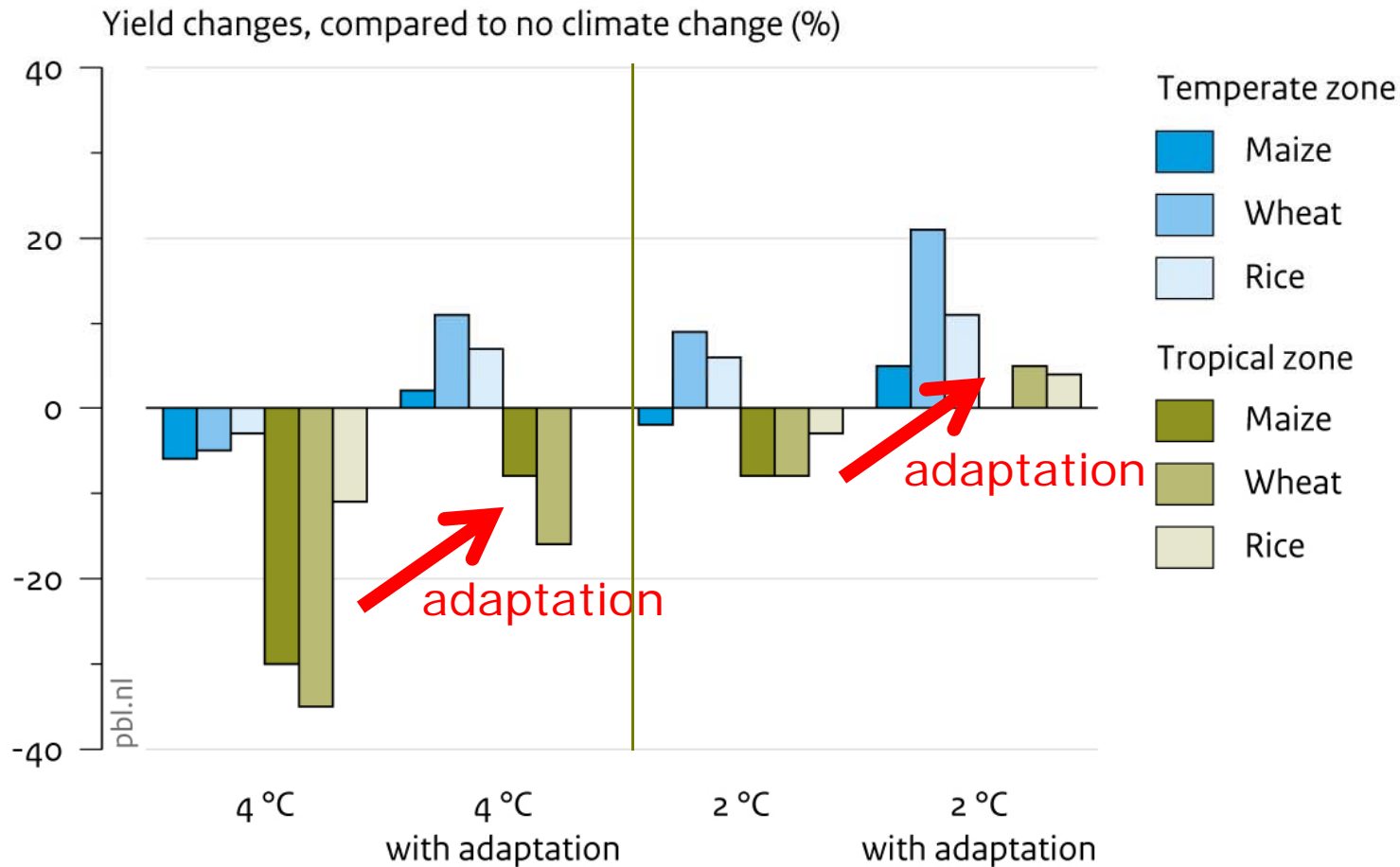
Competition for water will increase esp. in BRIIC and developing countries



Water for agriculture and food production under pressure

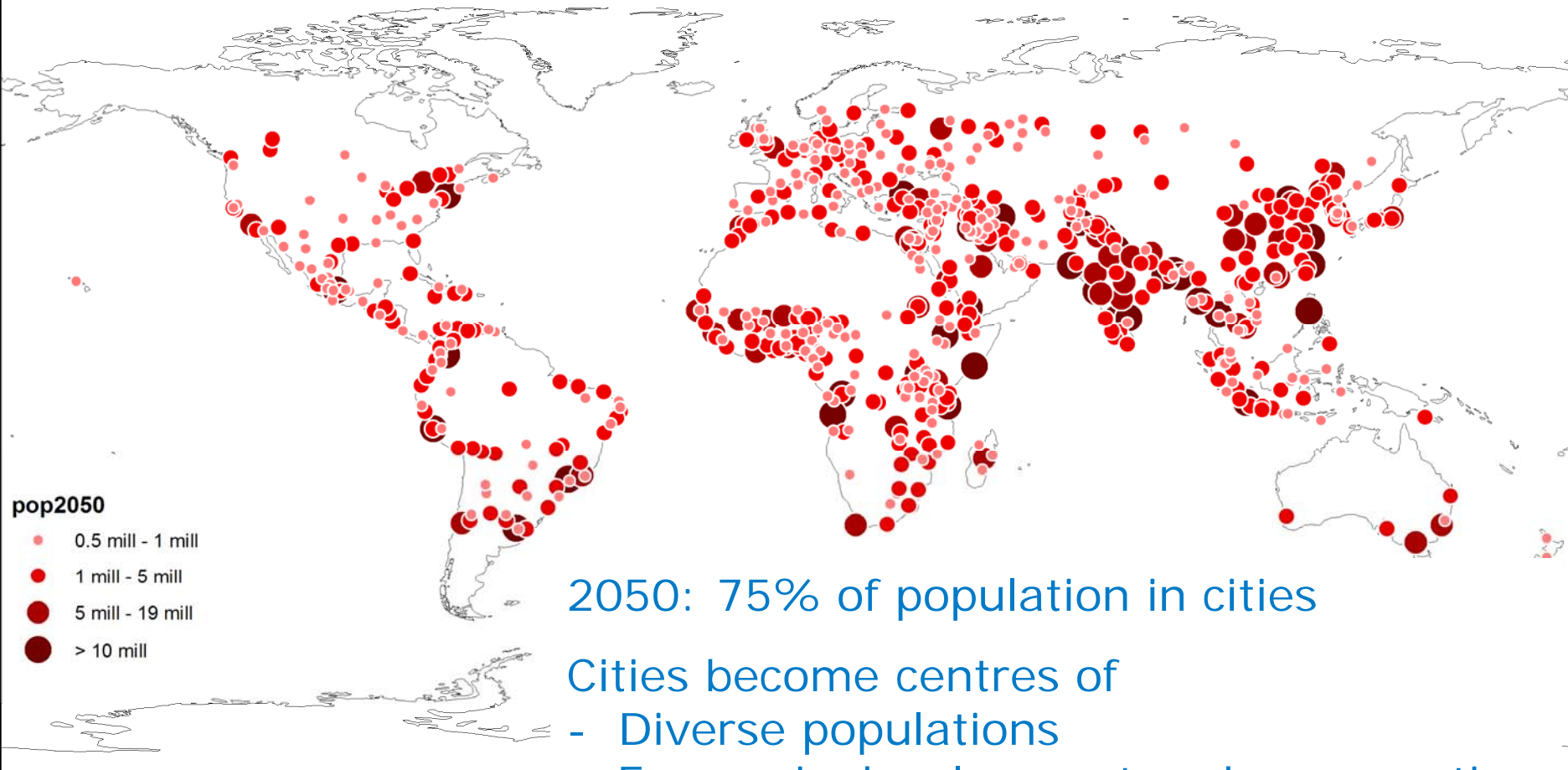
*Responsible water use and water allocation needed for sustainable growth*

# Unequal effects of climate change: yield changes 2050



# From global to local

*From a world of states to a world of cities*



2050: 75% of population in cities

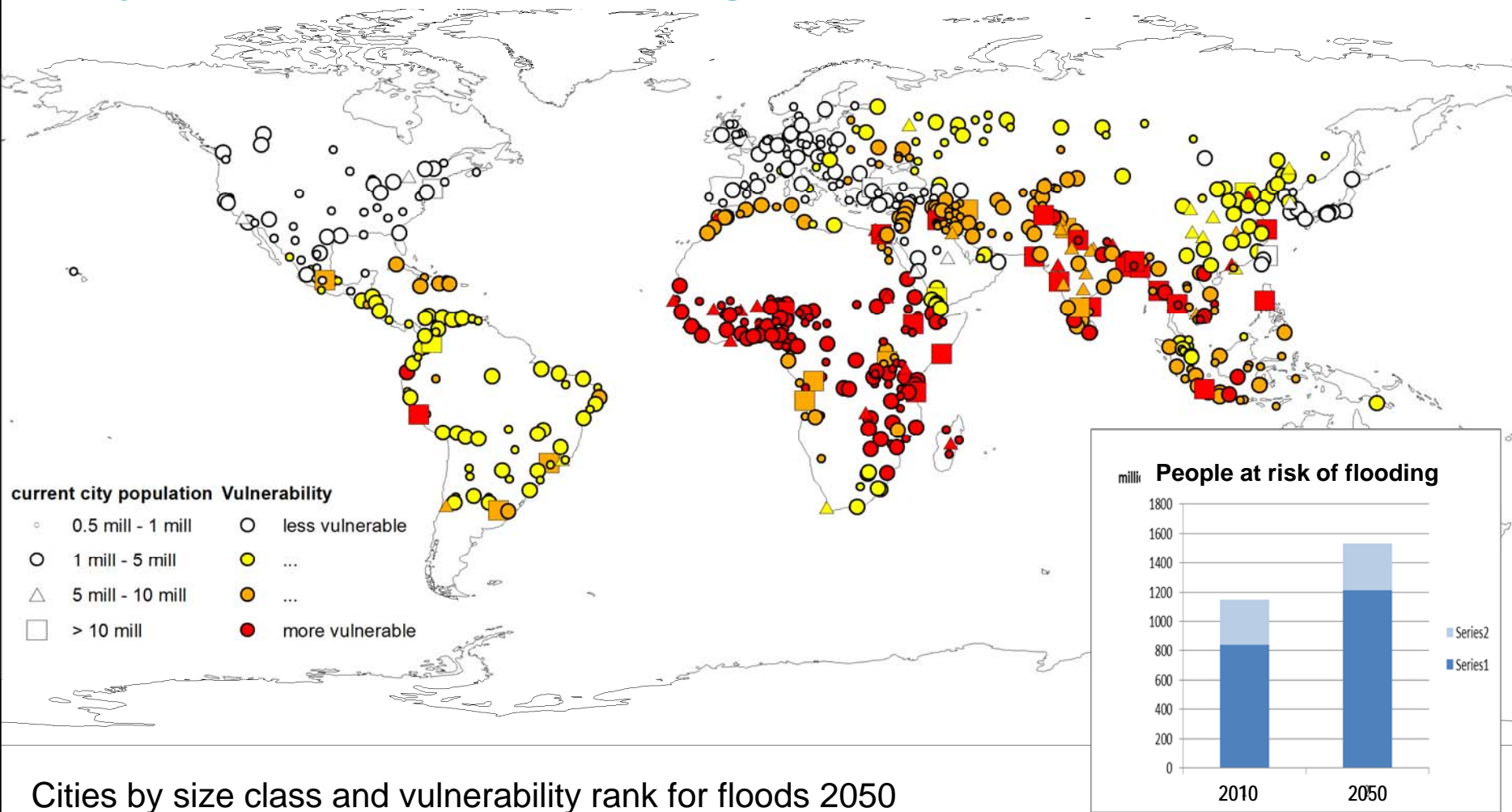
Cities become centres of

- Diverse populations
- Economic development and consumption
- International cultural development
- Energy use



# Water security: also flood risks

*Many cities vulnerable for flooding*

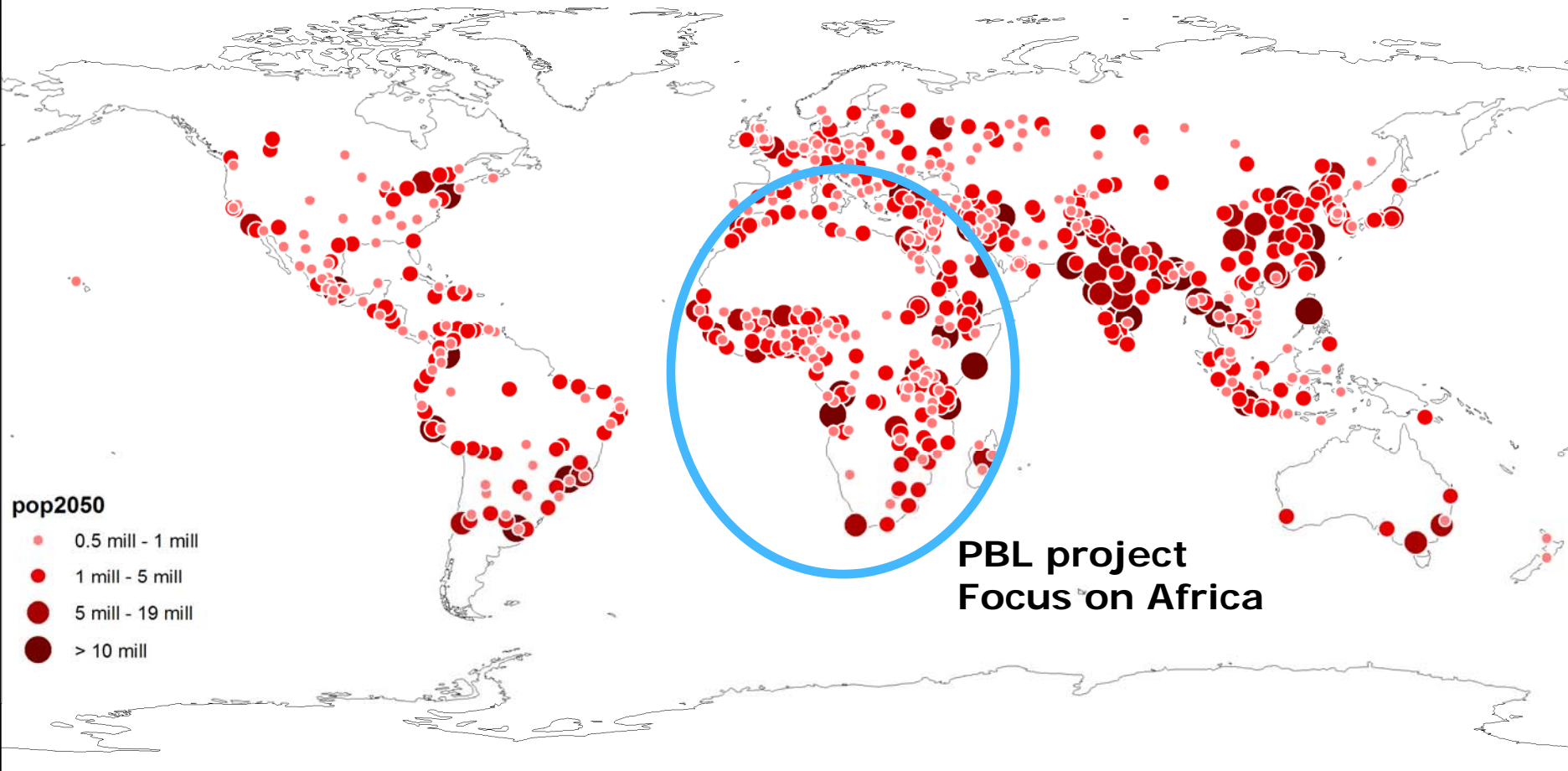


Cities by size class and vulnerability rank for floods 2050

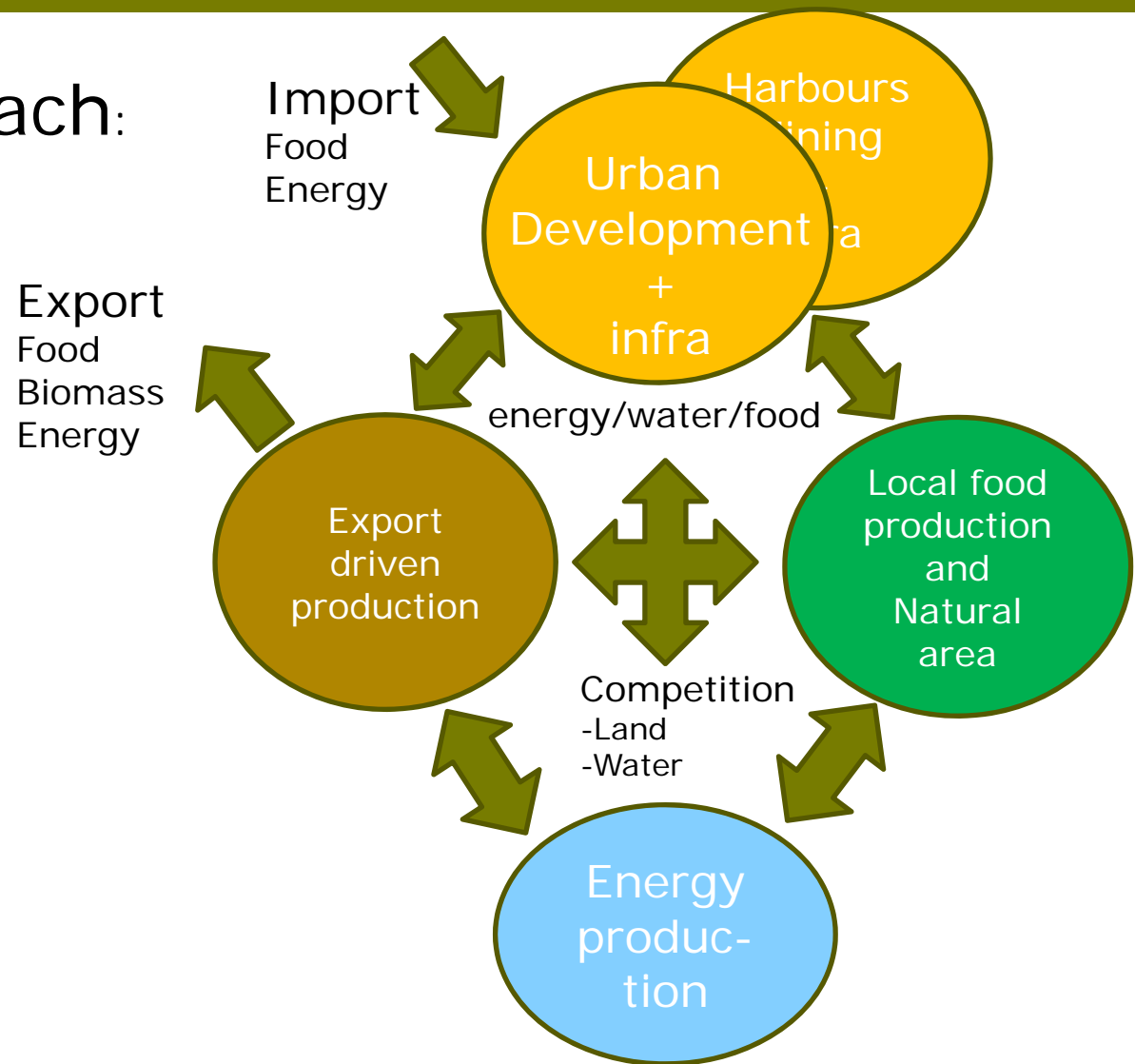
Vulnerability based on annual expected exposed population and GDP per capita

# From global to local

*From a world of states to a world of cities*



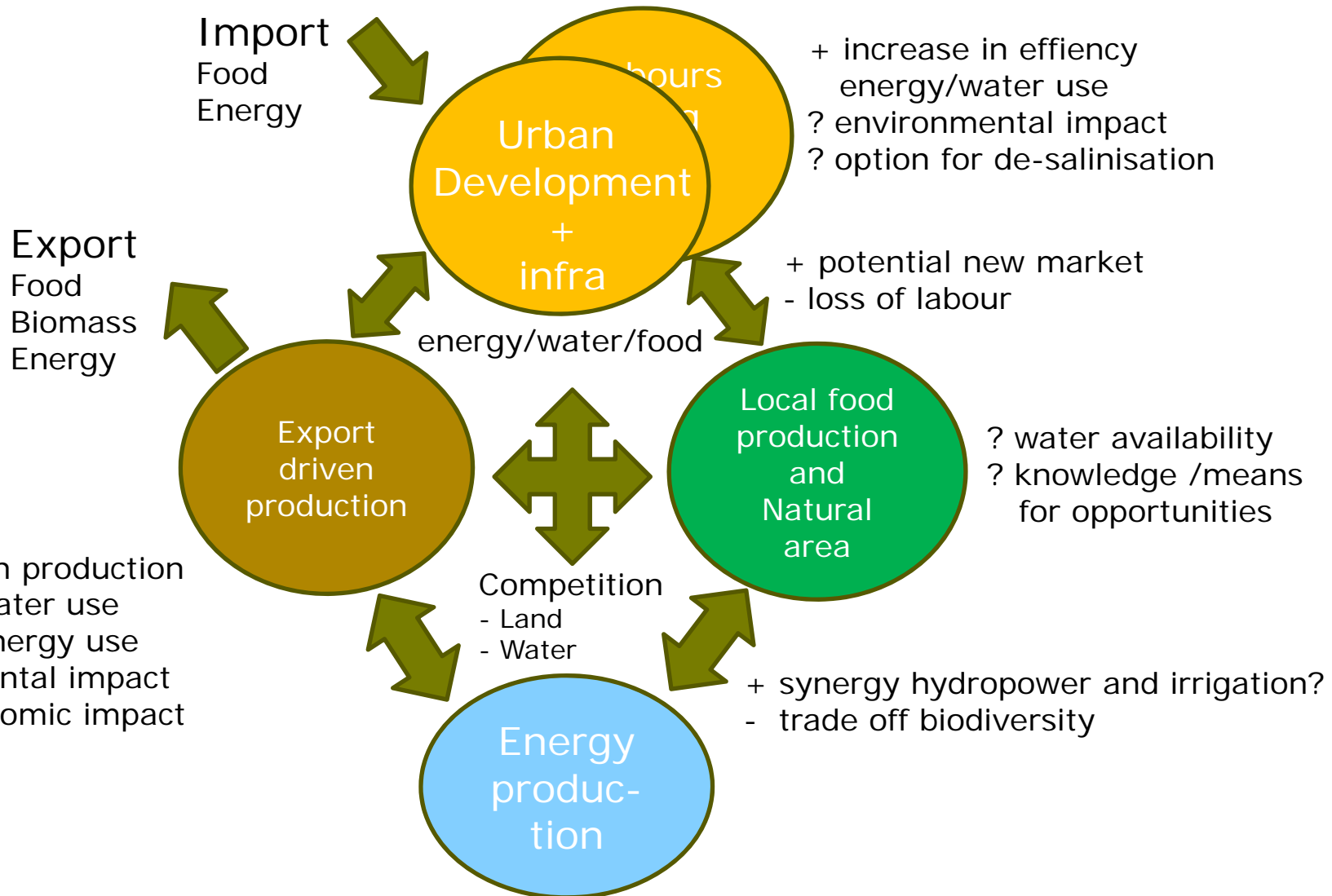
# System approach: Integrated and Inclusive Development of Regions

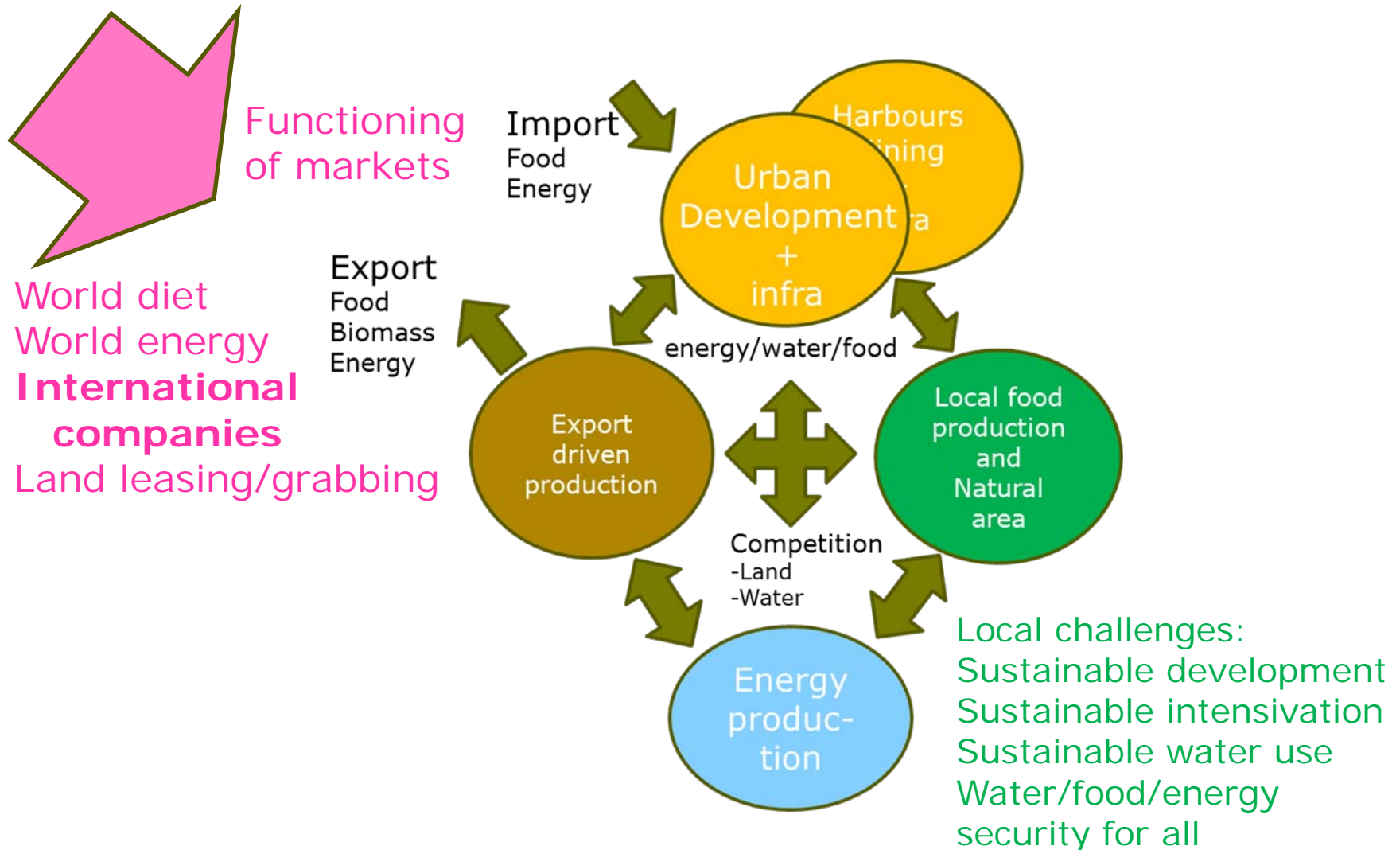


# Nexus integrated



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# Conclusions

- No golden bullet and easy solutions
- Solutions require inclusive development and integrated assessments on different scales: global ⇔ local
- Strategic options water ⇔ food ⇔ energy
  - \* adjusting global diet
  - \* increase resource efficiency (energy, water use)
  - \* reduce impacts of production (sustainable intensification)
  - \* explore synergy hydropower/irrigation
  - \* innovation in desalinisation with renewable energy
  - \* integrate social and environmental context
- Cities and regions key factor in development

## For discussion

Who to address for what and how?

- \* global – carbon trade/regulations on food trade/biomass
- \* supra-national – transport routes/river basins
- \* national – regulations/tax systems/stimulating regions/infra
- \* cities and provinces- inclusive urban/regional development
- \* international companies – Corporate Social Responsibility (CSR)
- \* investors – infrastructure, CSR

- \* who to address for adjusting trends in diet?

role of international aid and development?

