PBL Netherlands Environmental Assessment Agency

# The value of the water-food nexus approach

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# Water – Food nexus: some basic facts

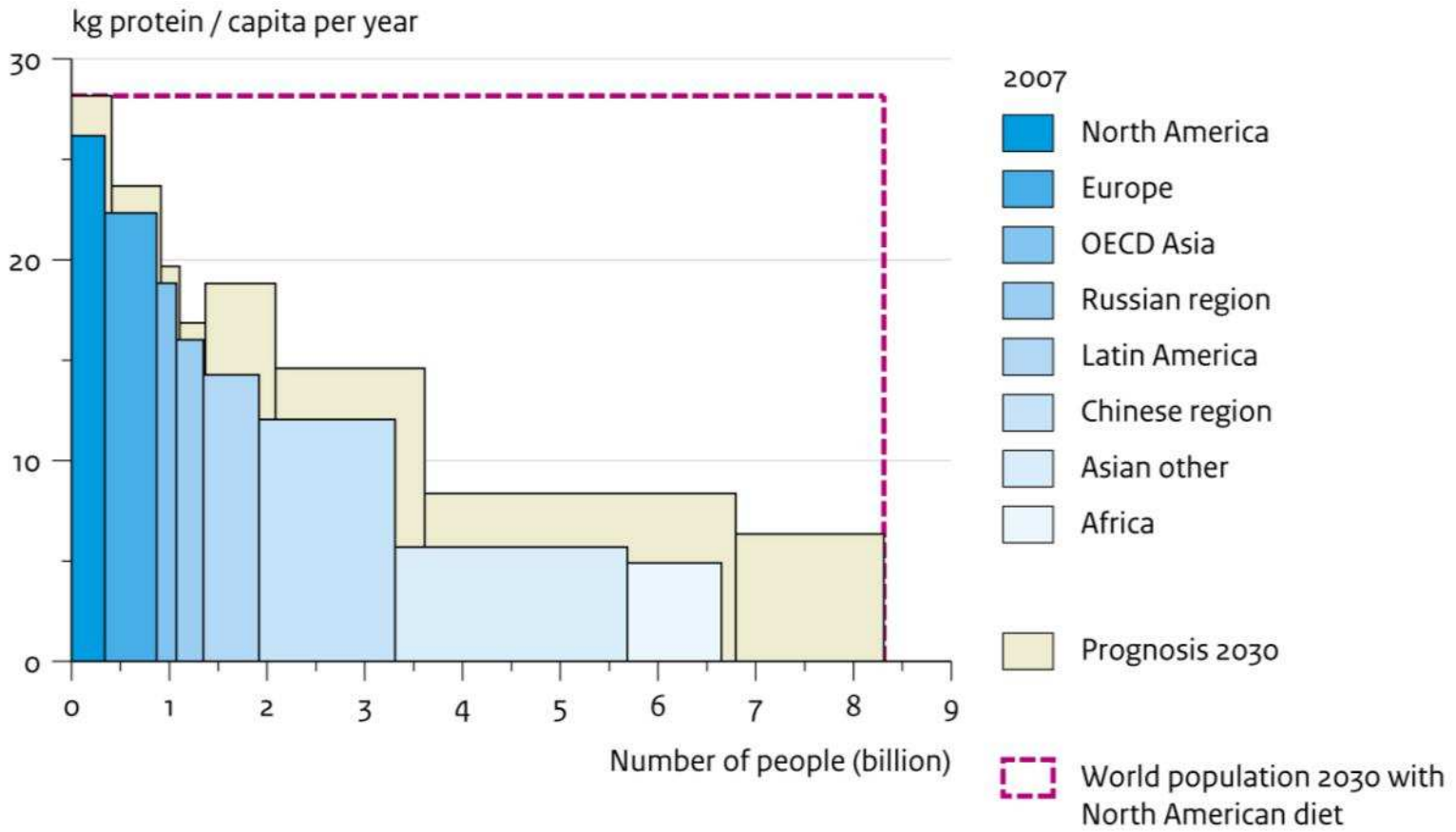
- 70% of 'blue' water use is for agriculture, demand is increasing
- In many regions water is *not* managed sustainable: depletion of aquifers and large-scale disturbance of river basins:
  → lower future crop yields
- In many regions, water is not used efficienctly: more crop per (rain)drop is certainly possible
- Limited water availability is one of the causes of low crop production & rural poverty, especially in sub-Saharan Africa
- Water is *one* of the essential natural resources for food production: others are Land & soils, Minerals, Biodiversity & EGS, Fossil fuels

# Water issues will aggravate → solutions needed

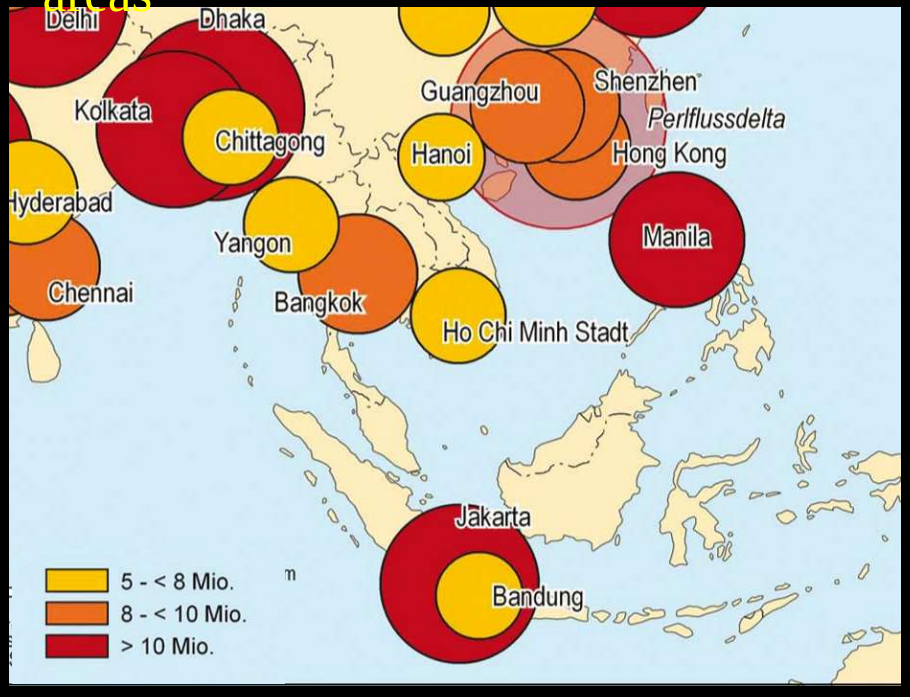
- Food production is expected to increase by 50-70% next 40 years
- Shifts in diets, due to urbanization, increased welfare, *supermarketization*
- *Dietaryr shifts: more meat and dairy, more non-traditional food products → more trade*
- Increased demand from other sectors
- Effect of climate change

- Look at water issue separately, or in larger context?

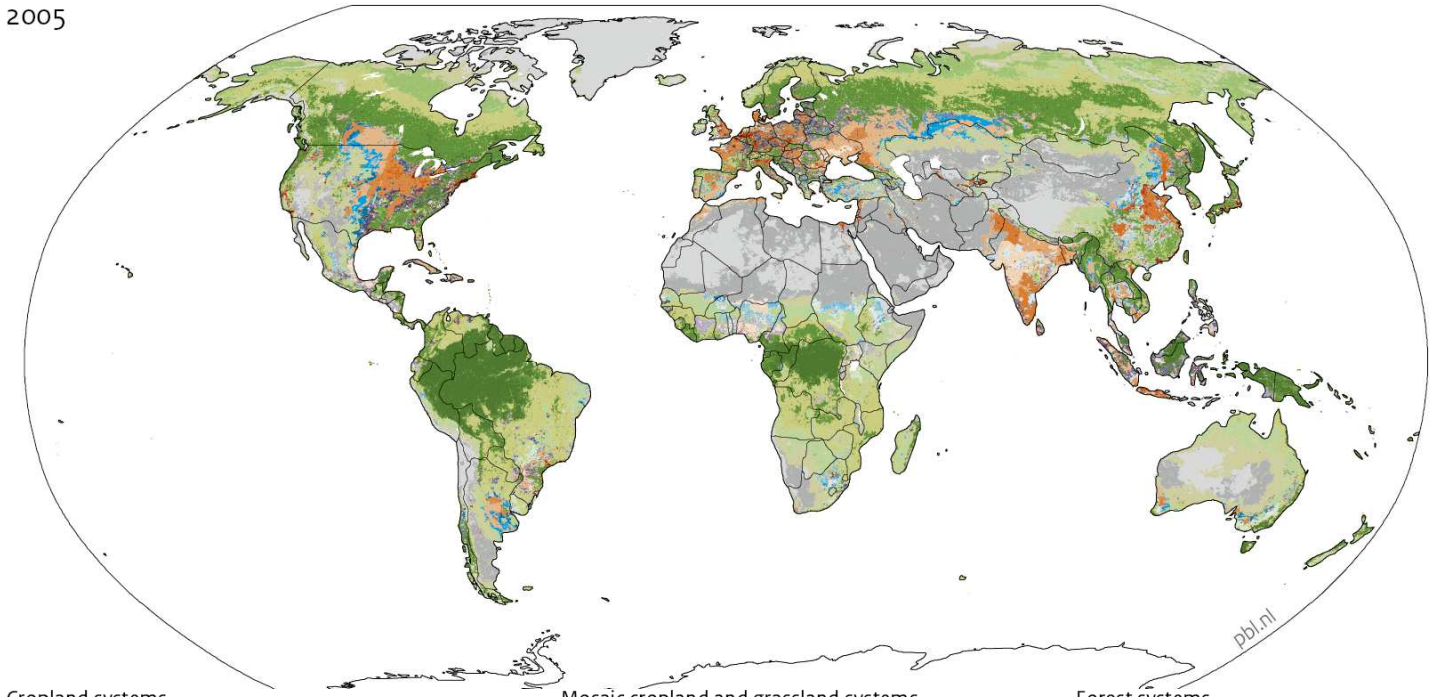
# Dietary changes towards animal proteins – with higher water footprint



Large population growth in rural areas



# Distribution of land systems: vast changes expected




Source: Van Asselen and Verburg 2013, PBL 2014

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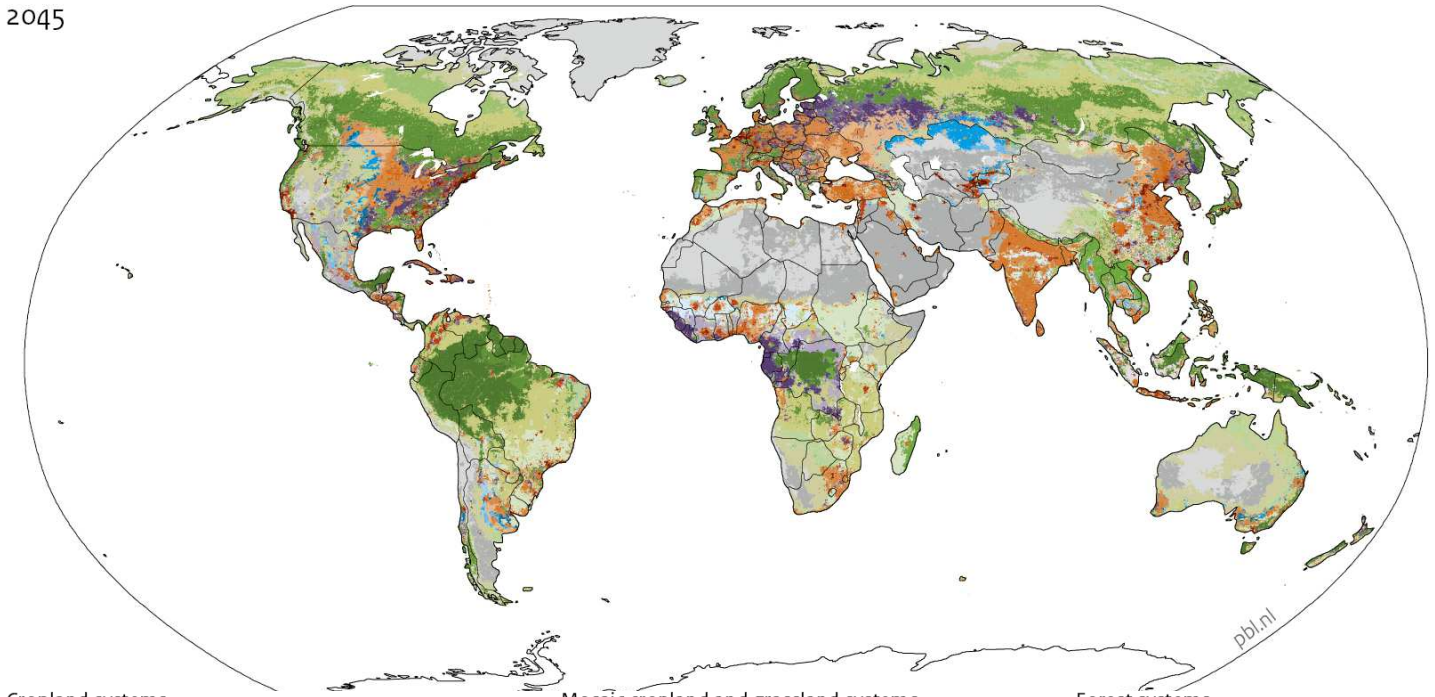



Cropland systems
- Extensive with few livestock
- Extensive with bovines, goats and sheep
- Extensive with pigs and poultry
- Medium intensive with few livestock
- Medium intensive with bovines, goats and sheep
- Medium intensive with pigs and poultry
- Intensive with few livestock
- Intensive with bovines, goats and sheep
- Intensive with pigs and poultry

Bare systems
- Bare
- Bare with few livestock

Mosaic cropland and grassland systems
- With bovines, goats and sheep
- With pigs and poultry
- Extensive; with few livestock
- Medium intensive; with few livestock
- Intensive; with few livestock

Mosaic cropland and forest systems
- With pigs and poultry
- Extensive; with few livestock
- Medium intensive; with few livestock
- Intensive; with few livestock

Settlement systems
- Peri-urban and villages
- Urban

Forest systems
- Dense
- Open with few livestock
- Open with pigs and poultry

Grassland systems
- Natural
- With few livestock
- With bovines, goats and sheep

Mosaic (semi-)natural systems
- Grassland and forest
- Grassland and bare

Source: Van Asselen and Verburg 2013, PBL 2014

# Integration at different levels

IWRM (Integrated water resource management)

# Integration at different levels

Resources = demand

| IWRM (Integrated water resource management) | ISFM (integrated soil fertility management) | ILM Integrated land management) | IPM Integrate pest management) |
|---|---|---|---|

# Integration at different levels

Consumption

Resources = demand

Food system

Consumption-side options
- Reduction of food wastes and losses
- Dietary changes

*Involvement of other actors: food companies, retailers*

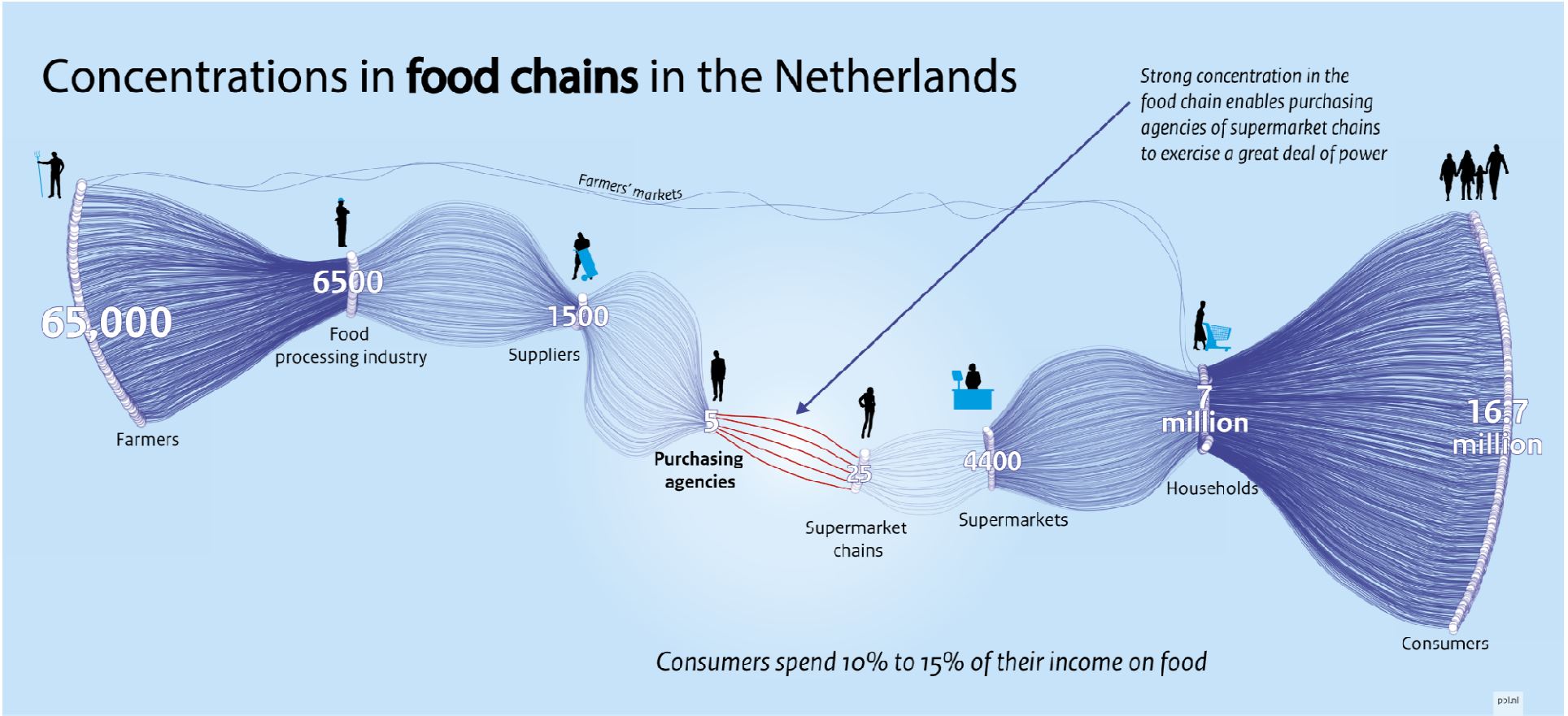
IWRM (Integrated water resource management)

ISFM (integrated soil fertility management)

ILM Integrated land management)

IPM Integrated pest management)

# Concentration of power in the Western-type food chain



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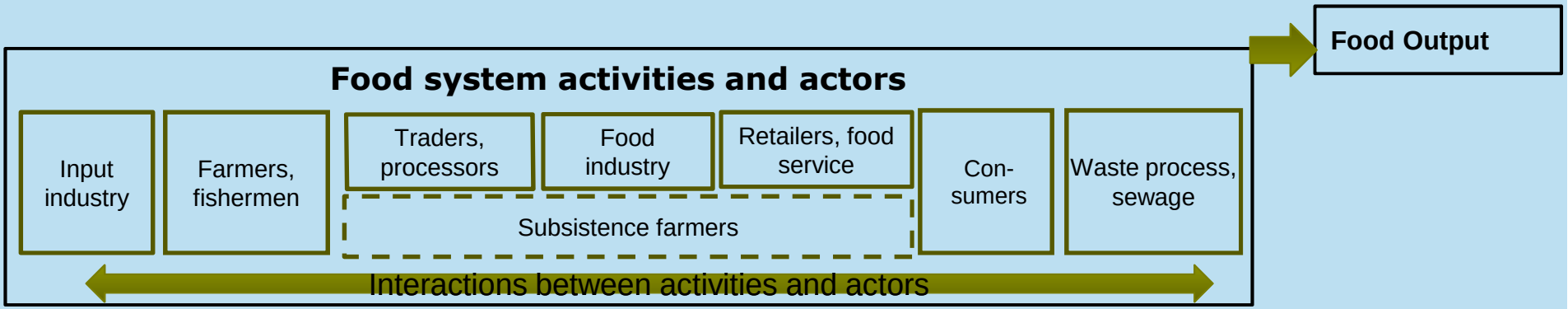
# Conceptual approach: ‘food systems’

- Looks *institutionally* at natural resources and environmental effects
- More prominent in science over the last 10 years
- Will be helpful in identifying new **challenges & opportunities**, both for governments as for private actors
  - And which ACTOR can leverage such opportunities
- Food systems are globally very diverse: this is also true for opportunities

# Conceptual framework food systems and natural resources



# Conceptual framework food systems and natural resources

**Environmental impacts**

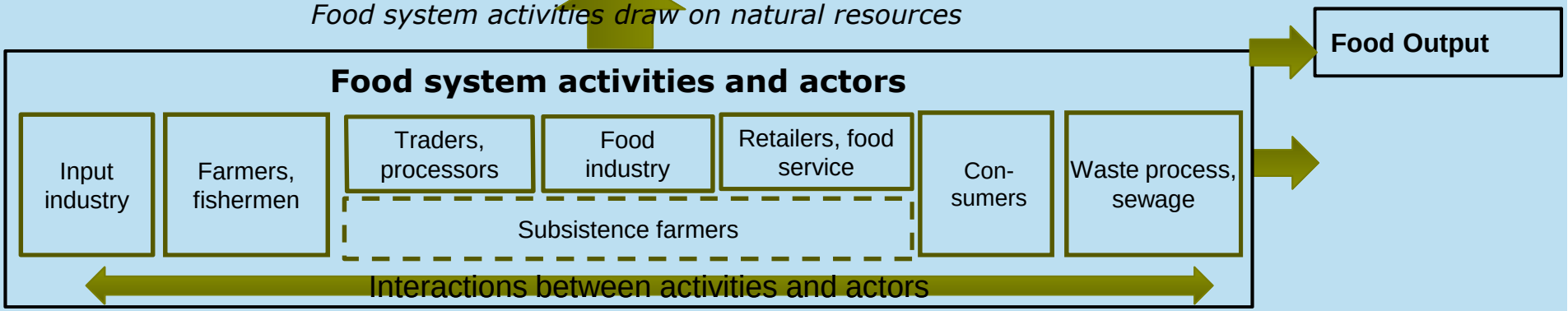
- atmospheric composition (e.g. from GHG emissions)
- air quality
- water quantity and quality, eutrophication, toxicity
- biodiversity loss

*Food system activities affect natural resources*

**Natural resources**

- Land, landscape and soils
- **Fresh water**
- Nutrients
- Marine resources
- Fossil fuels
- Biodiversity and EGS

*Food system activities draw on natural resources*



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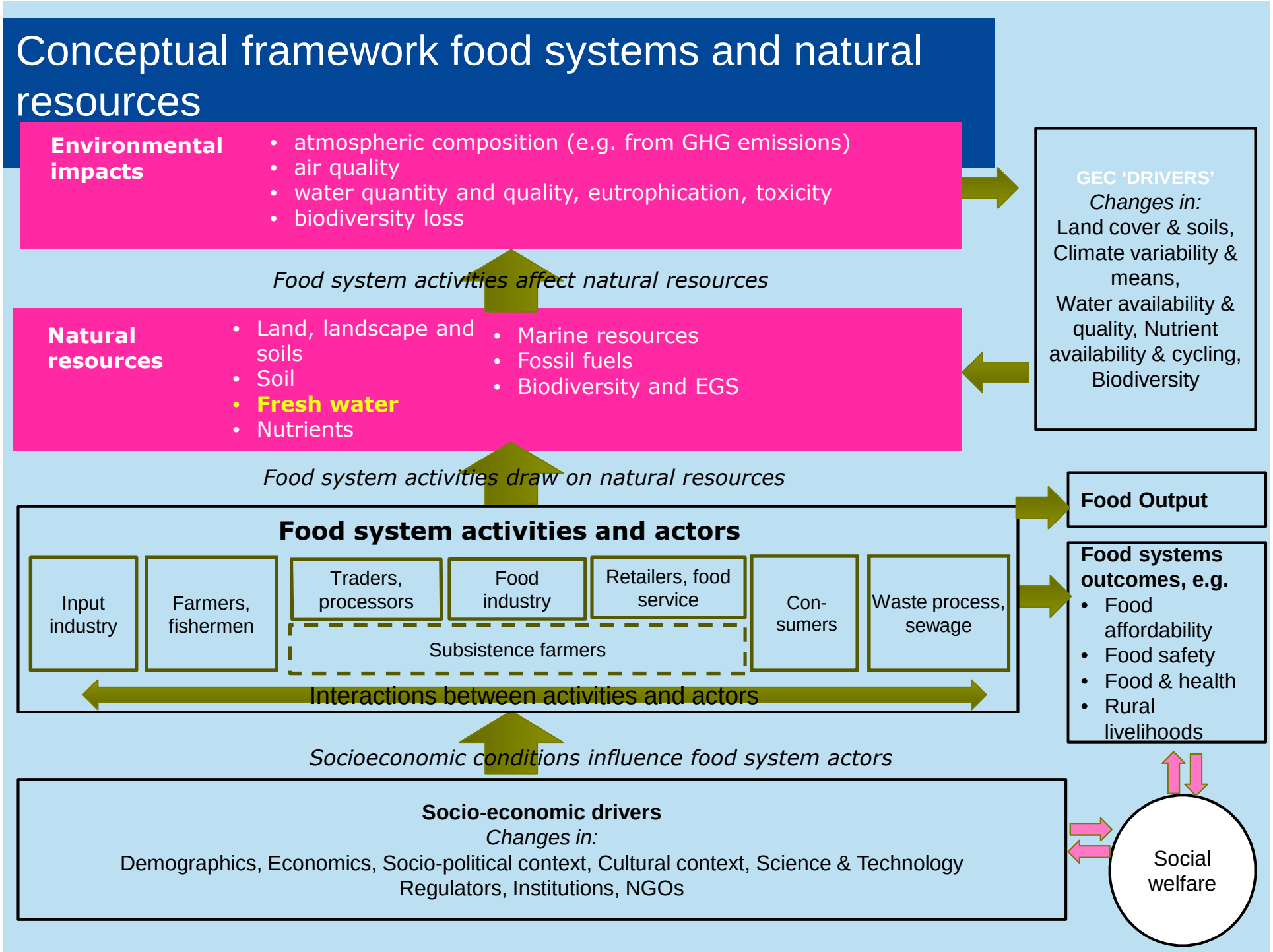

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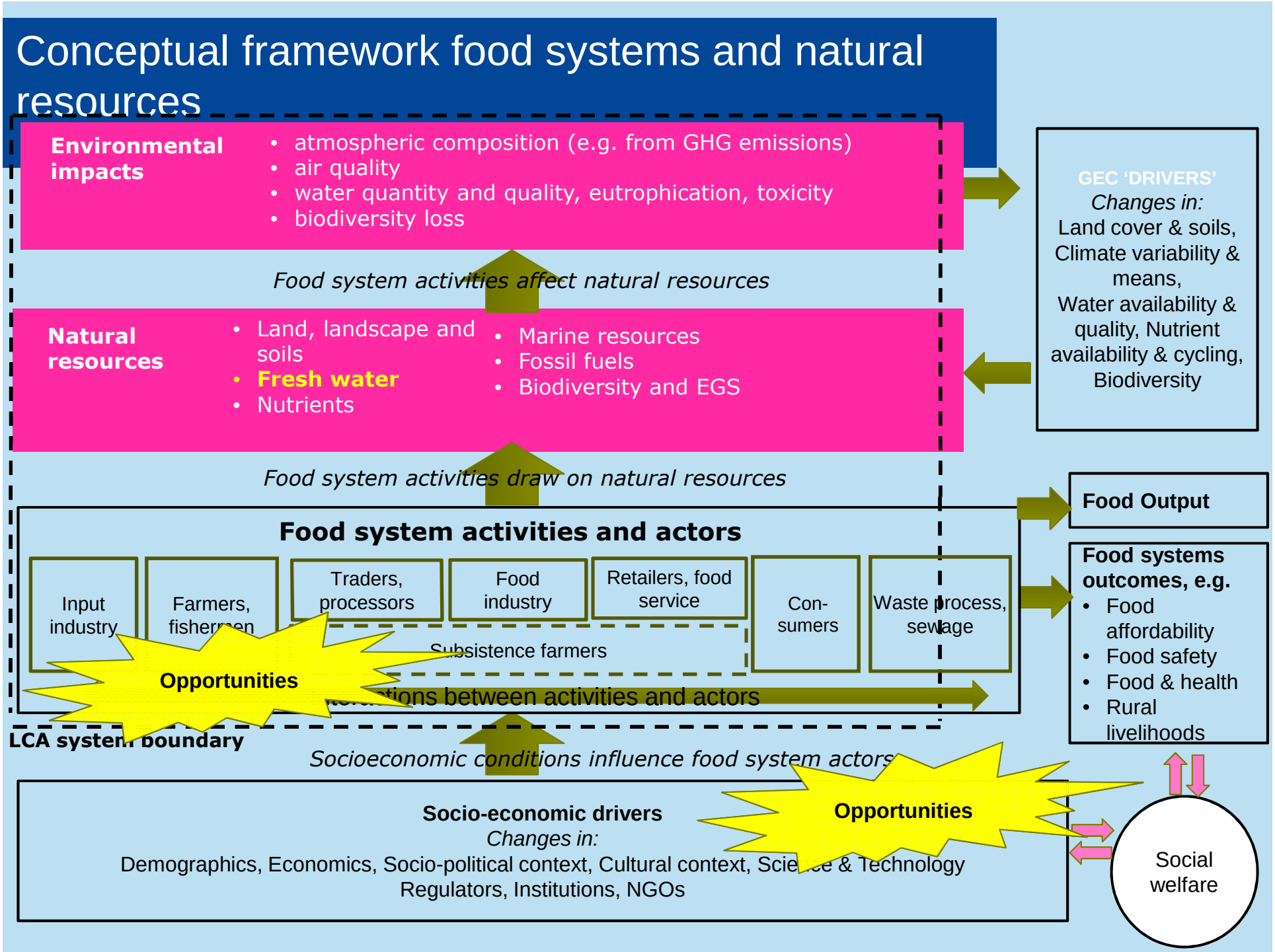


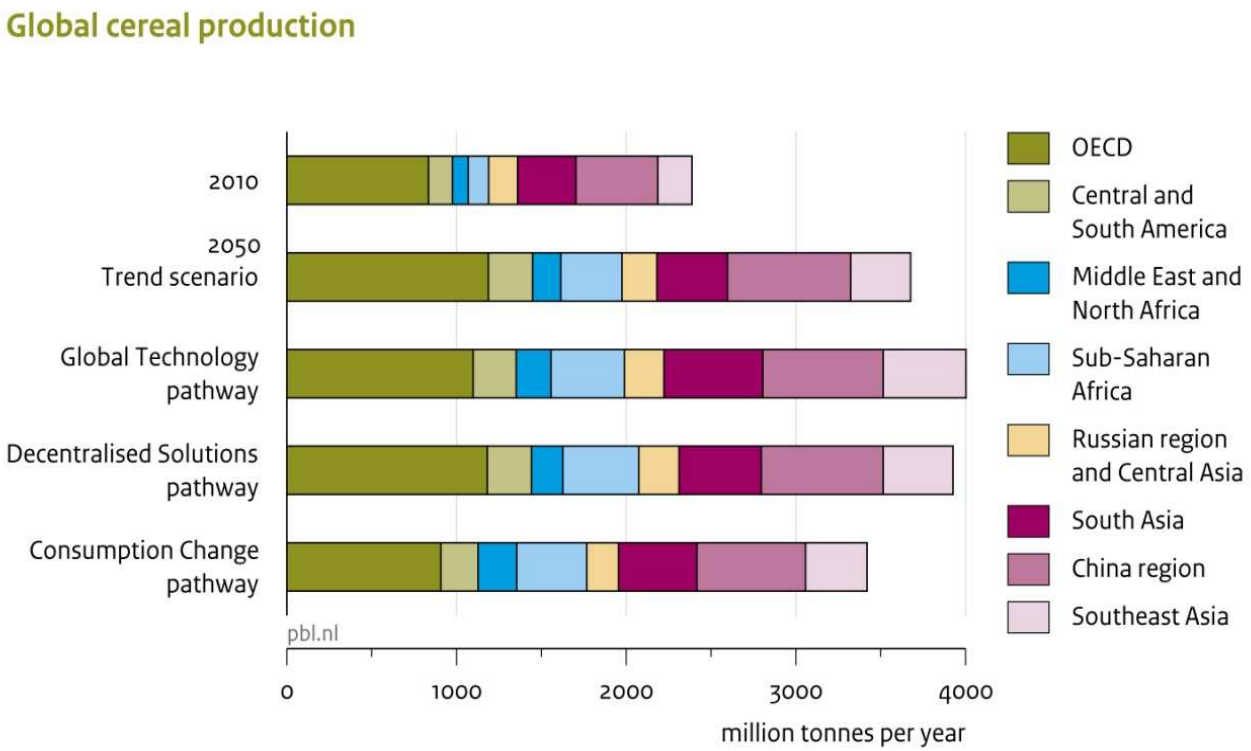
| | Sustainable use | Efficient use |
|---|---|---|
| **Land & Soils** | No or very limited land degradation / soil erosion | Appropriate crop yields |
| **Water** | No depletion of groundwater or disturbance of surface water systems | High water use efficiency |
| **Nutrients** | Low rate of depletion of mineral reserves | High nutrient efficiency across the food chain |
| **Genetic resources** | Maintain genetic diversity for resilient food systems | Use genetic resources with highest input/output ratio |
| **Energy** | Replacement of fossil fuels by renewable sources | Energy-efficiency at farms, fisheries, food processing, and transport |
| **Marine resources** | Sustainable management of fish stocks | Avoidance of by-catch, proper use of by-catch |

# Roads from Rio+20 study: three pathways

| | Global Technology | Decentralised Solutions | Consumption Change |
|---|---|---|---|
| **Access to food** | Trend | Inequality in access to food due to income inequality converges to zero by 2050 | Inequality in access to food due to income inequality converges to zero by 2050 |
| **Trade** | Full liberalisation of trade in agricultural products | Trend | Trend |
| **Consumption** | Trend | Trend | Meat consumption per capita levels off at twice the consumption level suggested by a supposed healthy diet (Stehfest et al., 2009; Willett, 2001) |
| **Waste** | Trend | Trend | Waste is reduced by 50% (15% of production) |
| **Agricultural productivity** | In all regions, 30% increase in crop yields and 15% increase in livestock 'yields' by 2050, compared with the *Trend* scenario | In all regions, 20% increase in crop yields and 15% increase in livestock 'yields' with least possible impacts on biodiversity (Biodiversity: MSA in agricultural area 40% higher than in the *Trend* scenario) | In all regions, 15% increase in crop yields by 2050, compared with the *Trend* scenario |

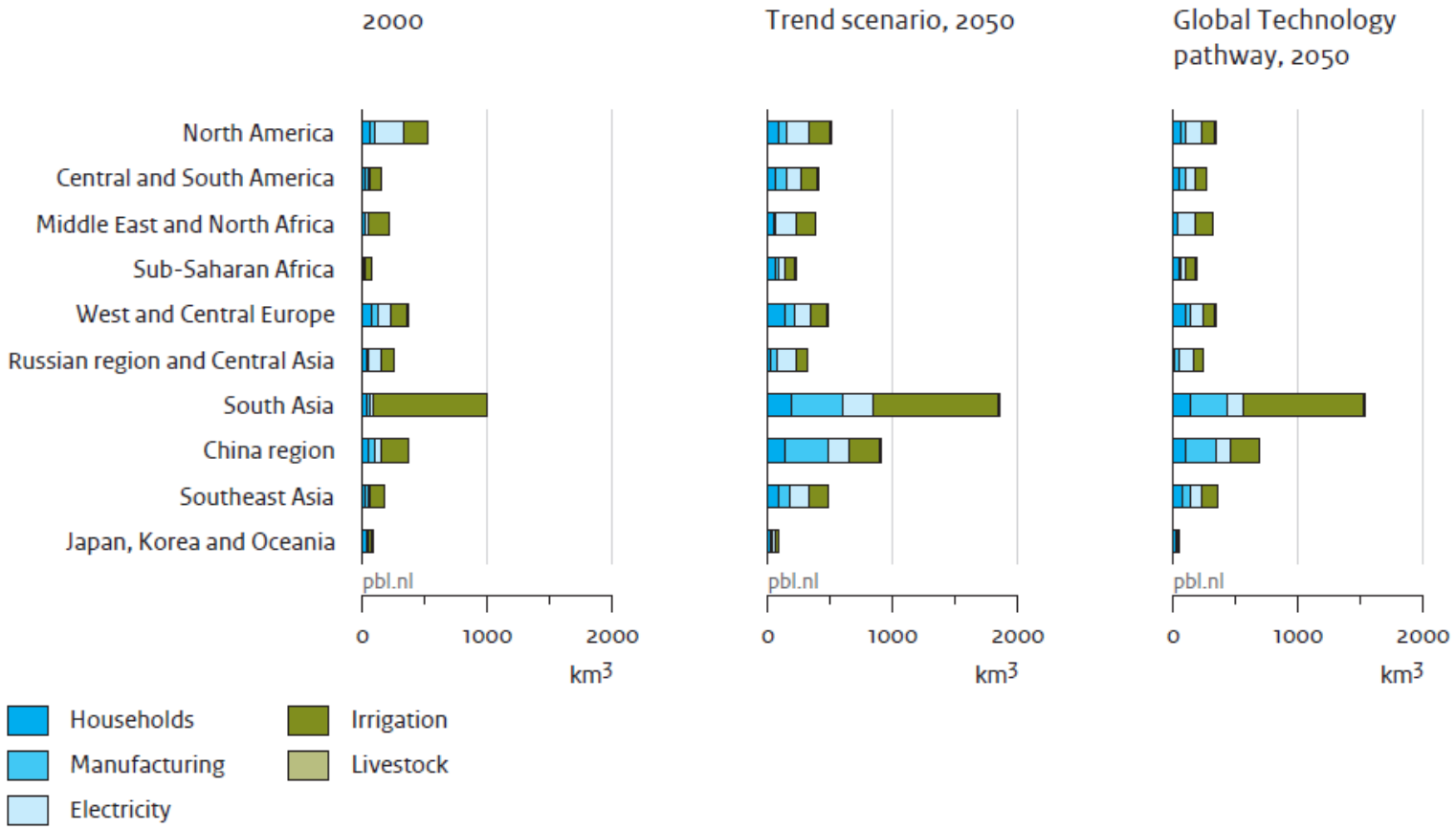
Source: PBL, 2012: Roads from Rio+20

# Global cereal production in three pathways




Source: PBL, 2012: Roads from Rio+20

## Global water demand per region




Source: PBL

Source: PBL, 2012: Roads from Rio+20

# Conclusion

- Water-food nexus highly relevant:
  - Opens up opportunities at the consumption side
  - Also addresses impacts on food security, rural livelihoods
- Could be extended to food system approach
- Looks institutinally at actors
- Large number of examples