
# The Water-Energy-Food Nexus

## be careful what you ignore ...

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European Commission

*Lunchtime Conference*
*External Cooperation Infopoint*
*Brussels, 10 November 2015*

# A science perspective to balance the three dimensions of sustainable development with institutional aspects


## SDGs in the post-2015 development agenda

29% WELL DEVELOPED

54% SHOULD BE MORE SPECIFIC

17% REQUIRE SIGNIFICANT WORK


## Enhancing the efficiency of water governance

*Principle 8 d*: Promote a strong science-policy interface to contribute to better water governance and bridge the divide between scientific findings and water governance practices

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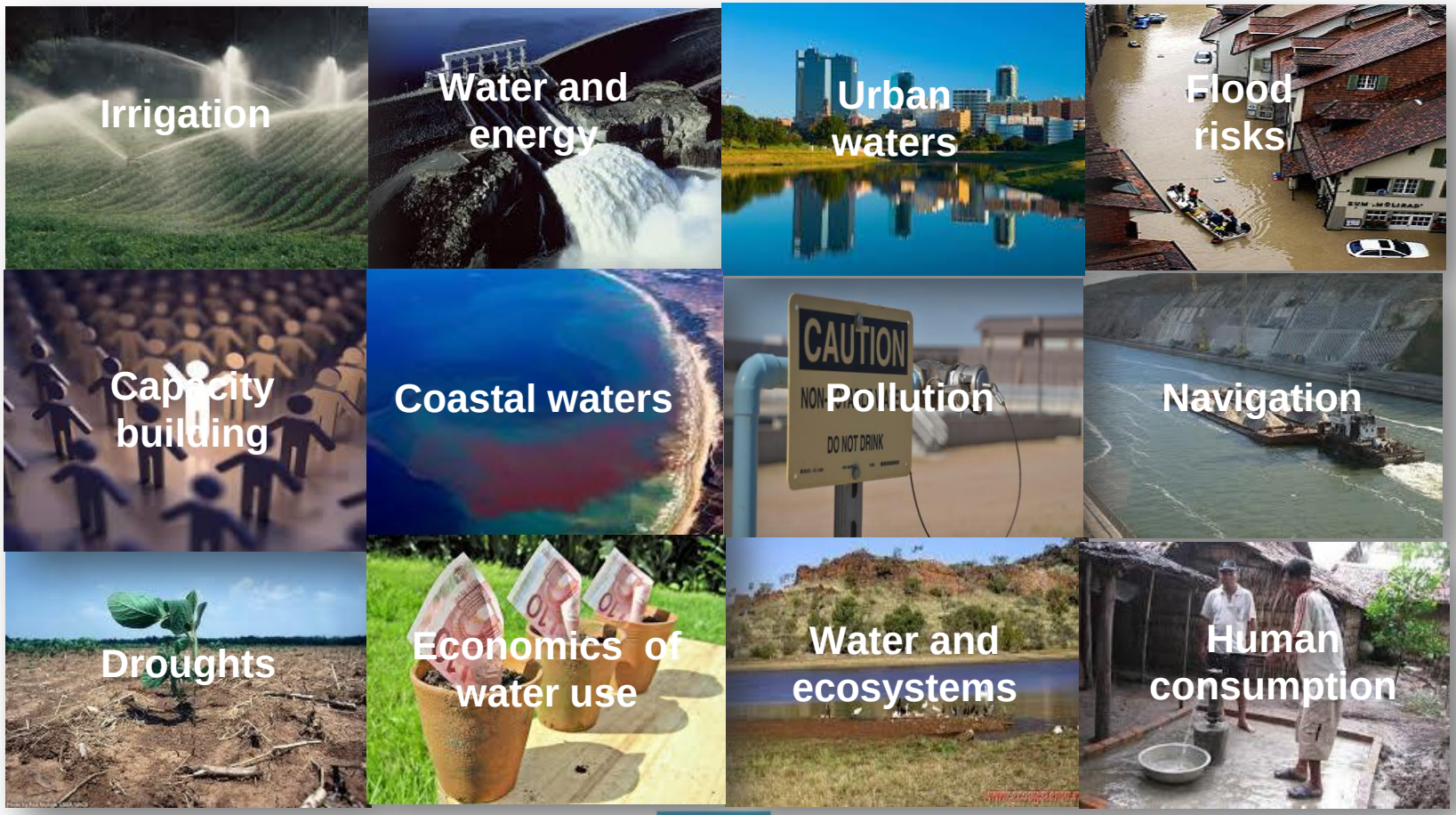
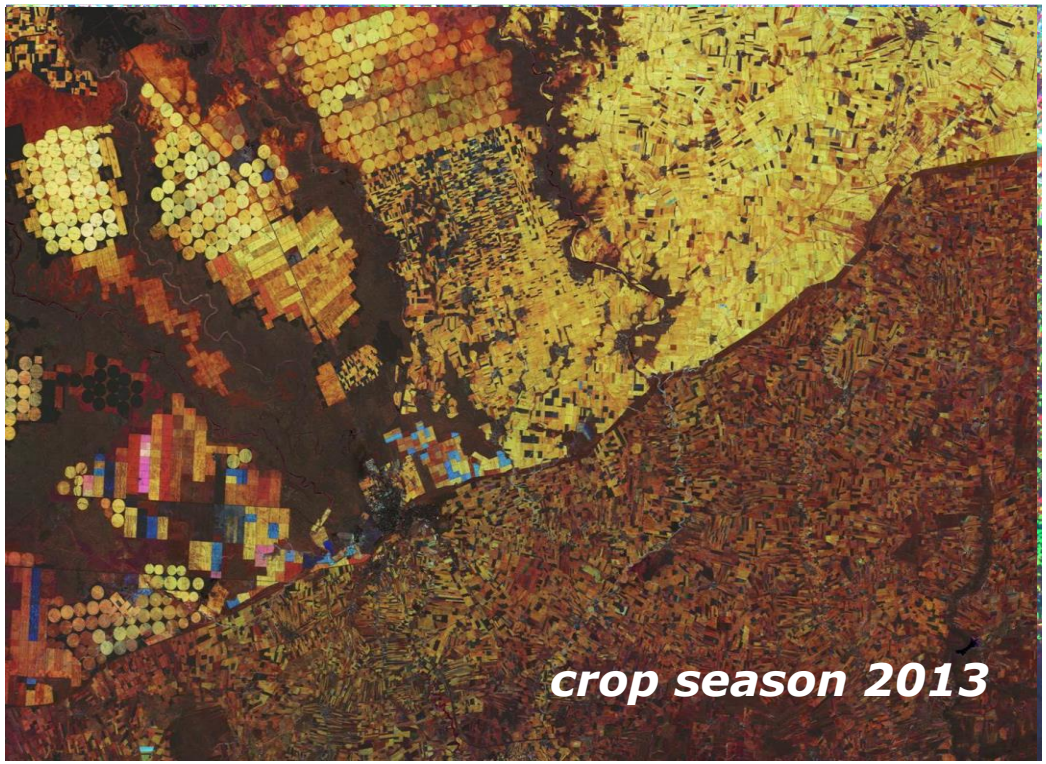
# JRC, the Commission's in-house science service

*Provide cross-cutting support to water-related sectoral policies*



# Managing interdependencies




Irrigated summer crop cultivation in July-August

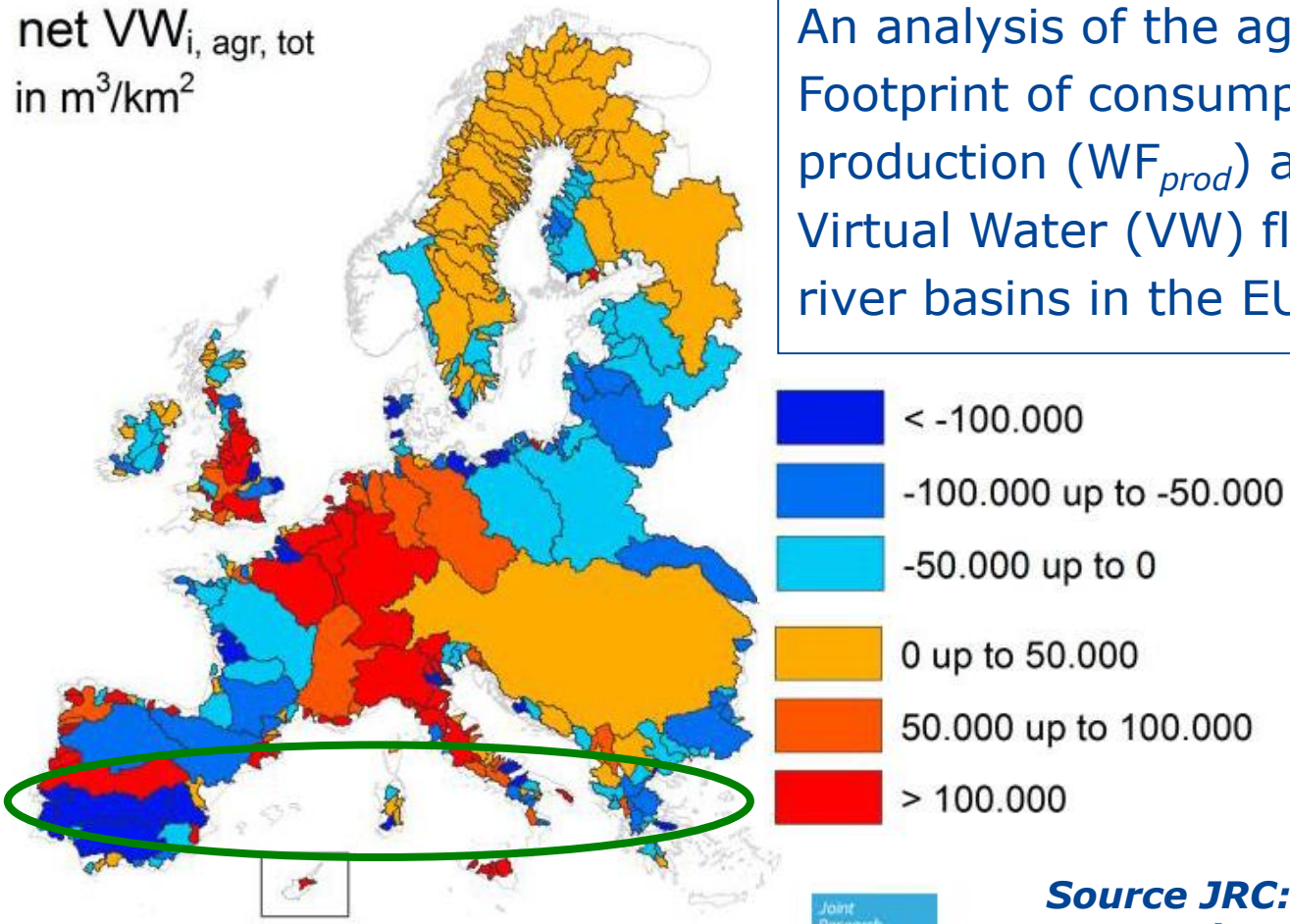
- 2007
- 2011
- 2015
- all periods

A Landsat NDVI composite image of summer crops for an area straddling the Syrian-Turkish north-eastern border.
The bright colours relate to irrigated crop areas

***Source JRC, Lemoine et al.***

# Interdependency of distant global geographies

*The Water Footprint of agricultural products*




An analysis of the agricultural Water Footprint of consumption ($WF_{cons}$) and production ($WF_{prod}$) and the resulting Virtual Water (VW) flow for 365 large river basins in the EU

*Net Virtual Water* ***export*** *basins*

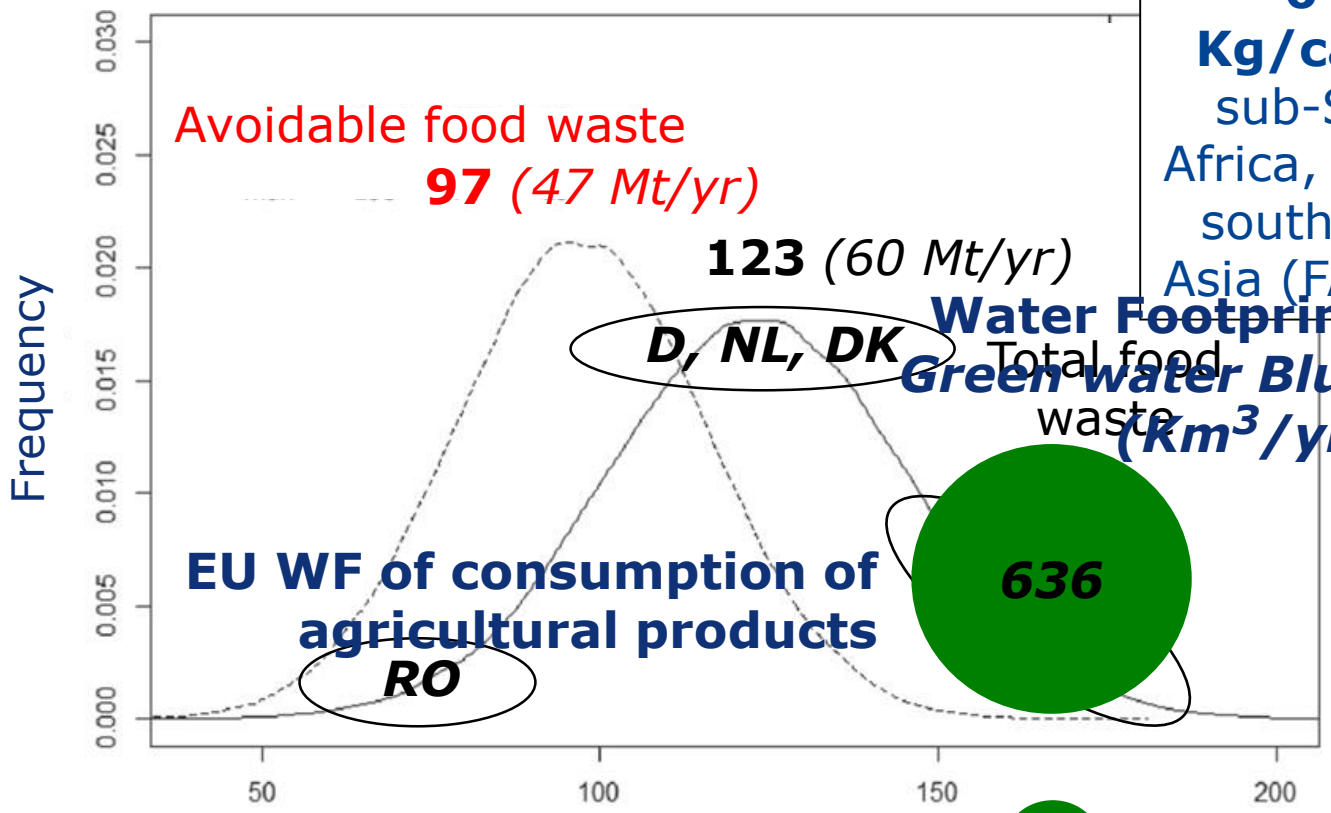
*Net Virtual Water* ***import*** *basins*

***Source JRC: Vanham and Bidoglio, Environ. Res. Lett. (2014)***

# Consumers, food supply chain and the Water Nexus

*Lost water resources due to EU consumer food waste*

**6 – 11 Kg/cap/yr** in sub-Saharan Africa, south and south-eastern Asia (FAO, 2011)




**Water Footprint (WF)**
***Green water Blue water***
***($km^3$/yr)***

**EU WF of consumption of agricultural products**

***RO***

***636***

***53***

**EU WF consumer food waste**

***52***

***5***

***Source JRC: Vanham et al., Environ. Res. Lett. (2015)***

# JRC addressing the knowledge base of the Water-Energy-Food Nexus

- Support anchoring the Nexus in global, regional and national policies and fostering the **policy dialogue** in the Post-2015 Development Agenda
- Nexus assessments: look at the implications of water resources allocation on the **security of the food and energy systems** and on **urban water governance**

# A systemic approach improving policy coherence, developing synergies and negotiating tradeoffs

Support the **development of Nexus indicators** addressing the spatial dimension of the cross-sectorial interdependences


- **Understanding baseline conditions**
- **From baselines to solutions**
- **Building on regional partnerships**

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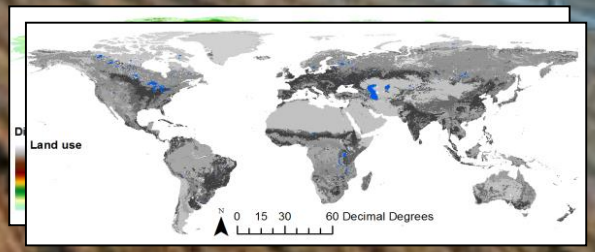
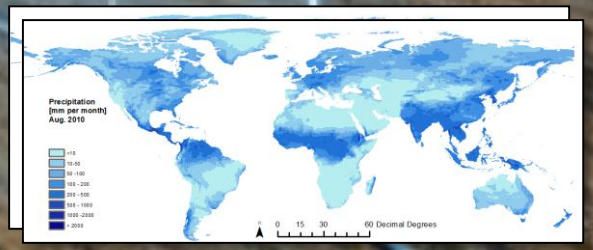
# Understanding baseline conditions

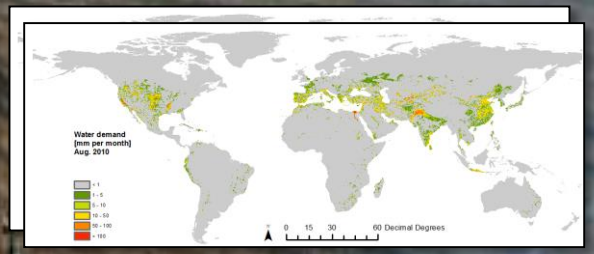
**Global spatial data: river network, land cover, elevation, etc.**



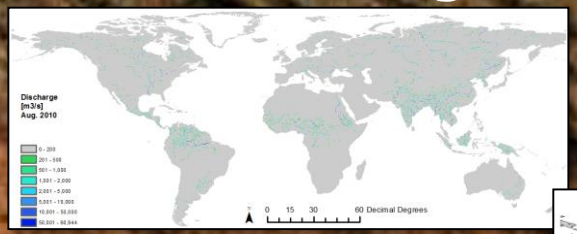

**Daily data: precipitation, temperature, wind speed, etc.**



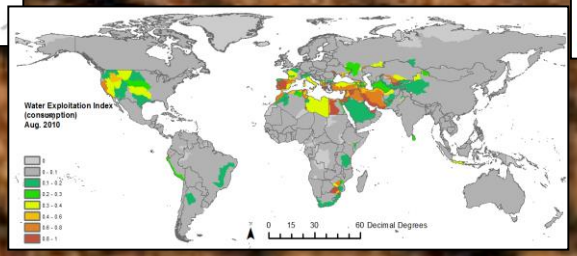

**Water demand: from energy, industry, livestock, irrigation, etc.**



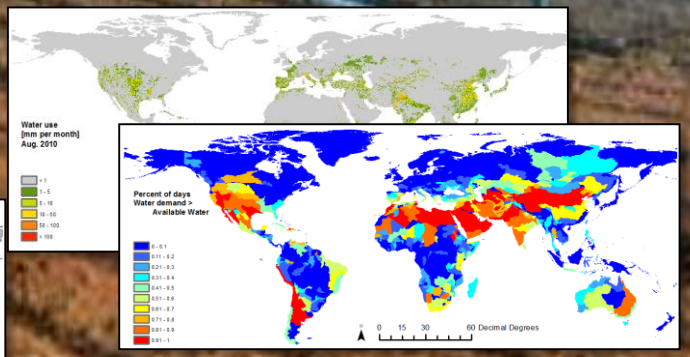

**River discharges**



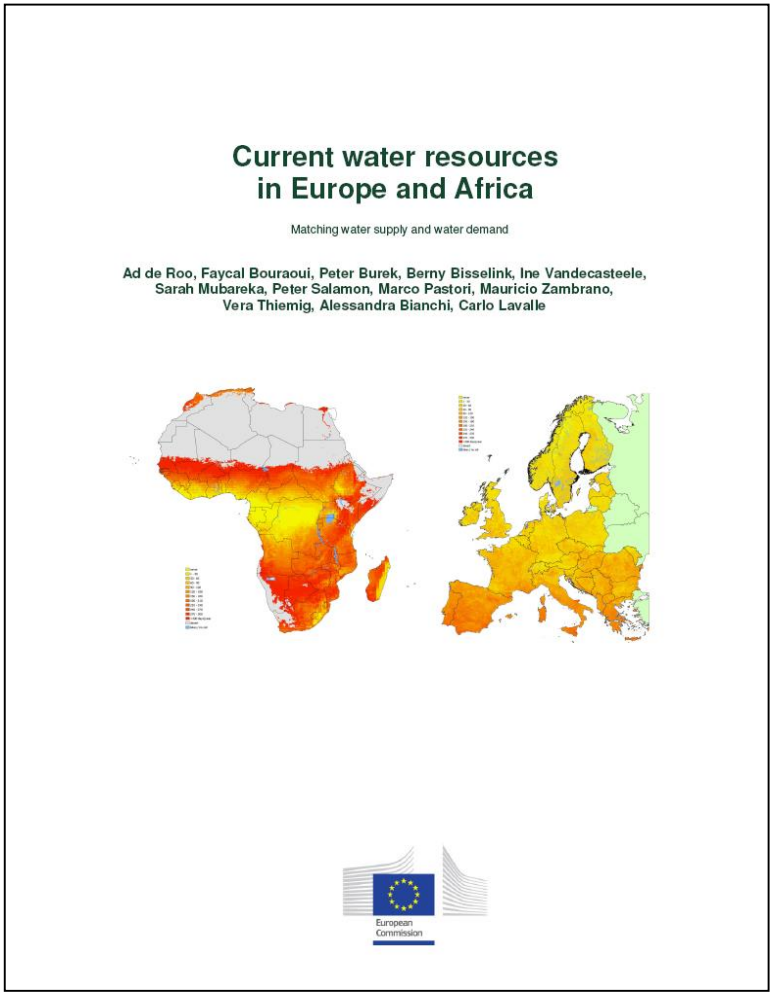

**Water Exploitation Index**



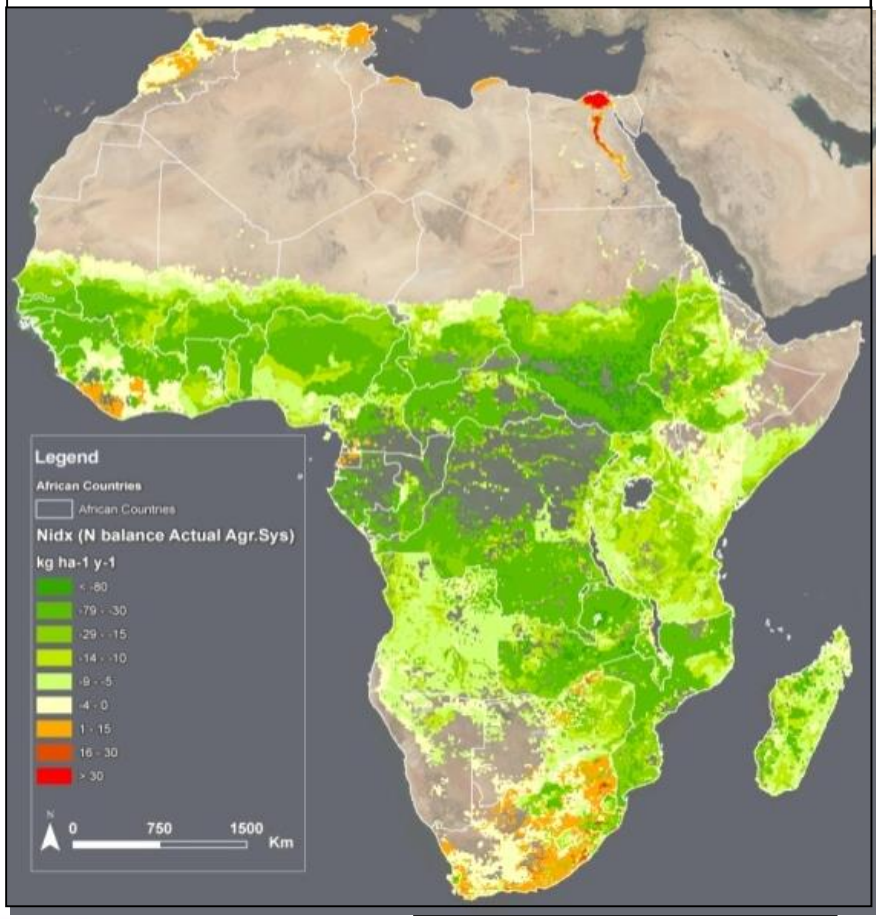

**Water availability**




**Percentage of days water demand > water availability**




## Nitrogen balance for 5 most diffuse crops (Kg $ha^{-1}$ $yr^{-1}$)




***Source JRC (2012, 2013)***

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# From baselines to solutions

## An hydro-socio-economic assessment of scenarios of sectoral water uses in 2030

**Participatory scenario building**

- Bias-corrected climate scenarios
- Land use scenarios
- Agro-economic scenarios
- (Bio)-Energy scenarios

*Spatial Data Infrastructure*

**Benchmarking regional knowledge**

- Survey of existing water uses
- Socio-economic survey
- Water quality survey

**Biophysical assessment**

- Surface hydrology / groundwater hydrogeology
- Water and agricultural land management
- Water quality, ecology, hydro-morphology

**Economic assessment**

- Energy, industry, agricultural demand / production / trade / prices / income effects of water use
- Non-market valuation of ecosystem services

**Multi-objectives optimization and uncertainty-sensitivity analyses**

**Analysis of tradeoffs and stakeholder negotiation**

# Testing scenarios for spatial planning of measures

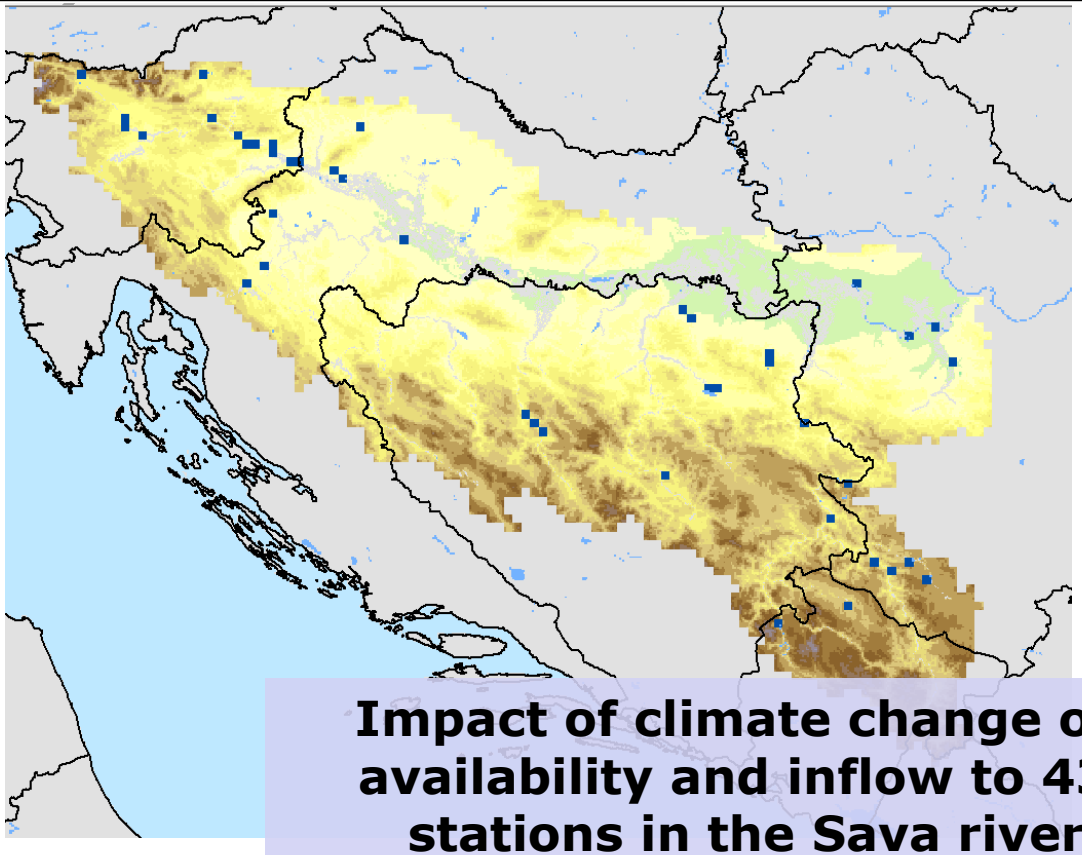
e.g. is there enough water to sustain a certain energy plan, which water requirements for the production of biofuels?

*Thematic Nexus assessments in the Sava River Basin in the context of the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes*

INTERNATIONAL SAVA RIVER BASIN COMMISSION

UNECE

European Commission



***Source JRC: De Roo et al. (2015)***

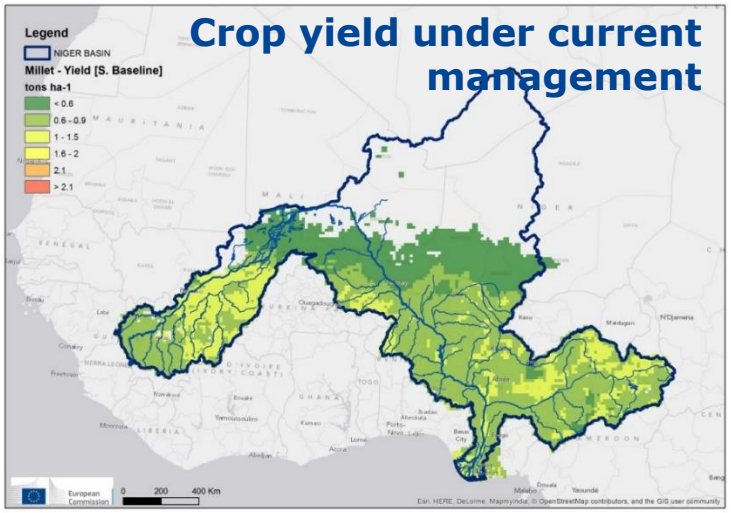
**Impact of climate change on water availability and inflow to 43 power stations in the Sava river basin**

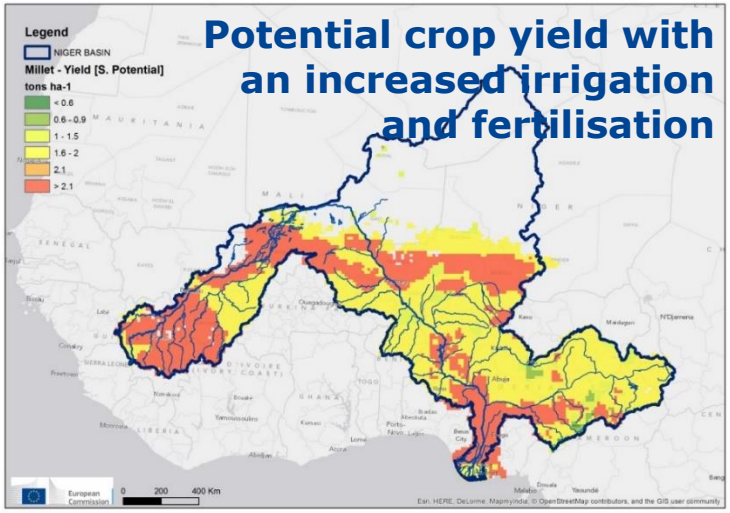
# Water for food, energy and ecosystems in the Niger and Mekrou river basins

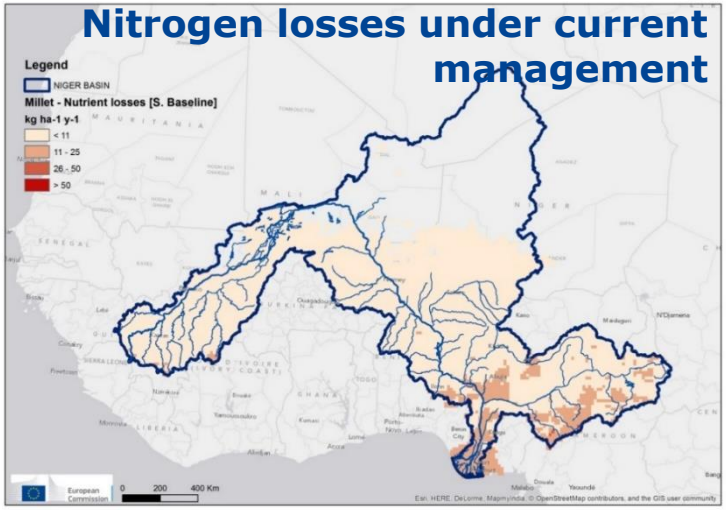
- How to improve allocation of water especially in the dry season?
- What are the most suitable areas for agriculture development and those at risk of flooding?
- Which impacts on water quality and land degradation may we face in the future?
- What socio-economic scenarios can be expected, taking into account crops yield and their economic value, markets accessibility, tradeoff between irrigated, rainfed agriculture and energy production?

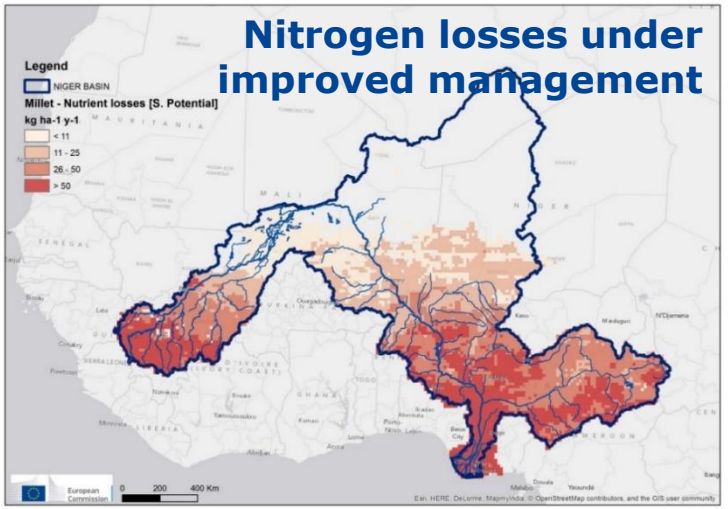

- Build spatial scenarios of maximum plausible agricultural water demand in the catchment
- Identify where demand comes closer to water availability, thus compressing water availability for other usages and for the functioning of ecosystems

# The millet case



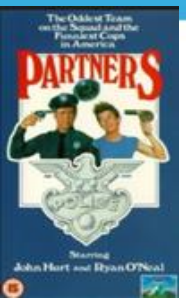



# Engaging stakeholders across sectors to identify priority areas for actions

| Sectors | Priorities | Data (preliminary) |
|---|---|---|
| Households | Safe minimum level of drinking water<br>Securing a minimum household income<br>Vulnerability and resilience to extreme events<br>Access to water services / water infrastructure<br>Securing safe nutrition standards<br>Reduction of diseases / securing safe health status | DHS Program, US AID, Demographic and Health data Surveys (Benin, Burkina Faso, Niger)<br>Population census (Burkina Faso)<br>General Statistics, (INSD) (Burkina Faso)<br>General Statistics, (INSAE) (Benin)<br>General Statistics, (INS) (Niger)<br>Database "Banque de données intégrée - Situation des points d'eau" (Benin)<br>Agriculture / Demographics survey, Living Standards Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA) World Bank project. (Niger)<br>Agricultural economic data, (Benin)<br>Agricultural economic data, (Burkina Faso)<br>Agricultural economic data, (Niger)<br>Small Farmer Survey 1998 (Benin)<br>Forest Outlook Studies for Africa (Benin, Burkina Faso, Niger)<br>Egoh et al. 2012, NASA, Woods Hole Research Institute, FAO-JRC, Africover, FAO, WWF, JRC (BIOPAMA) |
| Fishing, hunting, forest residues collection | Food security | |
| Agriculture and livestock | Adaptation to climate change/Access to land and water<br>Collective management of agricultural water use<br>Role of livestock system (sedentary vs transhumant)<br>Sustainable agriculture (new crops, water management)<br>Increase of yield productivity / Water efficiency<br>Eco labelling – Organic production – Fair trade<br>Sustainable consumption and local production | |
| Industry/ Transport/services | Compliance with environmental norms | |
| Ecosystem services / environment | Identification and valuation of the Mekrou ecosystem services<br>Evaluation of anthropogenic activities with negative impacts (pollution, sedimentation)<br>Securing safe minimum water level for the ecosystem services<br>Assessment of the recreation value of WPark<br>Valuation of reducing risk of extreme events | |
| Energy | Securing energy production under increased needs<br>Potential to develop renewable energy (biofuels, hydropower) | |
| Tourism | Sustainable tourism<br>Contribution to economic growth | |

Participatory approach involving national stakeholders




# Building on regional partnerships

## ACE-2 Water: the second phase of the African Network of Centres of Excellence on Water (2016-2017)

### Western African CoE Network members

- University of Cheikh Anta Diop (**Senegal**)- Hub
- International Institute for Water and Environmental Engineering (**Burkina Faso**)
- University of Benin (**Nigeria**)
- National Water Resources Institute (**Nigeria**)
- Kwame Nkrumah University for Sciences and Technology (**Ghana**)

### Southern African CoE Network members

- Stellenbosch University (**South Africa**) – Hub
- International Centre for Water Economics and Governance in Africa (**Mozambique**)
- University of KwaZulu-Natal (**South Africa**)
- University of Western Cape (**South Africa**)
- University of Malawi (**Malawi**)
- University of Zambia (**Zambia**)
- University of Botswana (**Botswana**)
- The Council for Scientific and Industrial Research, CSIR (**South Africa**)


**Eastern and Central Africa and MENA networks**

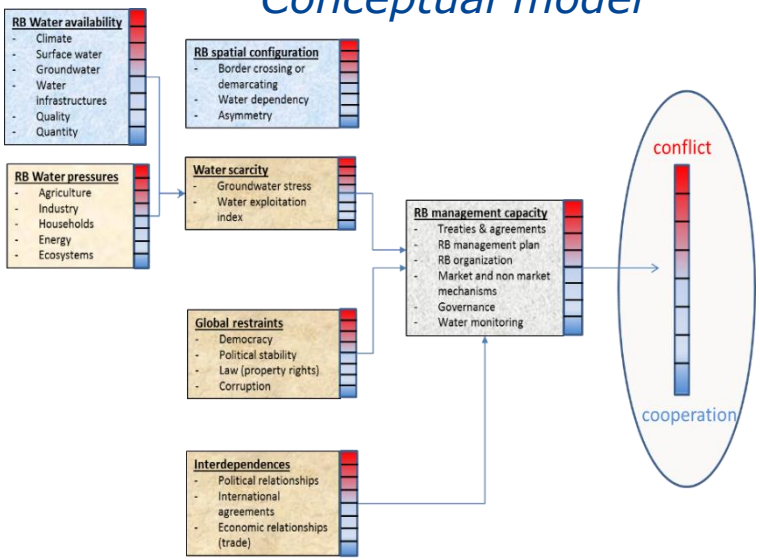
**Selection to be carried out in 2016-2017**

# Atlas of Regional Water Cooperation and Conflicts

## Objectives

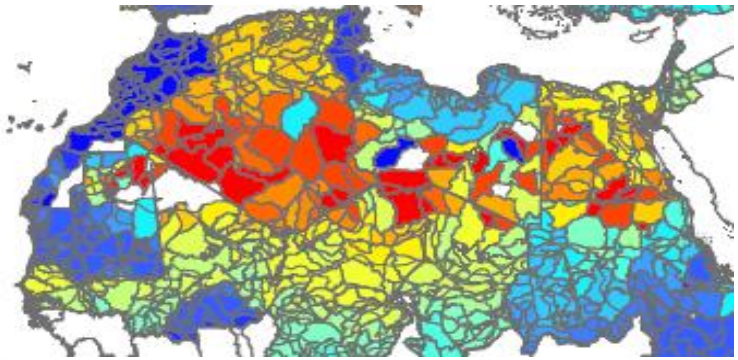
- Identify drivers and assess risk of water-related conflicts (river basin scale, global or regional coverage)
- Combine bio-physical with socio-economic and political data
- Increase awareness of water security
- Contribute to the development of the **EU water diplomacy**

*Conceptual model*




*Preliminary results*

**Probabilities of water conflict or cooperation events in some sub-catchments of Northern Africa**



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# Thank you for your attention

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# Red Latinoamericana de Centros de Conocimiento en gestión de Recursos Hídricos (RALCEA)

*(from 2010 to 2015)*

- Answering to the needs of the Conferencia de Directores Generales Iberoamericanos de Agua (CODIA) and EU Member States
- Thematic projects in line with the regional program EUROCLIMA (Quinta Cumbre de EU-LAC, Declaración de Lima, 2008)
- CODIA 2014 Declaration – Point 4: "We recognise RALCEA as a LA network for the development of tools and knowledge in support to the CODIA"