Leibniz Universität Hannover

Ecological sustainability assessment of water distribution for the maintenance of water-dependent ecosystems, their biodiversity and services

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GRoW
WATER AS A GLOBAL RESOURCE

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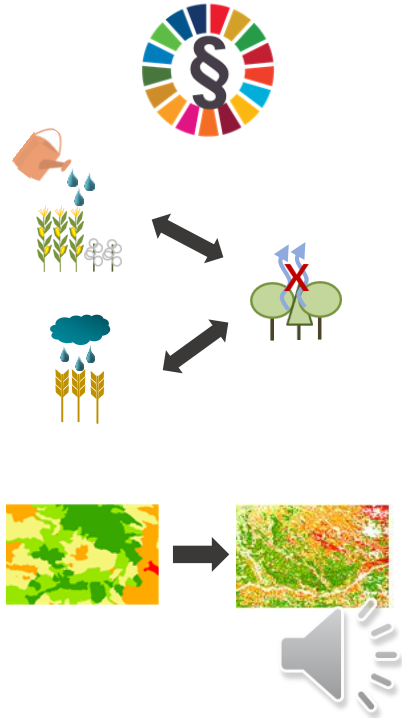
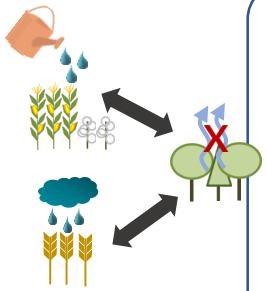
Enhancing existing assessment methodologies - The ViWA approach

- Transparency about what are minimum objectives by international law and what are voluntary, more ambitious achievements
- Reveal impacts of agricultural water use on water dependent valuable ecosystems
- Support application of assessment results by different adressees on different scales



Methodological considerations

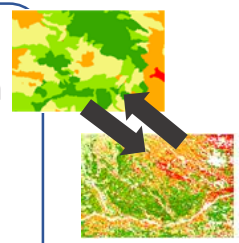


Scope

- Ecological sustainability
- Impact of agricultural water use on water-dependent ecosystems (spatial relation)
- Internal renewable resources

Scale

- 1*1 km grid cell
- Aggregation to sub-basin level
- Monthly values; aggregation over vegetation period (April – September)



Data

- Agro-hydrological model data (PROMET, LMU Munich); Hydrological model data (OpenGeoSys, UFZ Leipzig)
- Global open access data

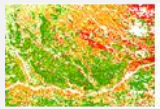
Reference

- Modelled status quo
- Maintaining status quo
- Legitimate sustainability standards (high transparency)

Assessment approach

Legitimized standards for sustainable water use

Ecological sustainability assessment: water distribution on sub-basin level



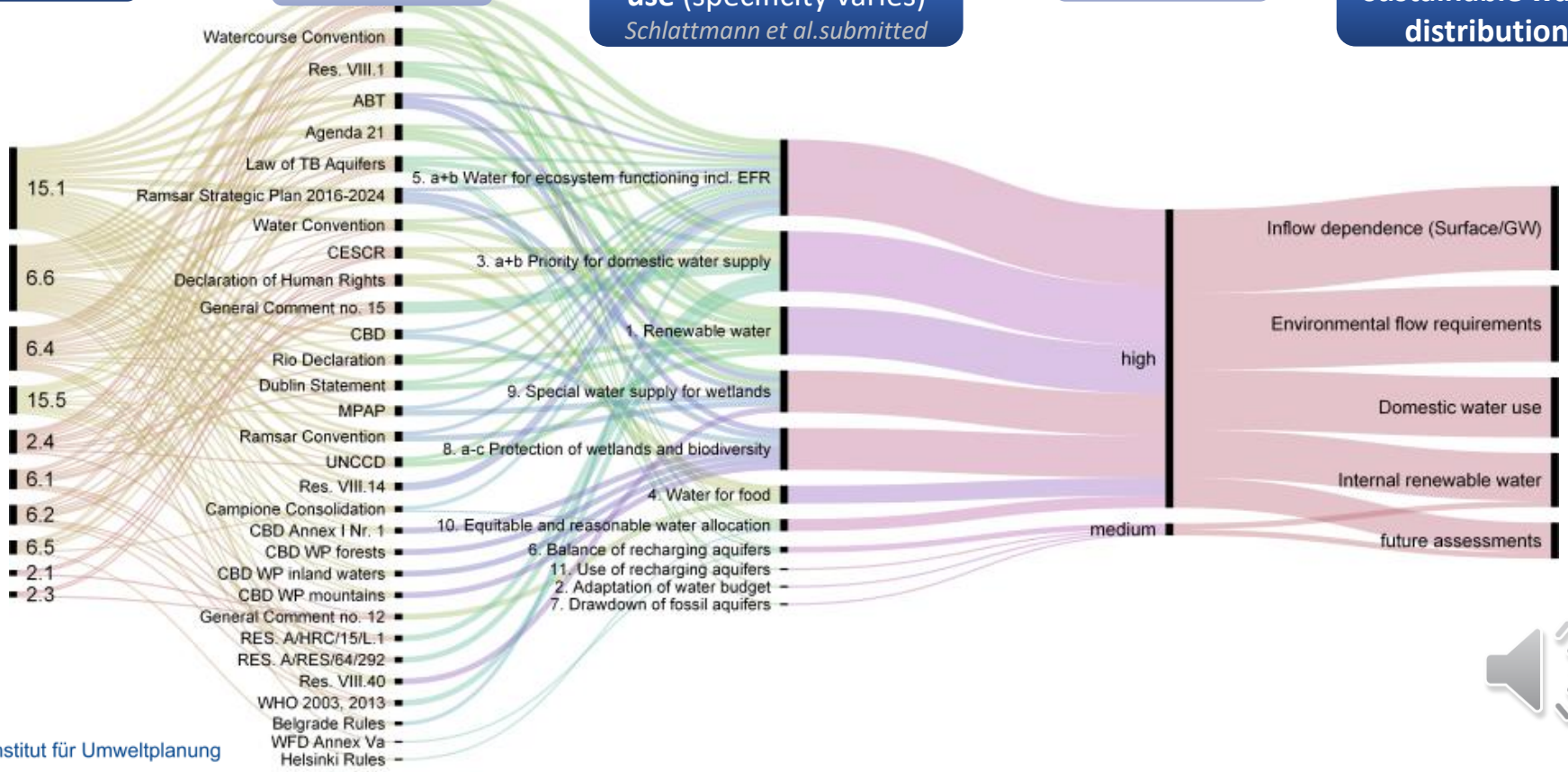
Risk to biodiversity/ vulnerable ecosystems on local level

Status quo assessment

Effects of changed crops or management locally and in the sub-basin

SDGs and international legislation as normative background

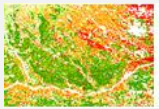
SDGs | Legislation | **Standards for water use** (specificity varies) *Schlattmann et al.submitted* | Legitimacy | **ViWA criteria for sustainable water distribution**



Assessment approach

Legitimized standards for sustainable water use

Ecological sustainability assessment: water distribution on sub-basin level



Risk to biodiversity/ vulnerable ecosystems on local level

Status quo assessment

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Development of assessment criteria for spatial application –

Example: "Water for ecosystem functioning"

Standards for sustainable water use §
"Water for ecosystem functioning"

Target ecosystems (semi-) terrestrial and inland aquatic ecosystems

Water-related target functions Habitat and biodiversity (basis for further regulating ES)

Identify ecosystem water requirements
- Soil moisture for transpiration
- Water bodies/ water flow as habitat

Determine spatially measurable indicators
- (Evapo-)transpiration
- River discharge/ water flows

Define criteria that describe "functioning"
- Actual Evapotranspiration
- Minimum flows

Scientific concepts
Green/ blue water*; EFRs**
Reference in law
e.g. EU WFD

Apply criteria
Maps and spatial indices describe where criteria are fulfilled and where not

Interpret results
Recommendations for users

*Assessment of green water flows (Rockström & Gordon 2001); ** Environmental Flow Requirements (Poff et al. 1997; Dyson et al. 2003; Wallace et al. 2003)

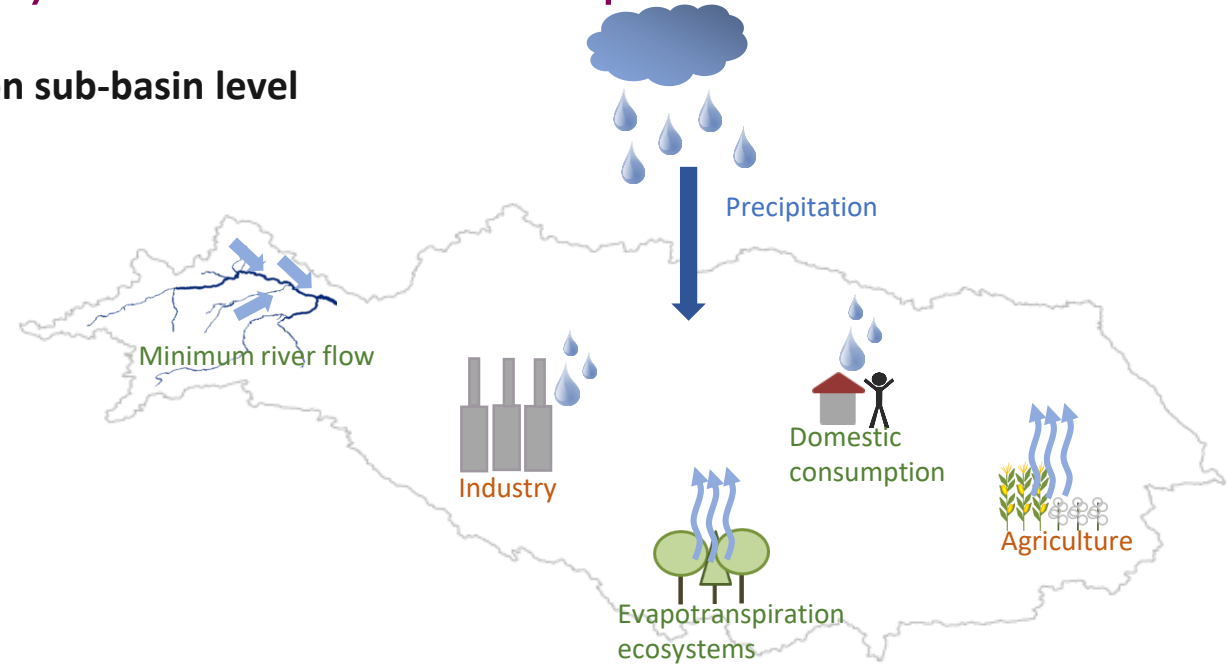
Ecological Sustainability Assessment – Concept

Water resources and water users on sub-basin level

Renewable water resources:
Precipitation generates usable evapotranspiration, river flow & groundwater recharge

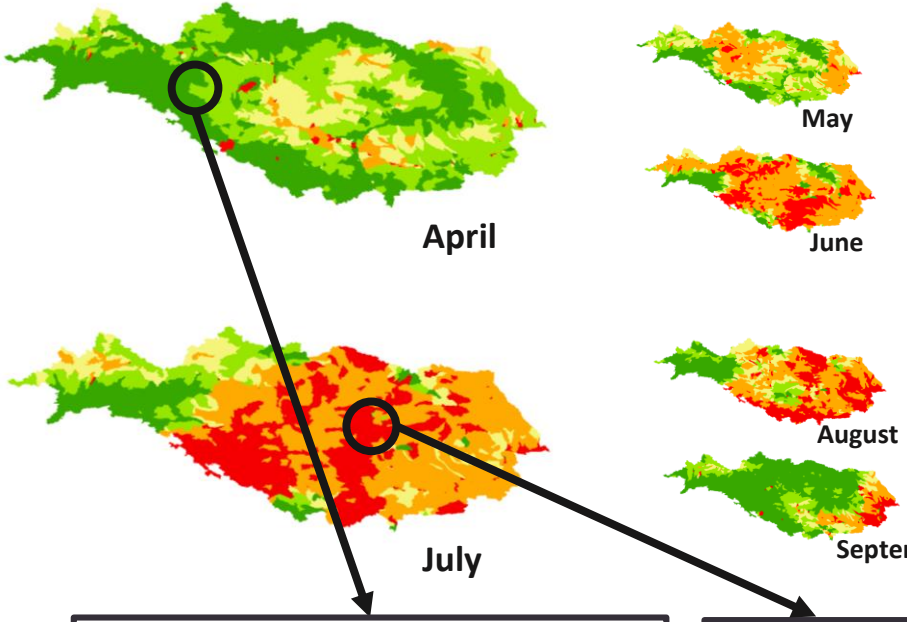
Priority water uses: Ecosystem water requirements, Domestic consumption

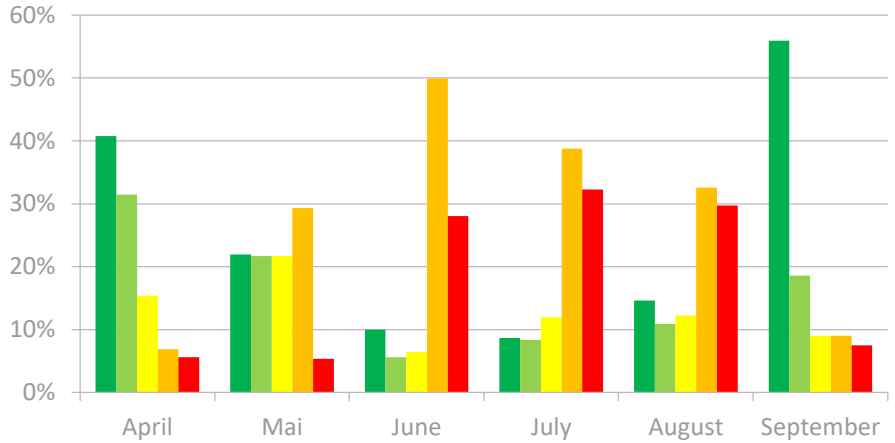
Further water uses:
Agriculture, Industry



Renewable water resources - Priority water uses ≥ Further water uses

Ecological Sustainability Assessment in the Danube basin





Water sustainability index (WSI) for the sub-basins of the Danube river basin from April to September 2017.

Sustainable use, water consumption does not exceed renewable resources and priority uses are met

Unsustainable use, overuse of renewable resources and priority uses are not always met

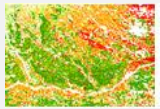
Water Sustainability Index

- 0 ≤ 0.3 (slightly exploited)
- 0.3 ≤ 0.6 (moderately exploited)
- 0.6 ≤ 1.0 (heavily exploited)
- > 1.0 (overexploited)
- < 0 (extremely overexploited)

Assessment approach

Legitimized standards for sustainable water use

Ecological sustainability assessment: water distribution on sub-basin level



Risk to biodiversity/ vulnerable ecosystems on local level

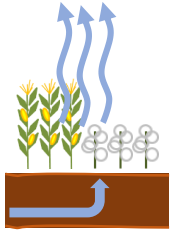
Status quo assessment

Effects of changed crops or management locally and in the sub-basin

Ecological Risk Assessment – Concept

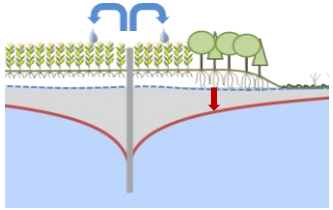
Water use impacts on grid cell level

Crop water depletion of renewable water resources – Water Depletion Index (WDI): Crop transpiration exploits soil moisture with impact on percolation and groundwater recharge

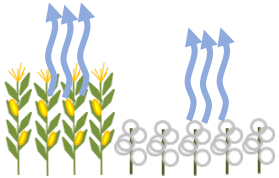


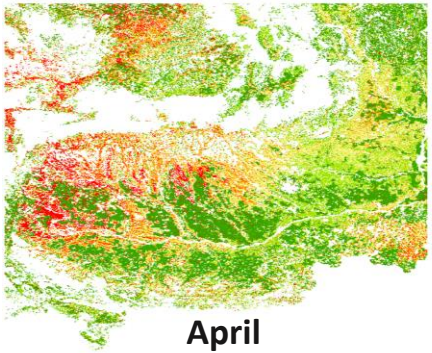
Compliance with environmental flow requirements (EFRs): Water use alters flow regime of rivers with impact on aquatic ecosystems

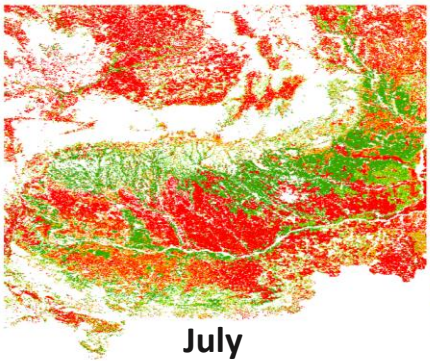
Impact on groundwater dependent ecosystems (GDEs): Water pumping impacts on groundwater table behaviour and can be a risk for vulnerable ecosystems



Depletion of water resources by crops in the Danube basin

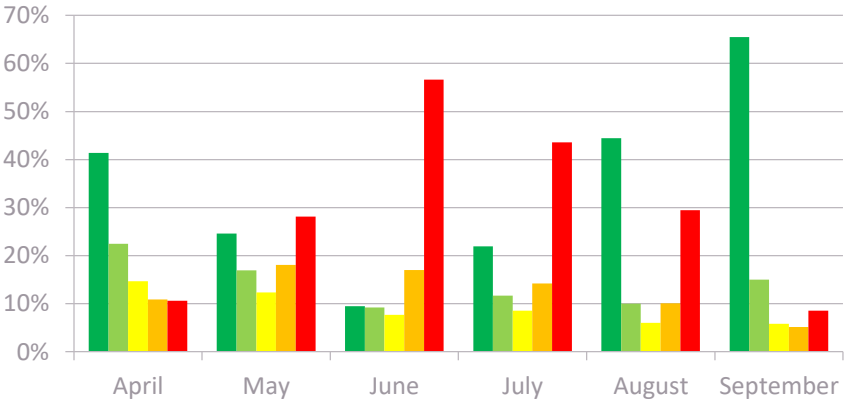






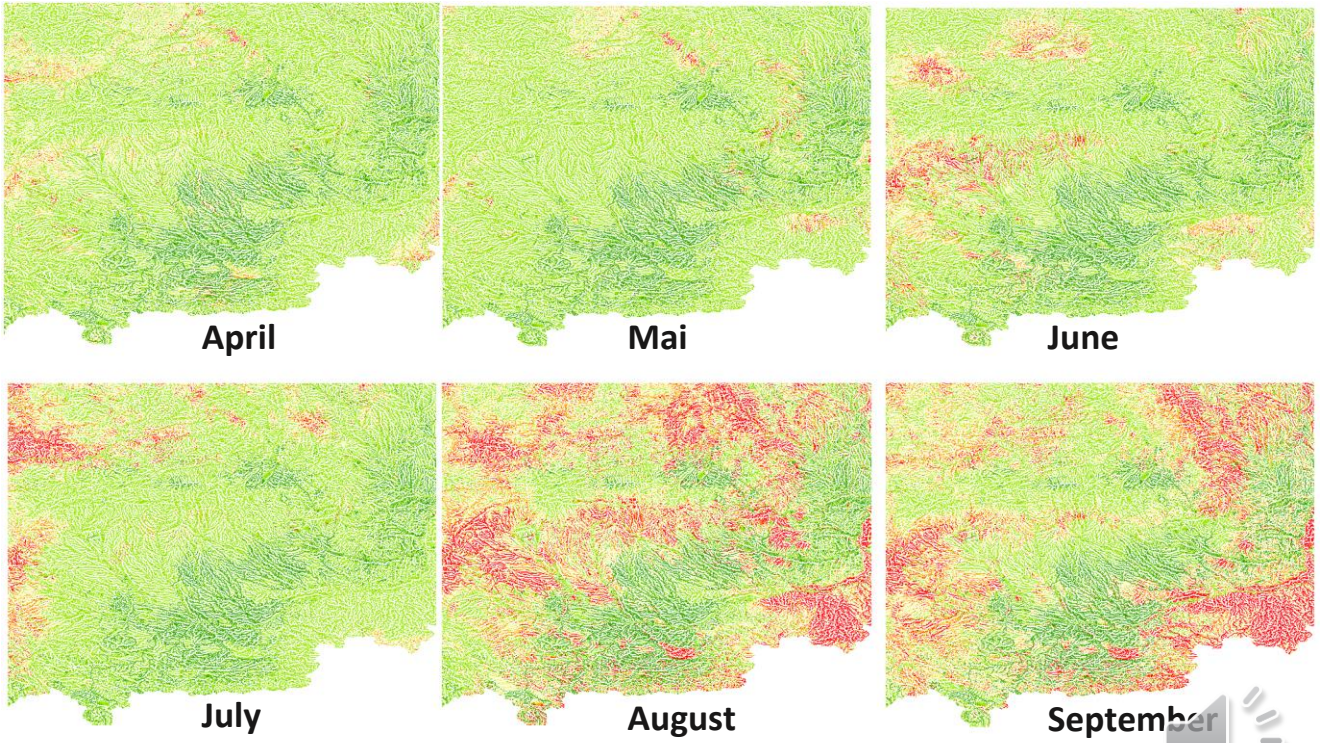
Water Depletion Index

- 0 < WDI ≤ 0.3 (low crop water exploitation)
- 0.3 < WDI ≤ 0.7 (intermediate crop water
- 0.7 < WDI ≤ 1.0 (almost full crop water exploitation
- 1 < WDI ≤ 1.5 (low to considerably overuse)
- WDI < 1.5 (significant crop water overuse)



Water depletion index (WDI) for the Danube river basin on grid cell level from April to September 2017.

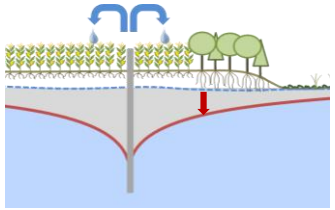
Compliance with Environmental Flow Requirements

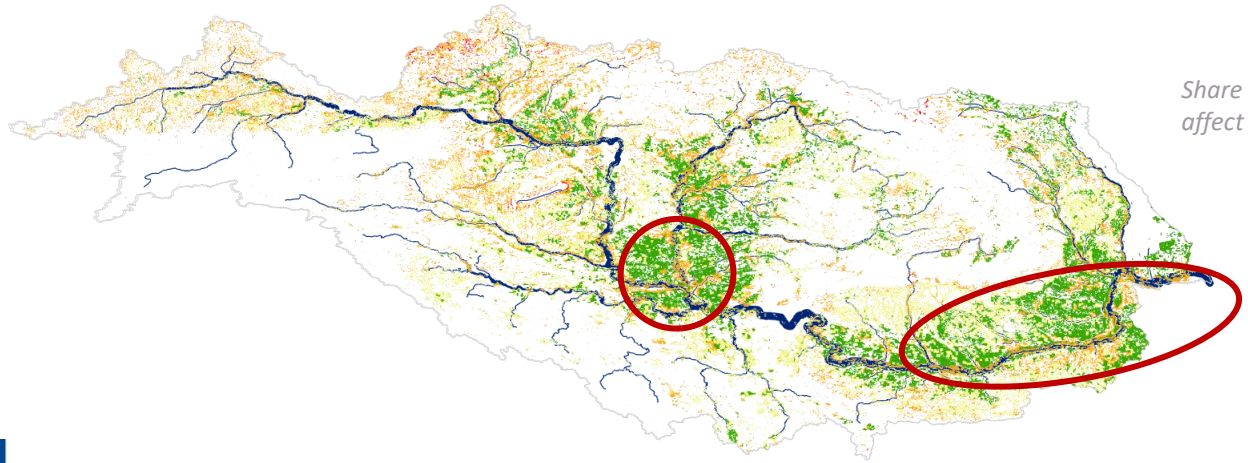


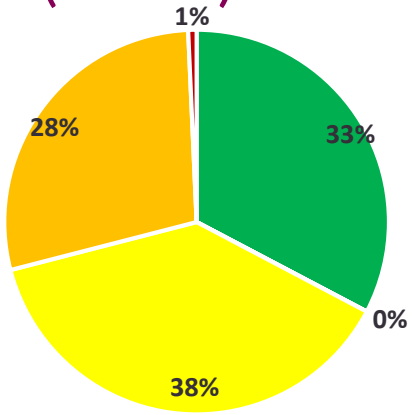
Compliance with EFRs

- Q ≥ EFR & Q 1 month ≥ 200% MAF (EFRs fully met)
- Q ≥ EFR (monthly EFR met)
- 0.7 < Q < 1.0 (EFRs slightly deteriorated)
- 0.4 EFR < Q ≤ 0.7 (flow moderately unsustainable)
- Q ≤ 0.4 EFR (flow extremely unsustainable)

Risk for groundwater dependent ecosystems (GDEs)







Share of agricultural areas that are at risk to negatively affect GDEs in case of groundwater pumping.

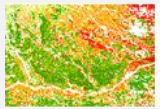
Risk to groundwater dependent ecosystems

- No risk
- Low risk
- Moderate risk
- High risk
- Very high risk

Assessment approach

Legitimized standards for sustainable water use

Ecological sustainability assessment: water distribution on sub-basin level



Risk to biodiversity/ vulnerable ecosystems on local level

Status quo assessment

Effects of changed crops or management locally and in the sub-basin

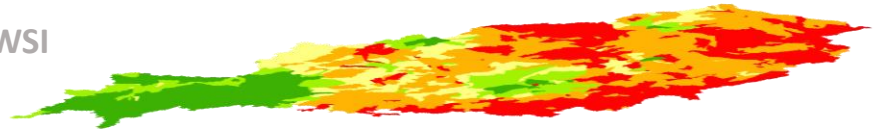
Status quo - regionally and locally

Evaluation: Agricultural water use

- **Endangers** vulnerable ecosystems?!
- contributes to unsustainable water use in the basin?!

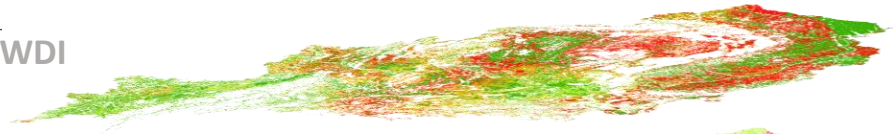
Ecological sustainability assessment

WSI

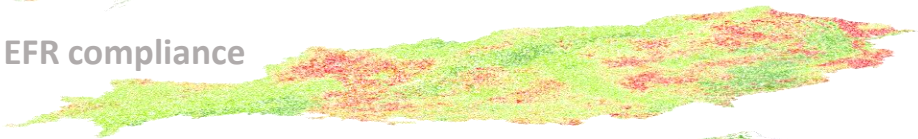


Joint interpretation for ecological risk assessment

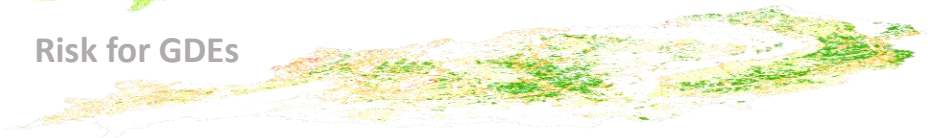
WDI



EFR compliance



Risk for GDEs

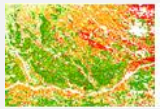


Status quo assessment of ecological sustainability and ecological risk for August 2017

Assessment approach

Legitimized standards for sustainable water use

Ecological sustainability assessment: water distribution on sub-basin level



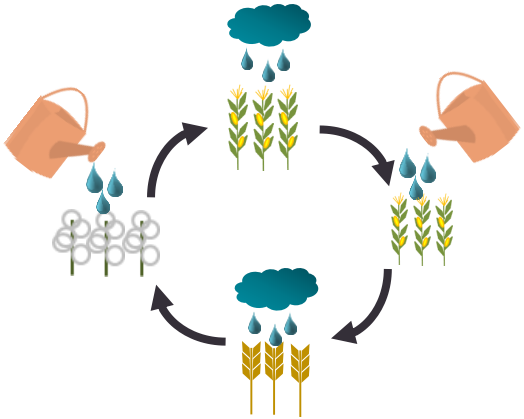
Risk to biodiversity/ vulnerable ecosystems on local level

Status quo assessment

Effects of changed crops or management locally and in the sub-basin

Future applications - scenario analysis

- Can the change of crops or management support sustainable water distribution in a sub-basin or locally?
- Is the change of agricultural practices (increased irrigation) responsible for unsustainable water distribution in a basin or endangerment of vulnerable ecosystems?



Benefits and applications of the assessment results

Application in scenarios

- Link with information on yield and water use efficiency to address trade-offs between food production and natural ecosystems

Sustainable management options

Added value for addressees

- Design of sustainable policies (agricultural aids; import-export policies, land-use planning)
- Safe investments for development banks
- Compliance with sustainability standards of food companies

Sustainable ‘import regions’

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Thank you for your attention!

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