

**Universiteit Utrecht**



King Abdullah University of  
Science and Technology



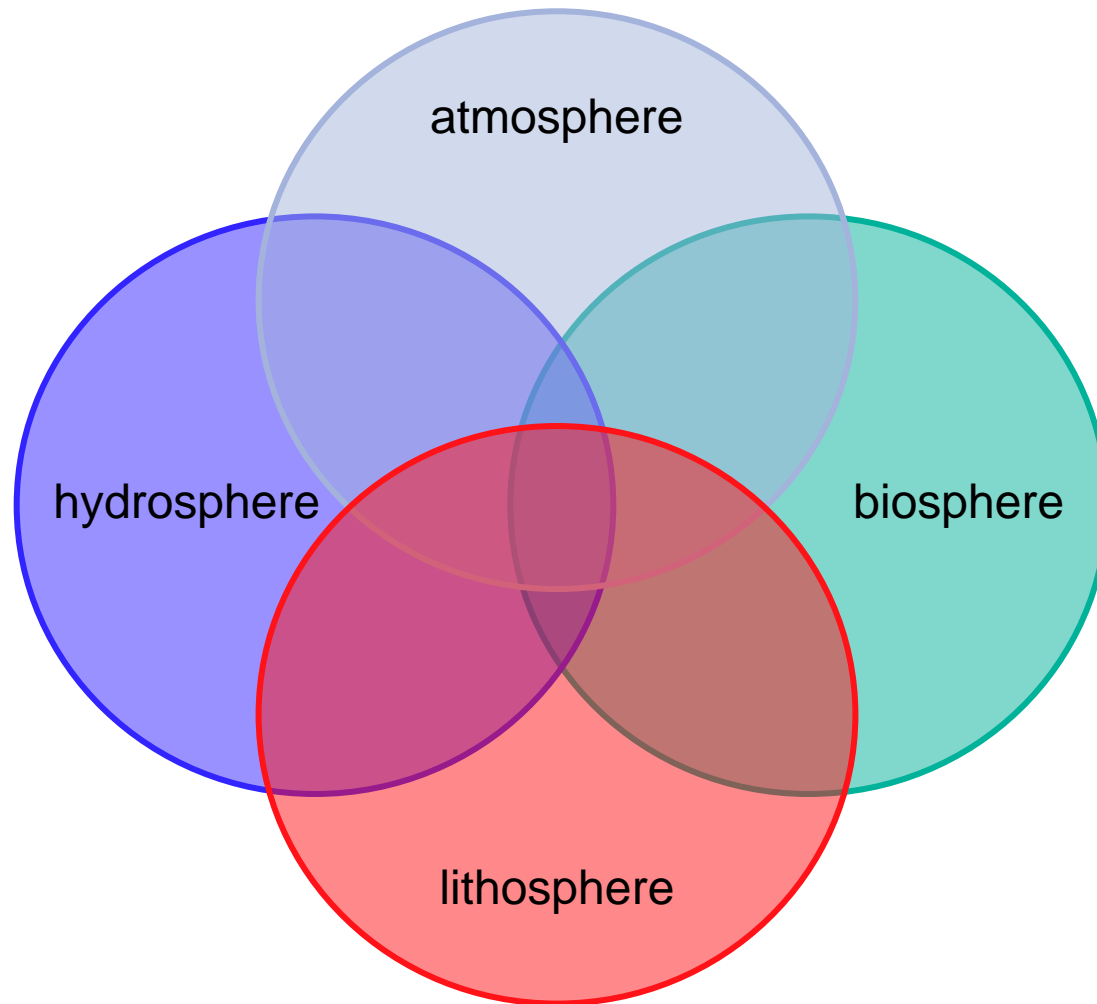
# Where Air, Water, Rocks and Life Meet: Towards the Sustainable Use of Soil, Water and Coastal Resources

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Utrecht University

Department of Earth Sciences

# Soils, water resources and coastal ecosystems



# Essential environmental resources



## Ecosystem functions and services:

- food/biomass production
- drinking water supply
- habitat and biodiversity
- storage, filtering and transformation
- cultural heritage, recreation
- support for man-made structures, protection
- regulation climate (carbon sequestration)
- ...





## **The value of the world's ecosystem services and natural capital**

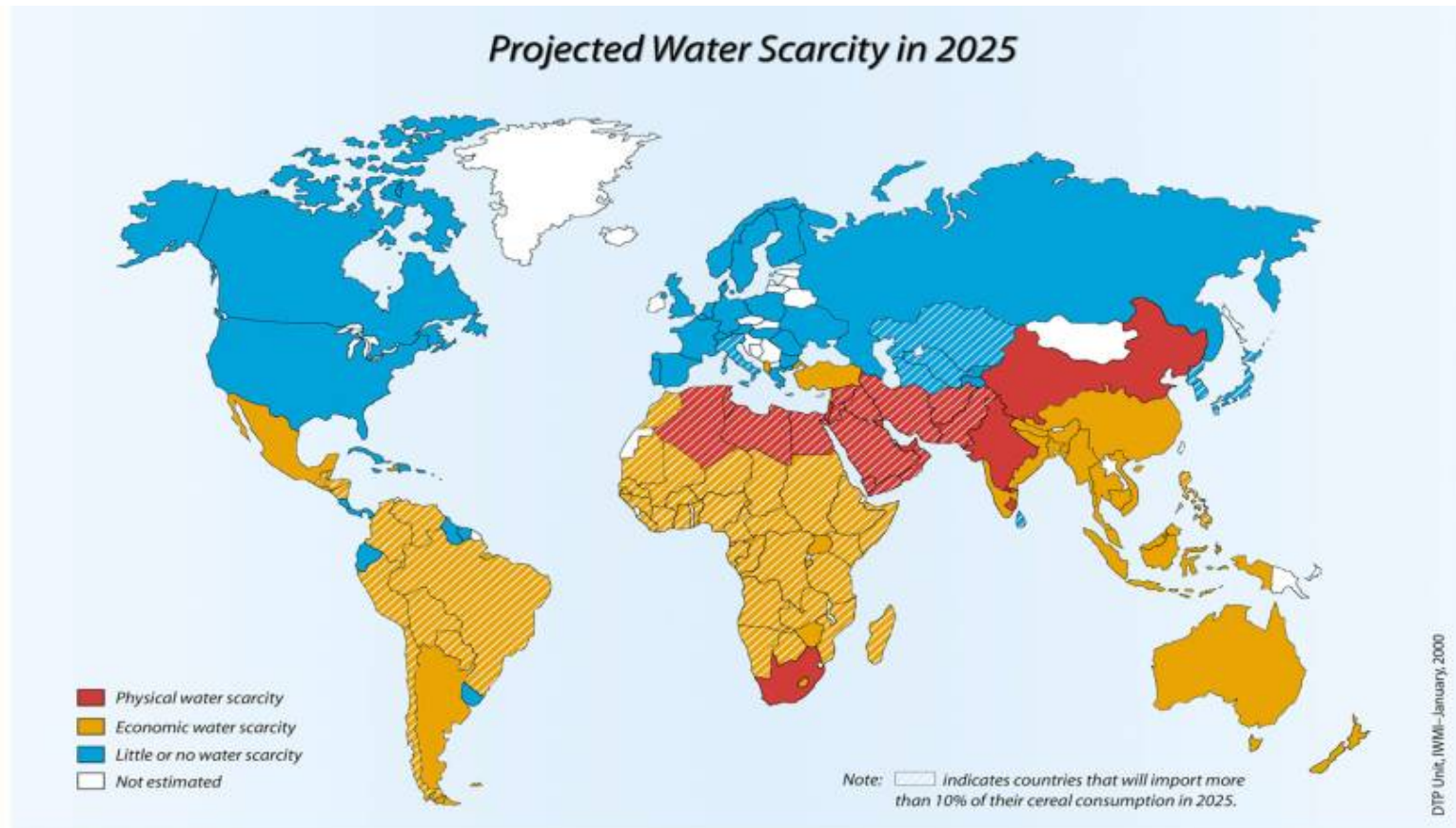
Costanza, d'Arge, de Groot, Farber, Grasso, Hannon, Limburg, Naeem, O'Neill, Paruello, Raskin, Sutton, van den Belt

*In Nature* (1997)

“... For the entire biosphere, the value (most of which is outside the market) is estimated to be in the range of US\$ 16-54 trillion ( $10^{12}$ ) per year, with an average of 33 trillion per year. Because of the uncertainties, this must be considered a minimum estimate. Global gross national product total is around US\$ 18 trillion per year....”

“... ca. 63% is contributed by marine ecosystems, mainly coastal systems ...”

# Limited and ...

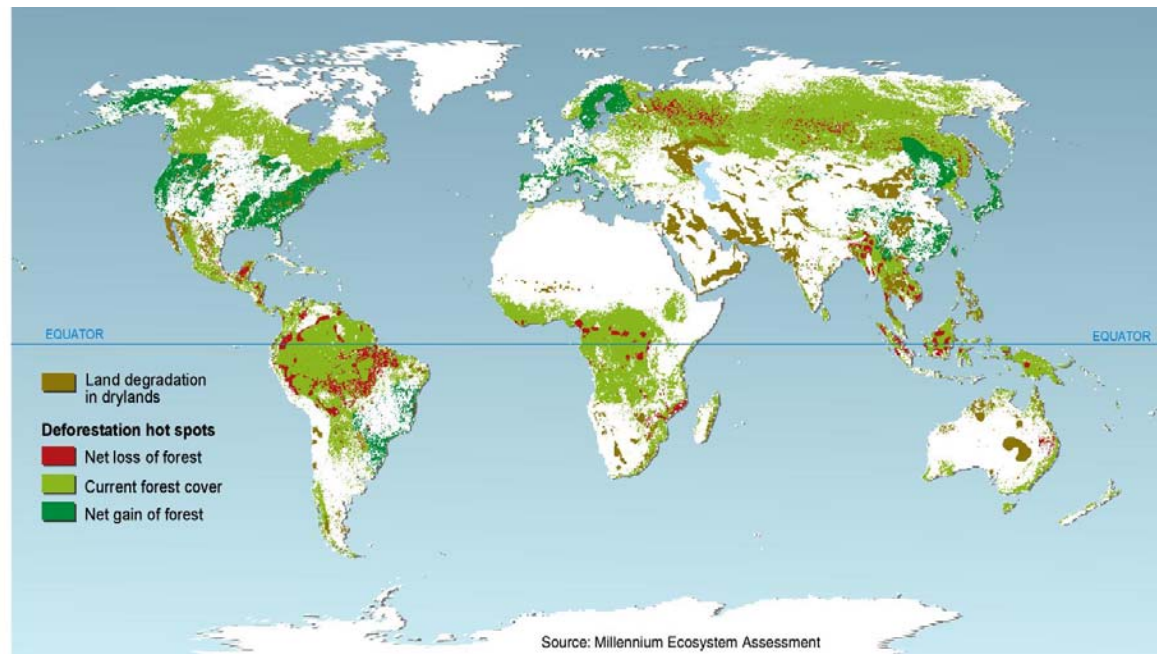


# ... threatened



## Example: global threats to soils

- erosion
- decline of soil organic matter
- contamination
- decline in soil biodiversity
- salinisation
- soil sealing and compaction
- floods and land slides
- desertification

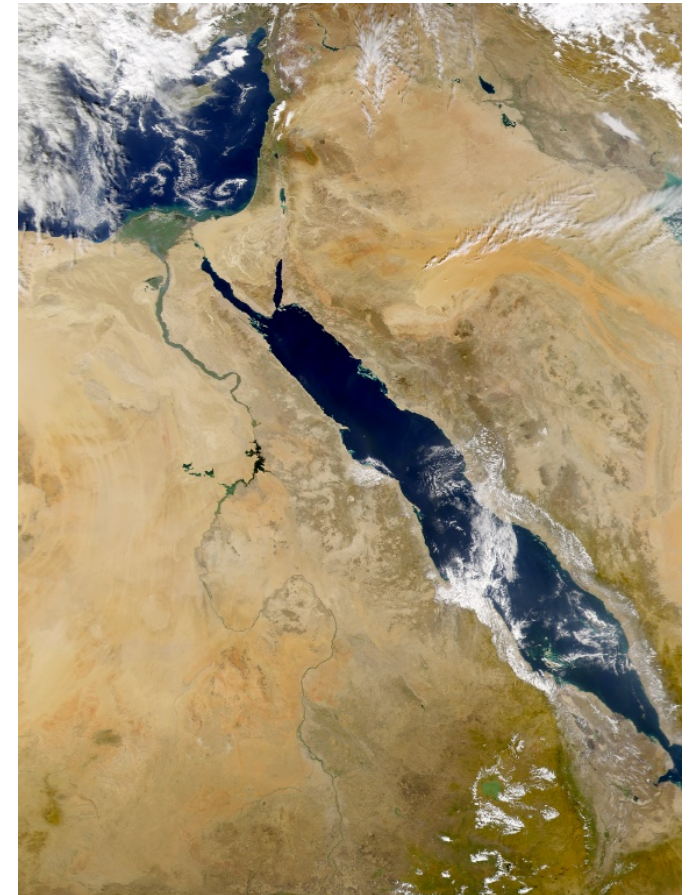


# Another example: coastal eutrophication

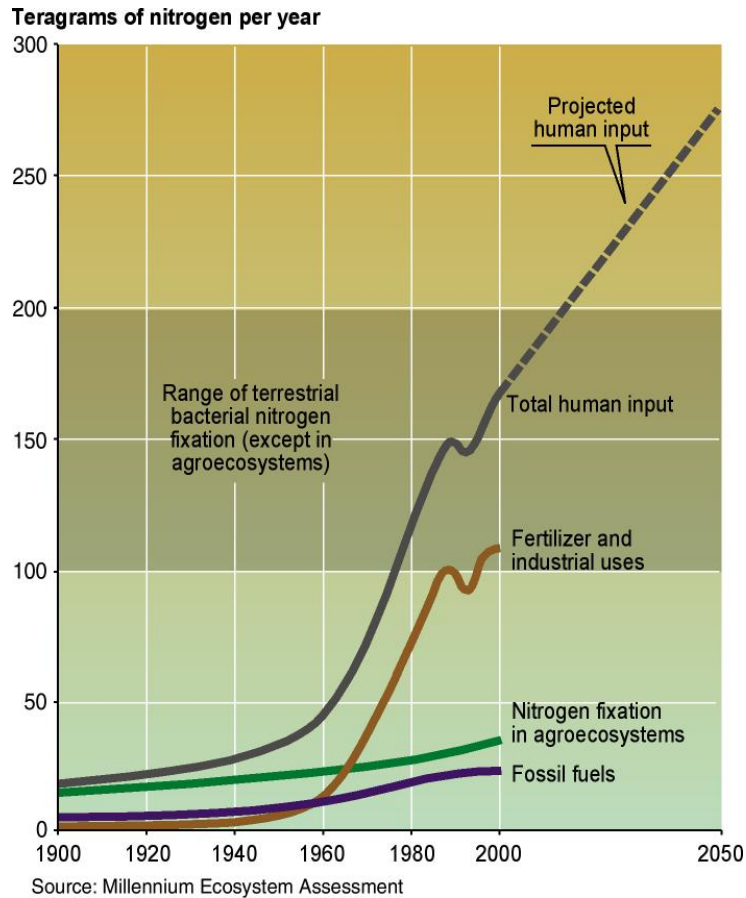


**Cause:** increased supply of nutrient elements (nitrogen, phosphorus) due to fertilizer application, sewage spills, soil erosion, aquaculture, ...

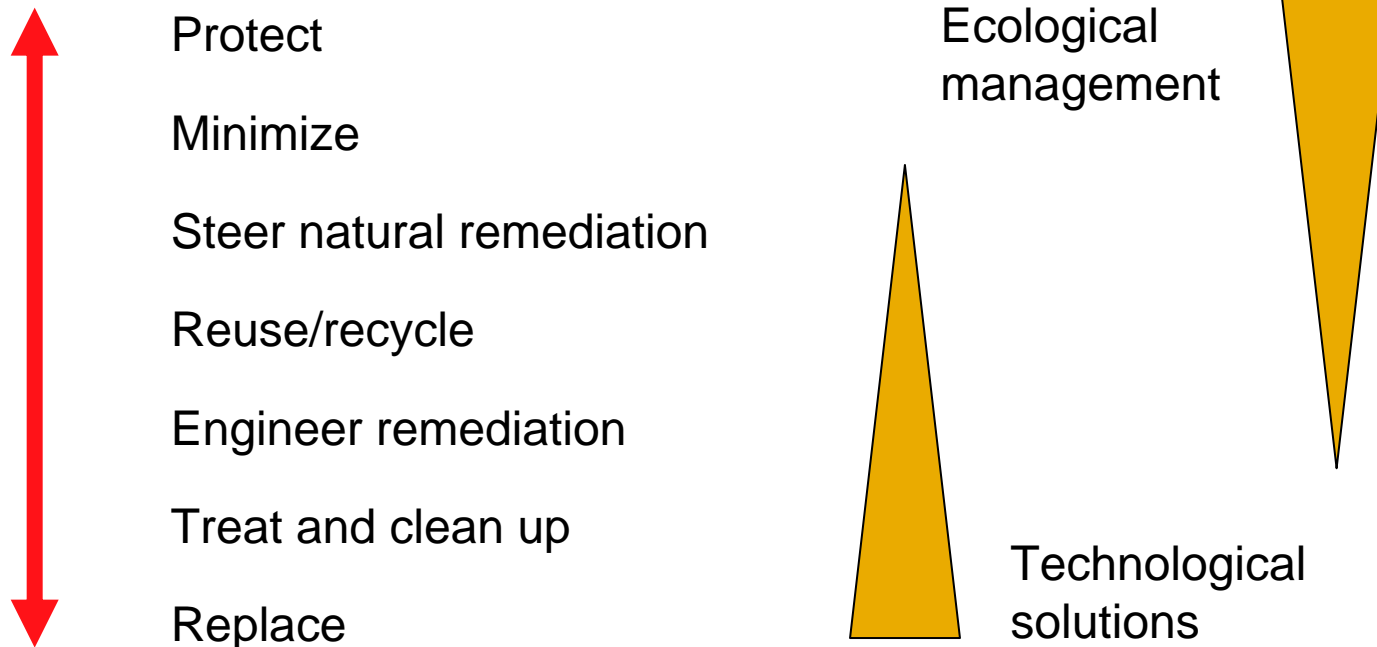
**Effects:** harmful algal blooms, oxygen depletion (hypoxia), loss in biodiversity, declines in fisheries and recreational value



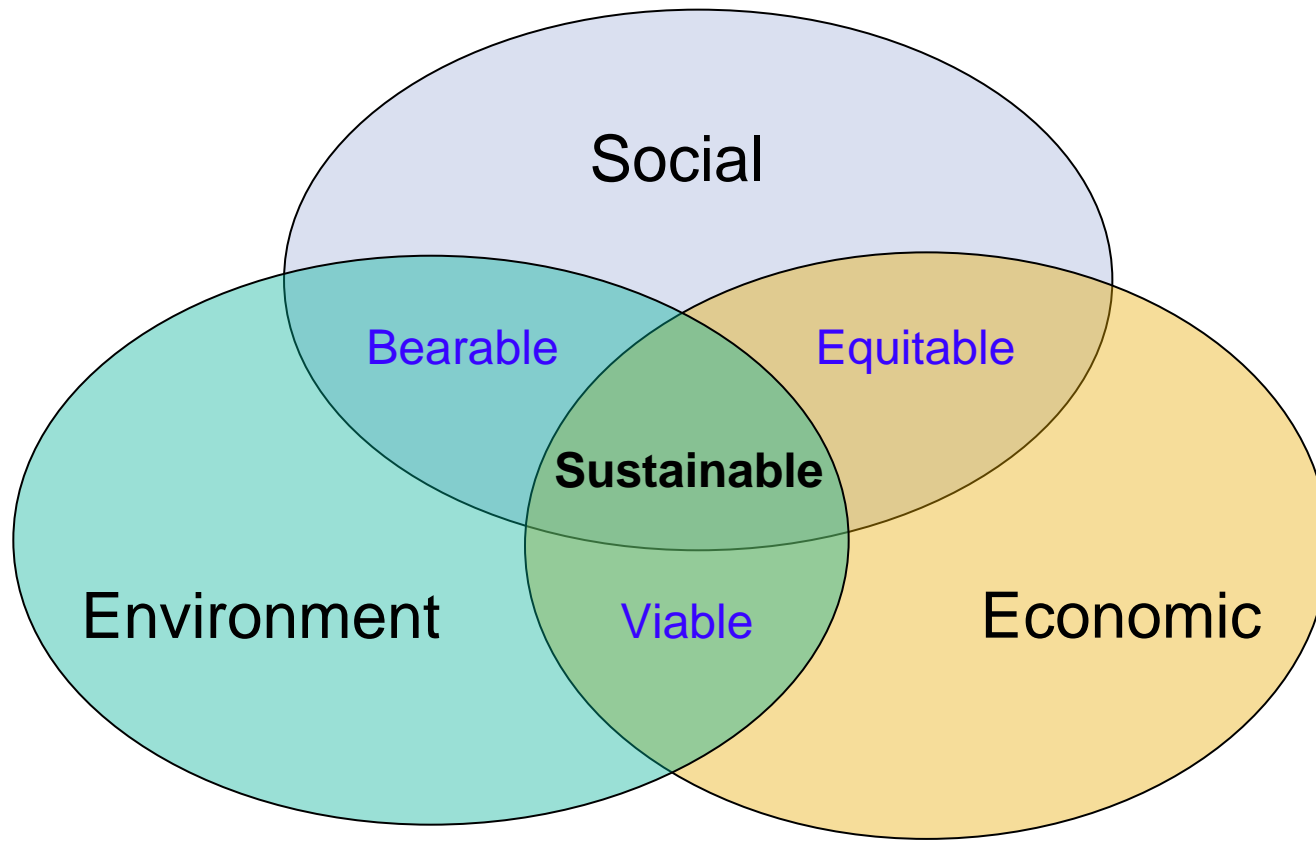
# Harmful algal blooms



# Natural resource degradation: solutions



# Sustainable solutions





KAUST Global Research Partnership  
Center in Development  
for  
**Soil, Water and Coastal Resources**  
(SOWACOR)

# Mission



SOWACOR will develop new soil and water remediation technologies, advance our fundamental understanding of how ecosystems function and respond to threats, and create more reliable environmental modeling tools



University departments, fundamental research institutes, applied research organizations, and consulting companies:

## 1. **CORE PARTNERS:**

- ❖ Utrecht University (Department of Earth Sciences, Department of Biology)
- ❖ UNESCO-IHE Institute for Water Education
- ❖ Netherlands Institute of Ecology (NIOO)
- ❖ Deltares - TNO (Netherlands Institute of Applied Research)
- ❖ Flemish Institute of Technological Research (VITO)



## 2. ASSOCIATED PARTNERS:

- ❖ Technical University Munich
- ❖ Université Pierre et Marie Curie - Paris VI
- ❖ Belgian Ceramic Research Centre
- ❖ Helmholtz Centre for Environmental Research - UFZ
- ❖ DHI Water Environment Health
- ❖ TAUW Environmental and Civil Engineering Consultants
- ❖ Netherlands Water Partnership (NWP)
- ❖ Netherlands Centre for Soil Quality Management and Knowledge Transfer (SKB)



Geologists, geochemists, ecologists, microbiologists, hydro(geo)logists, soils scientists, environmental chemists, biotechnologists, physical chemists, material scientists, environmental modelers, managers, environmental consultants, engineers, ....

➡ Multidisciplinarity

➡ Innovation

➡ Technology transfer

# Research areas

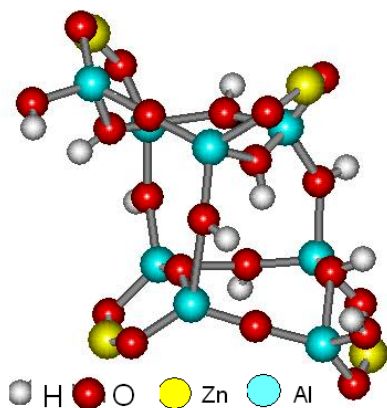


1. ***Ion exchange***: new materials for the removal of inorganic contaminants from water
2. ***Biosorption***: toxic metal removal from water by microorganisms
3. ***Electro-osmosis***: application to soil remediation (organic contaminants)
4. ***Bioremediation***: natural cleaning capacity of soils and groundwaters
5. ***Nutrients***: nutrient flows in coastal environments

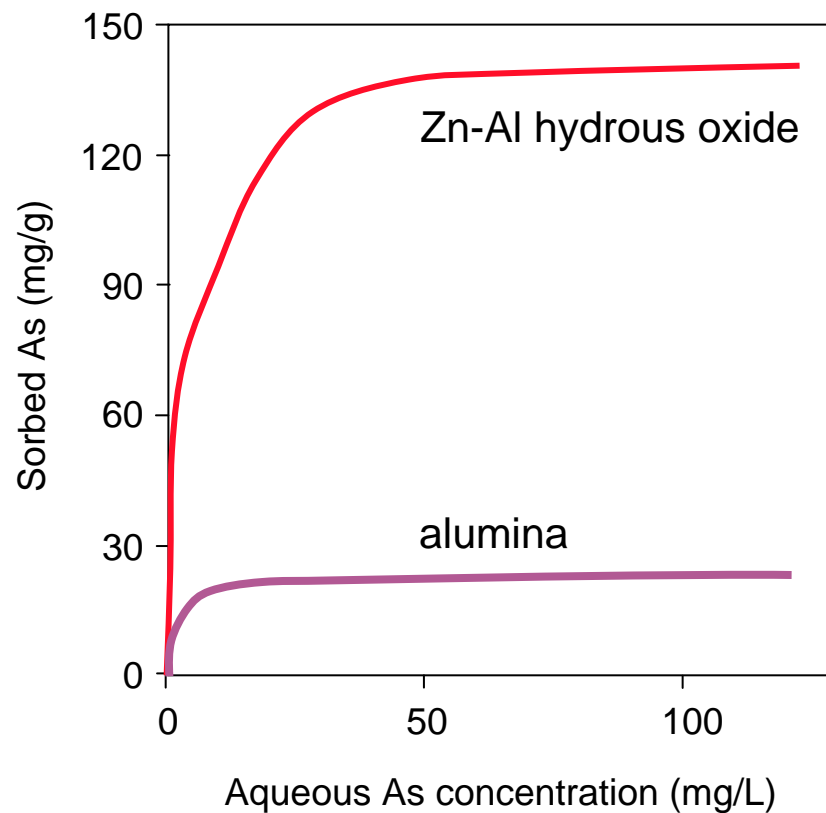
# Previous experience: example



Ion exchanger: Zn-Al hydrous oxide



Arsenic removal from water



# Water treatment



fundamental



applied

Synthesis (ion exchangers), growth (biomass)

Key material properties (chemical, mechanical, thermal)

Contaminant removal mechanisms (bonding)

Competitive effects (multiple contaminants)

Physiological effects (biomass)

Durability contaminant removal

Regeneration potential (ion exchangers)

Upscaling (bench scale → pilot scale → industrial scale)

# SOWACOR: outreach activities



1. **Facilities:** analytical environmental laboratory, environmental modeling laboratory, coastal observatory and demonstration site in Saudi Arabia
2. **Education:** curriculum development, short courses, student exchanges (KAUST - UU - UNESCO-IHE)
3. **Innovation:** technology development and transfer (open innovation model)