Groundwater-based Natural Infrastructure Solutions - The Missing Link to Resilience?

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GRIPP GROUNDWATER SOLUTIONS INITIATIVE FOR POLICY AND PRACTICE

IWMI International Water Management Institute

Water for Food ROBERT B. DAUGHERTY INSTITUTE at the University of Nebraska

igrac International Groundwater Resources Assessment Centre

IGES Institute for Global Environmental Strategies

CAWR Center for Advanced Water Research

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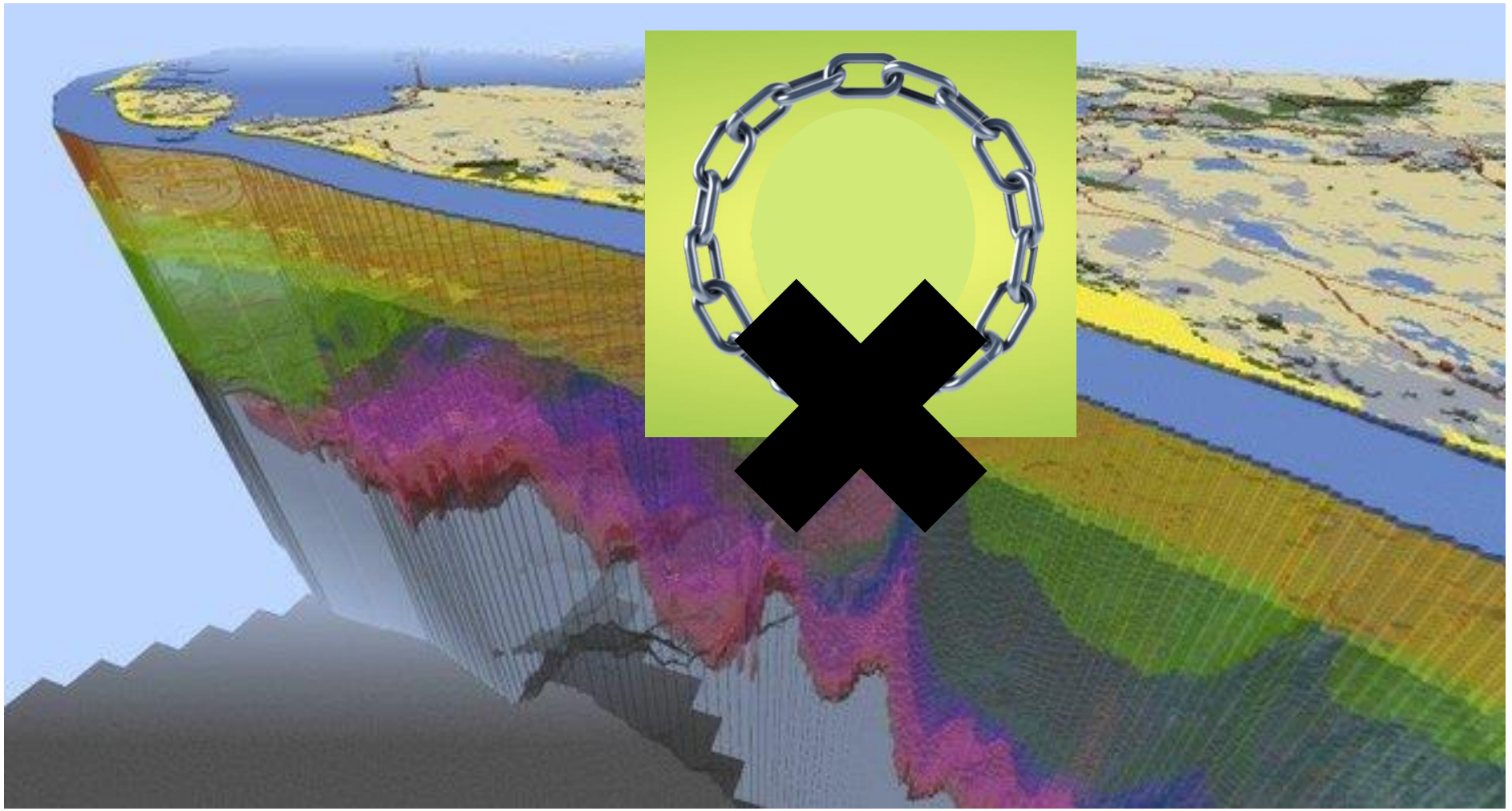
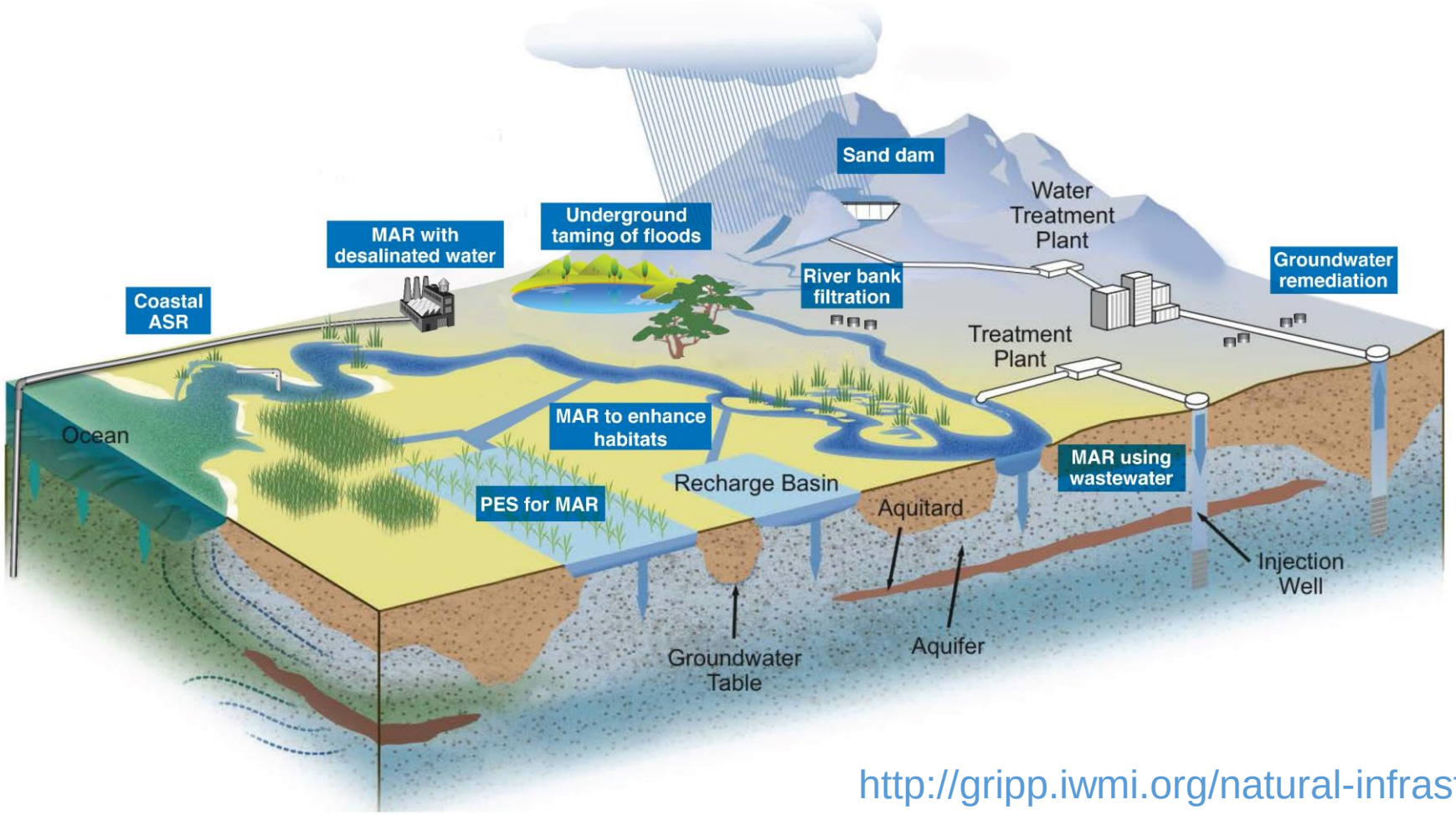
Background/rationale



Intervention/approach



http://gripp.iwmi.org/natural-infrastructure/

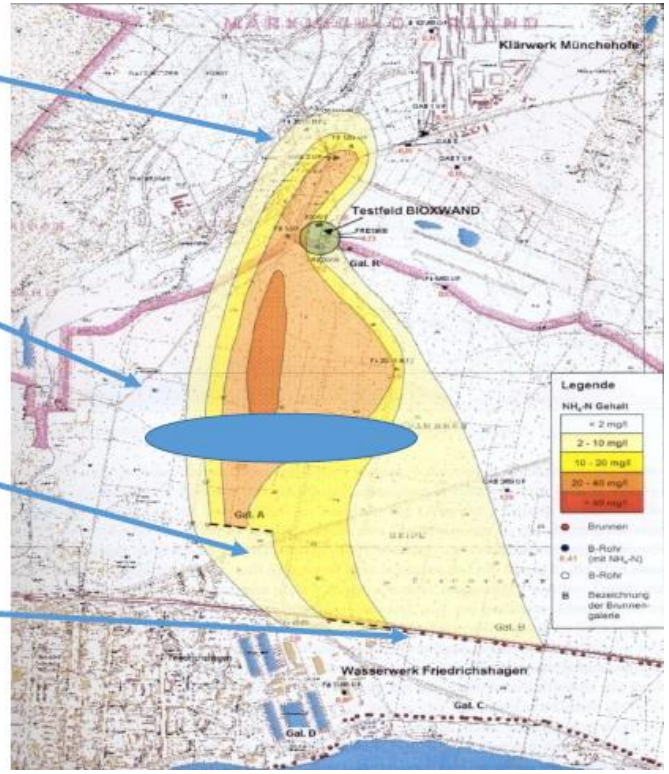
Impact/engagement

Contamination source

In-Situ Remediation (1km “curtain”)

Remediated groundwater

Borehole field



Guide for GBNI solutions

Function	Goal	Solution	Green infrastructure	Grey infrastructure	Policy intervention	Examples
Groundwater storage	• Increased water security • Restoring depleted aquifers • Counteract subsidence • Counteract coastal saline intrusion • Increased water supply	• Managed aquifer recharge (MAR) • Aquifer storage and recovery (ASR)	• Natural infiltration • Revegetation • Conservation agriculture [i]	• Water retention/infiltration basins • Runoff harvesting • In-channel mechanisms • Recharge wells • Riverbank filtration	• MAR policies • Protection of recharge zones • Managing groundwater discharge • Land use regulations • Managing groundwater use/entitlements • Groundwater markets/payments for ecosystem services (PES)	• Japan • United Arab Emirates • India • Spain • Nebraska, USA • Kenya
Water retention/regulation	• Increased climate change resilience • Increased disaster risk reduction (DRR) • Increased water supply	• MAR and ASR during floods/wet periods • Recovery during dry periods	• Floodplains • Wetlands and lakes	• Water retention/infiltration basins • Runoff harvesting • In-channel mechanisms • Irrigation canals • Recharge wells	• Climate change adaptation • DRR policies • Land use regulations • Managing groundwater use/entitlements	• Ethiopia/Kenya • India

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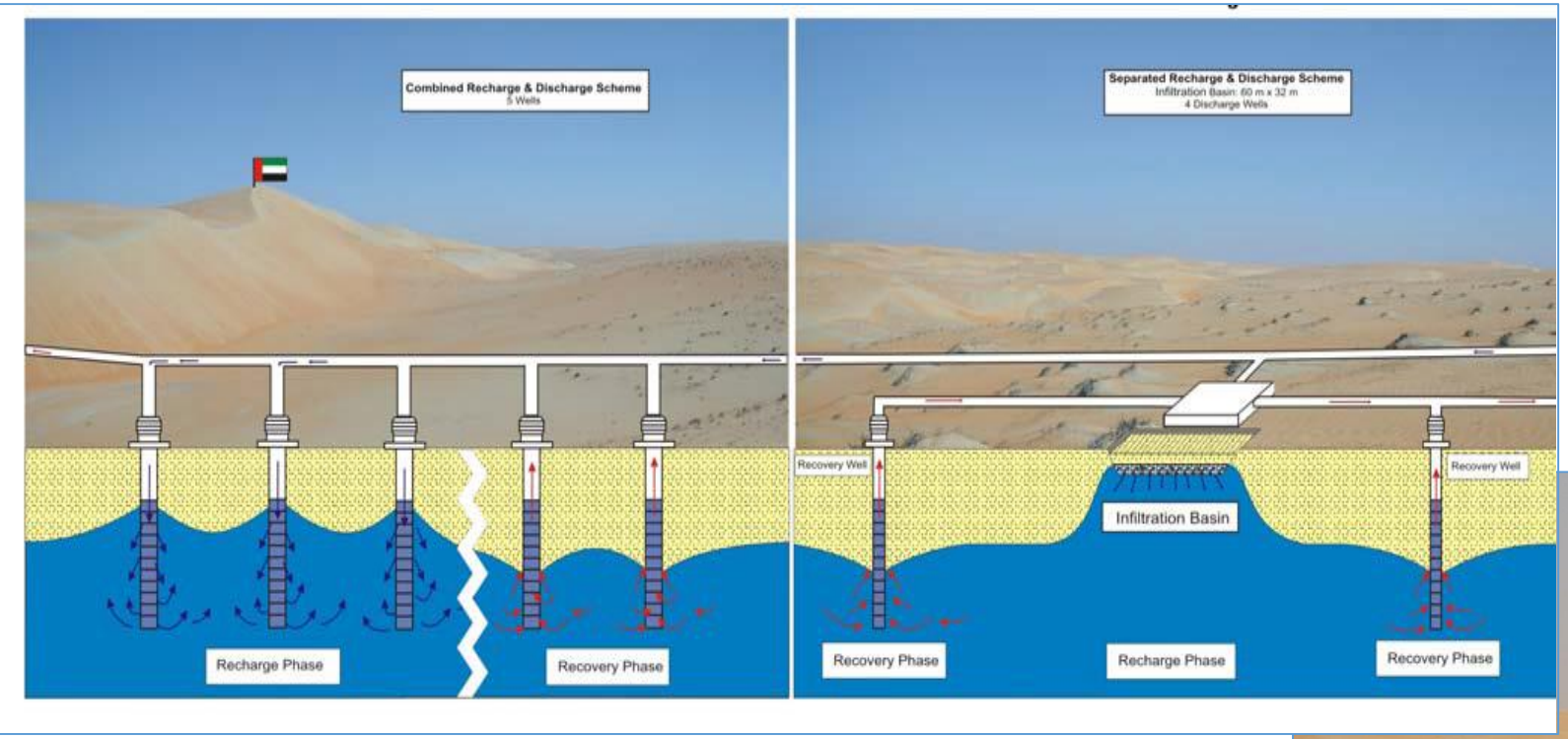
Water quality	• Improved water quality • Enhanced environmental quality • Counteract coastal saline intrusion	• Water purification through (partial) in-situ processes • MAR and ASR	• Subsurface environment providing: • Natural and in-situ attenuation of contaminants [ii] • Carbon and nutrient regulation [iii] • Riparian buffer strips	• Pump-and-treat solutions • Managed/enhanced in-situ soil and aquifer treatment • Reactive subsurface barriers • Subsurface dams • Riverbank filtration • Injection wells in coastal areas	• (Ground)water and soil quality standards • Groundwater and soil protection policies • Pollution liability regulations • Stormwater, wastewater and sanitation policies	• The Netherlands • India • Germany • Australia • Bangladesh • India
Environmental support	• Increased environmental flows	• MAR and ASR • Natural recharge and discharge protection	• Protecting springs • Protecting pressure of artesian aquifers	• Water/runoff retention/infiltration basins	• Reserve/ environmental flow requirements • (Ground)water quality	• California, USA • India

				• Riverbank filtration • Injection wells in coastal areas		
Environmental support	• Increased environmental flows • Protected biodiversity • Increased water supply • Increased aesthetic value	• MAR and ASR • Natural recharge and discharge protection	• Protecting springs • Protecting pressure of artesian aquifers • Protecting natural recharge and discharge areas	• Water/runoff retention/infiltration basins • In-channel mechanisms • Irrigation canals • Recharge wells • Capping freely flowing artesian wells	• Reserve/ environmental flow requirements • (Ground)water quality standards • Recipient environmental quality standards • Land use regulations • Managing groundwater use/entitlements • Regulation of recharge/discharge • Regulation of boreholes and drilling	• California, USA • India • Australia

[i] Conservation agriculture is based on three principles: minimal soil disturbance, permanent soil cover and crop rotations (http://www.fao.org/ag/ca/).

[ii] The United States Environmental Protection Agency (US EPA) defines natural attenuation as "a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. https://toxics.usgs.gov/pubs/eos-v82-n5-2001-natural/

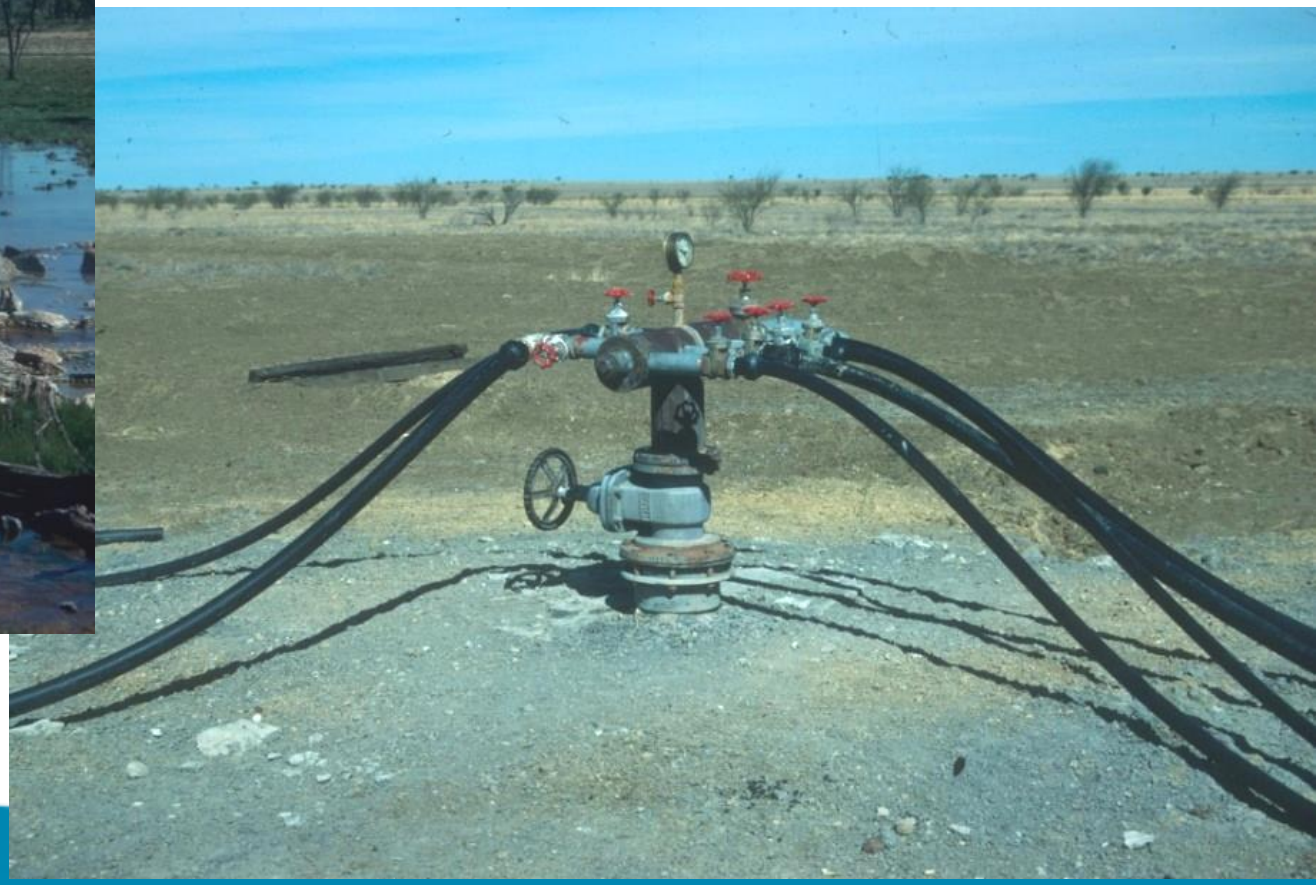


Abu Dhabi Emirate

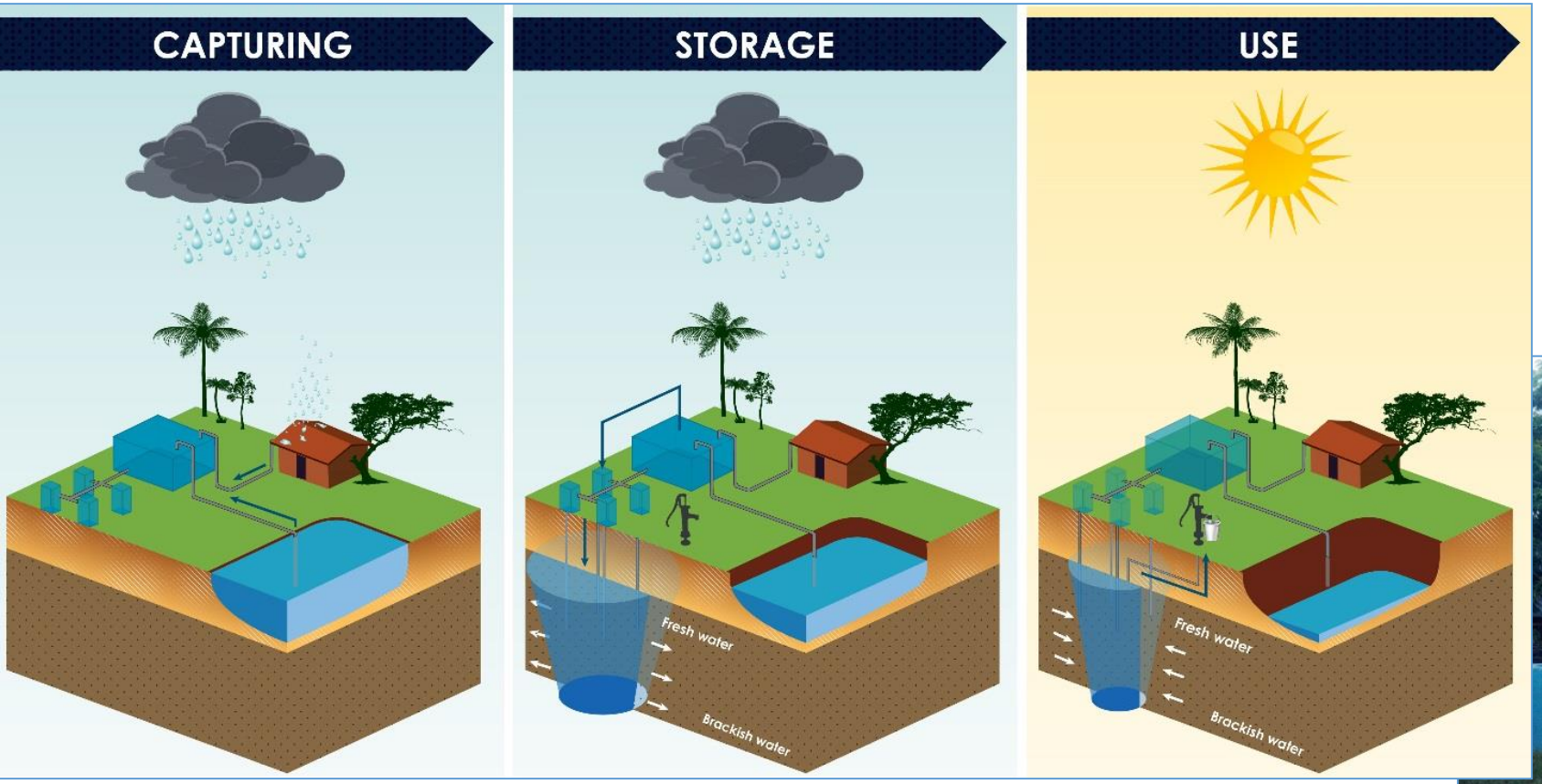
Strategic water reserve

Australia

Securing artesian groundwater



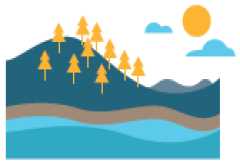
Cases



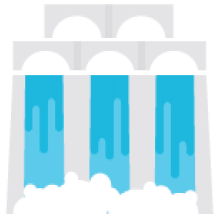
Bangladesh

Salinity and Arsenic

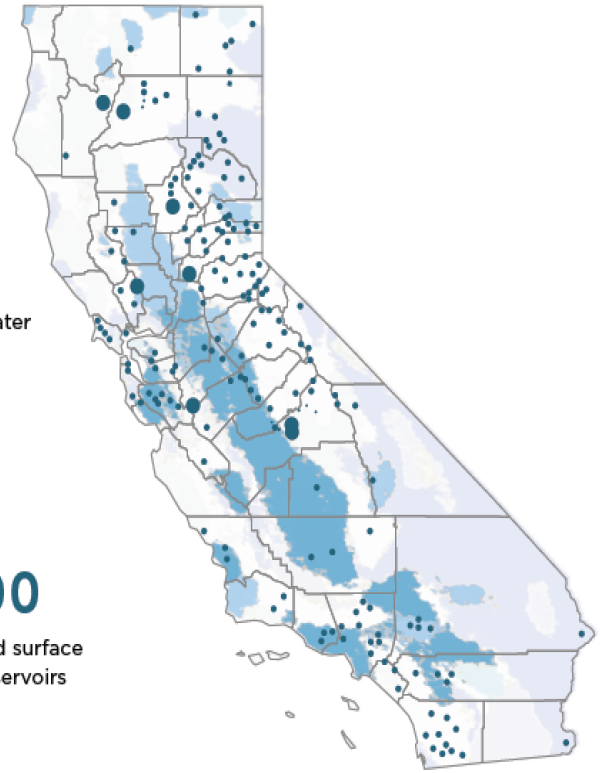
Cases

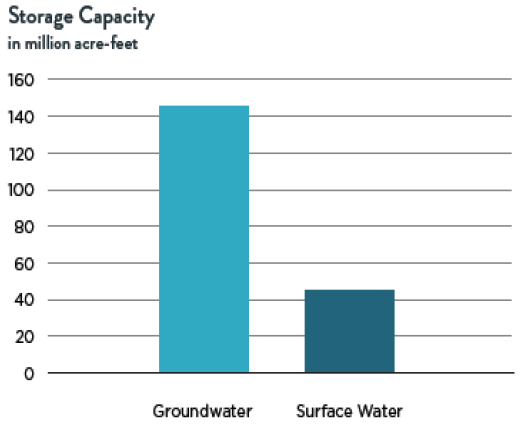


515
groundwater basins



1,300
dams and surface water reservoirs



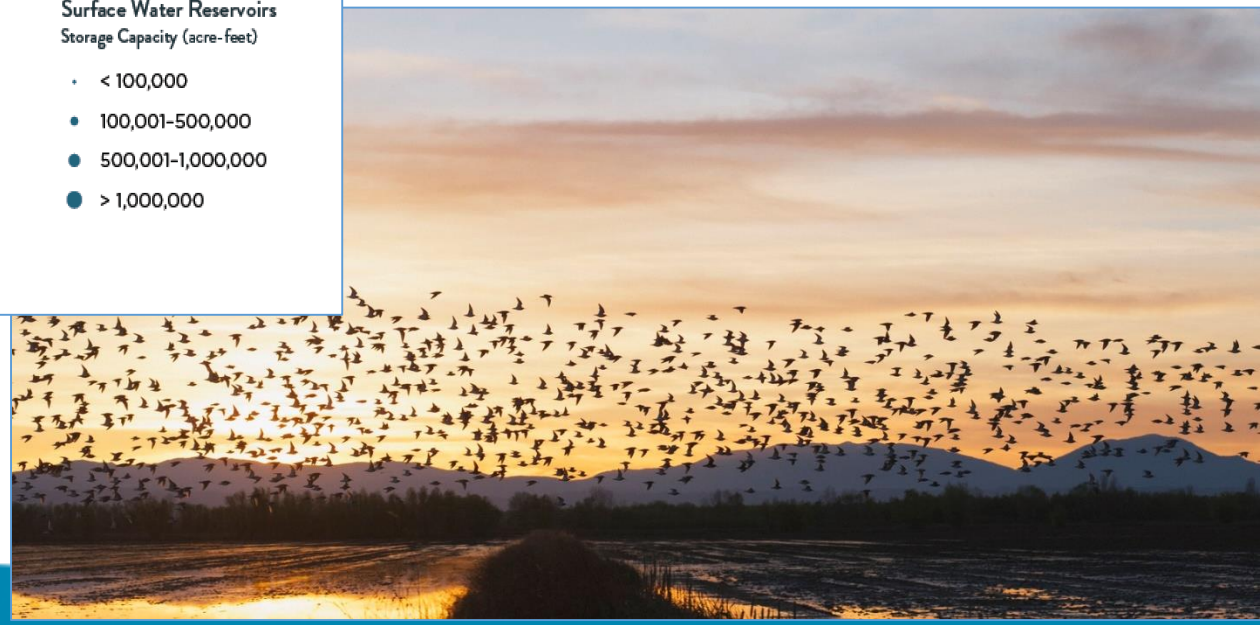


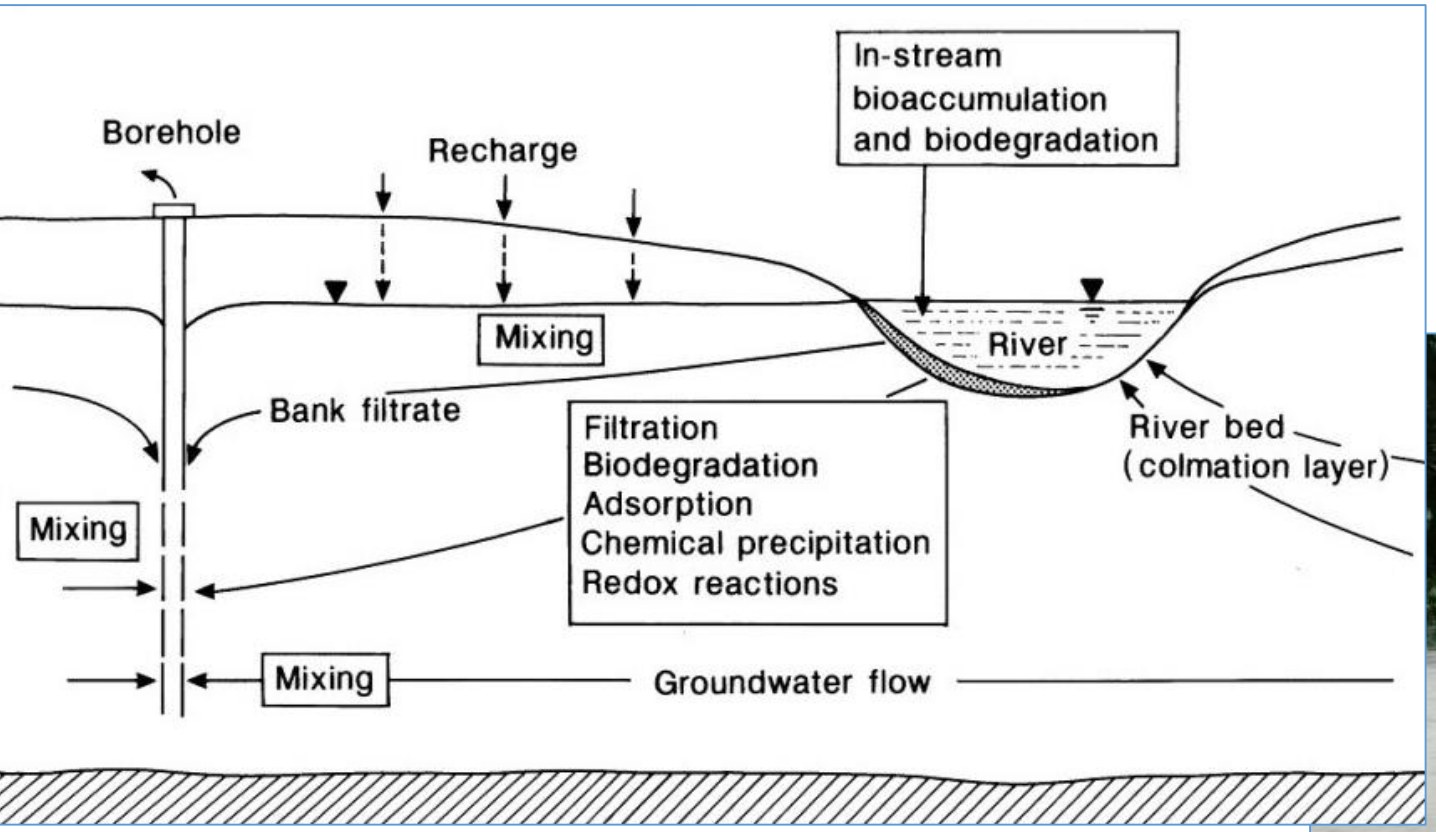
Groundwater Basins
CASGEM Prioritization
- High
- Medium
- Low
- Very Low
- County Boundary

Surface Water Reservoirs
Storage Capacity (acre-feet)
- < 100,000
- 100,001-500,000
- 500,001-1,000,000
- > 1,000,000

California

Bird habitat and agriculture

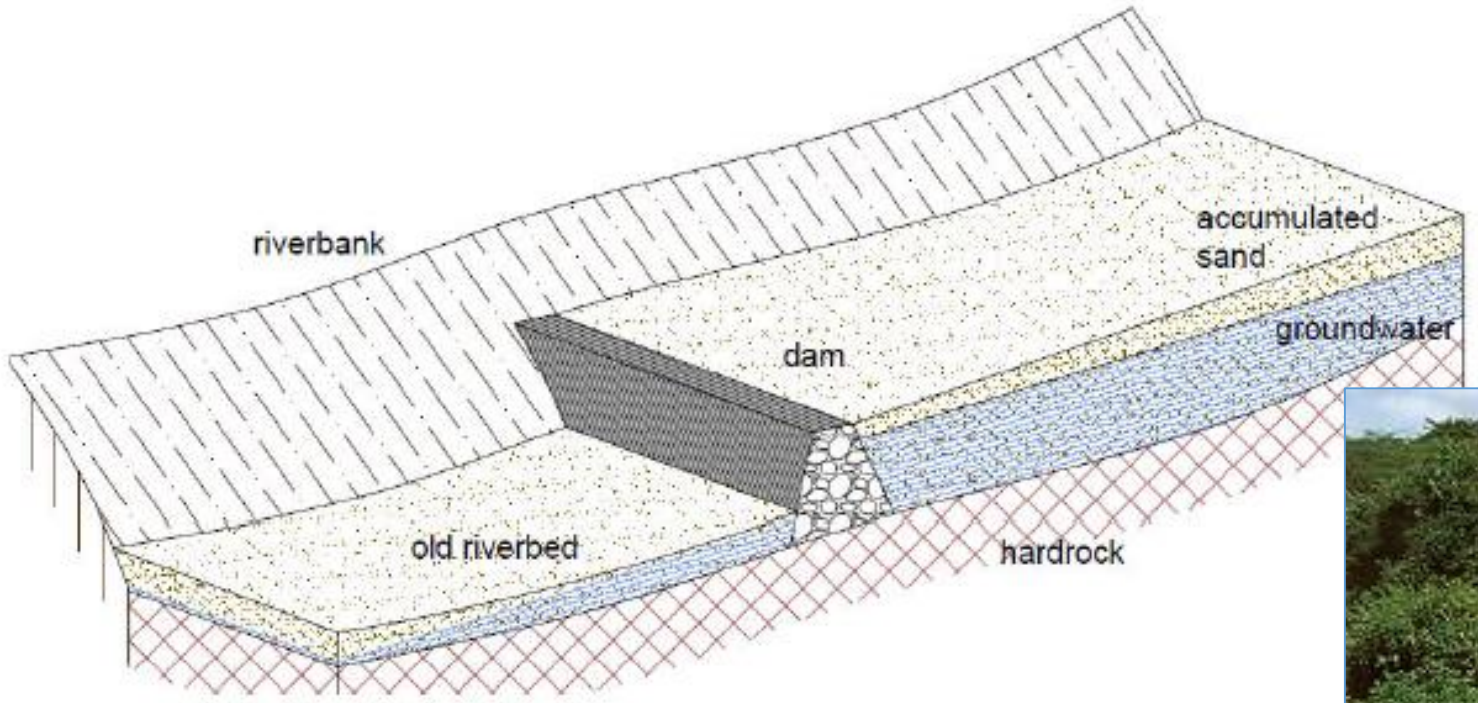




India

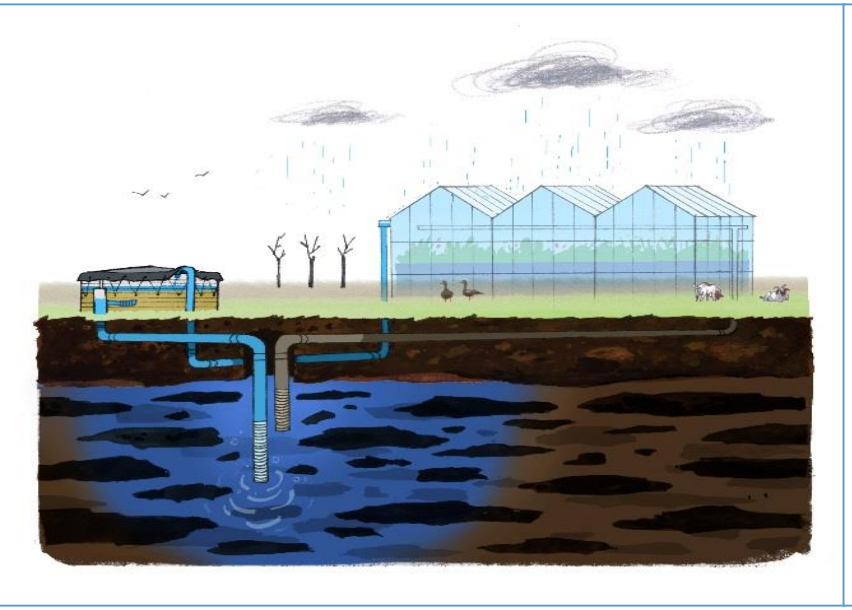
Riverbank filtration

Cases



Kenya

Sand dams



The Netherlands

Freshwater from salty aquifers

GBNI the panacea?

Thank you

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GROUNDWATER SOLUTIONS INITIATIVE FOR POLICY AND PRACTICE

Groundwater Solutions Initiative for Policy and Practice (GRIPP)

A global partnership for sustainable groundwater management

PIC: Shaoyu Liu/IWMI

THE GROUNDWATER CHALLENGE

Groundwater use is soaring. It is being pumped at unprecedented rates for irrigation, industry, and urban development. As surface water supplies dwindle, we are now making withdrawals from our subterranean water bank that cannot be sustained. Groundwater is also increasingly being degraded because of human pollution and other uses of the subsurface space. Impacts in many places are damaging to the environment and imperiling food supplies, jobs and health.

Yet in some regions, groundwater remains plentiful. If managed sustainably, it has the potential to boost agricultural production and lift millions out of poverty.

Climate change is likely to intensify our dependence on groundwater, so the need for solutions is becoming critical. Without coherent policies, attaining many of the UN's Sustainable Development Goals (SDGs) will be challenging.

There is no *one-size-fits-all* approach. Nevertheless, with new technologies, smart governance and community action, there is huge scope for progress.

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