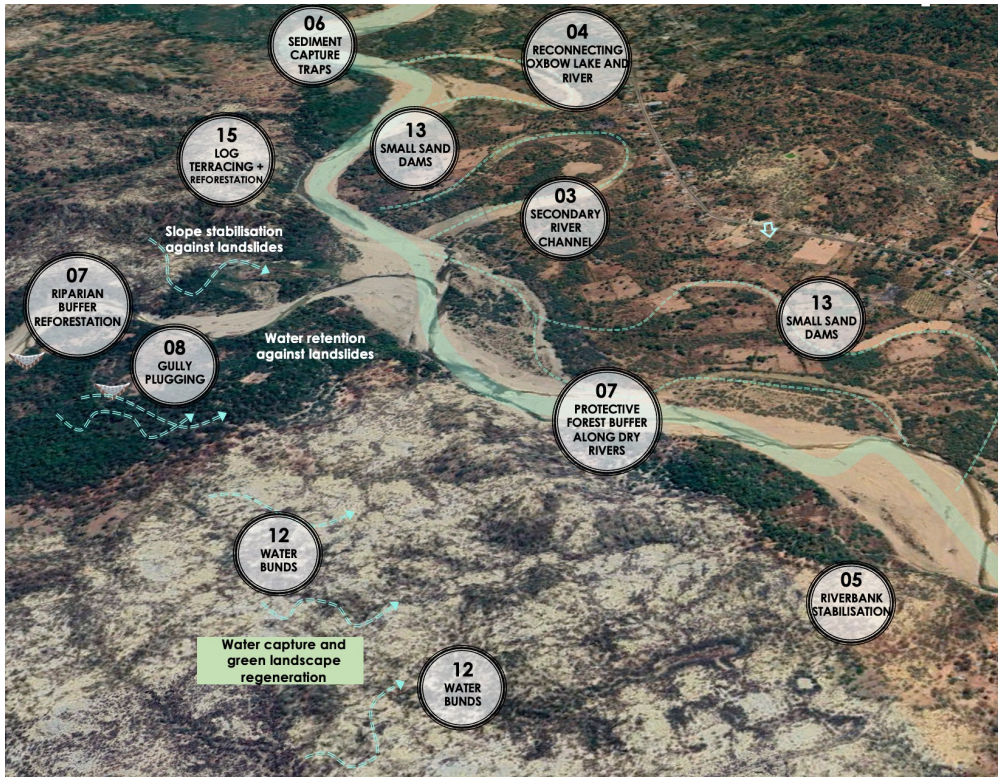
NbS-10: MANAGED AQUIFER RECHARGE (MAR)



Managed Aquifer Recharge (MAR) is a nature-based solution (NbS) that uses surface water to replenish aquifers, enhancing water availability and providing environmental benefits. In Southeast Asia, where challenges like seasonal rainfall variability, groundwater overuse, saltwater intrusion, and water quality issues are common, MAR offers a sustainable approach. By storing water underground, MAR minimizes evaporation losses and ensures reliable water supplies, especially in drought-prone regions.

MAR restores depleted aquifers, prevents land subsidence, and mitigates saltwater intrusion. It also improves water quality through methods like bank filtration and surface infiltration. Ecologically, MAR supports aquatic ecosystems and preserves natural hydrological cycles.

Techniques include infiltration ponds, recharge dams, and runoff harvesting to enhance water infiltration and manage stormwater. For areas with low-permeability soils, direct injection via wells or boreholes replenishes aquifers. MAR reduces reliance on surface reservoirs, cutting infrastructure costs while securing water for agriculture, industry, and households.

LANDSCAPES SUPPORTED

EbA (ECOSYSTEM-BASED APPROACHES)

- FLOOD AND STORMWATER MANAGEMENT
- WATER STORAGE AND REGULATION
- SOIL & WATER REGENERATION
- WATER QUALITY IMPROVEMENT
- IN-STREAM FLOW MAINTENANCE

MAIN PROBLEMS ADDRESSED

- SOIL EROSION
- BIODIVERSITY LOSS
- FLOOD CONTROL
- DISASTER RISK REDUCTION
- FOOD SECURITY

ECOSYSTEM SERVICES AND ACTIONS

SUPPORTING

- **Soil and Water Regeneration:** MAR supports soil moisture retention and prevents erosion, which enhances soil fertility and agricultural productivity.

REGULATING

- **Flood and Stormwater Management:** By intercepting runoff and enhancing infiltration through recharge dams and sand dams, MAR helps reduce flood risks and improves water quality by filtering stormwater.

PROVISIONING

- **Water Storage and Supply:** MAR provides a reliable underground water storage system, ensuring water availability during dry seasons and supporting agriculture, industry, and domestic water use.

SOCIAL BENEFITS

- **Community Engagement:** MAR promotes local participation in water management, creating opportunities for community involvement and strengthening resilience.

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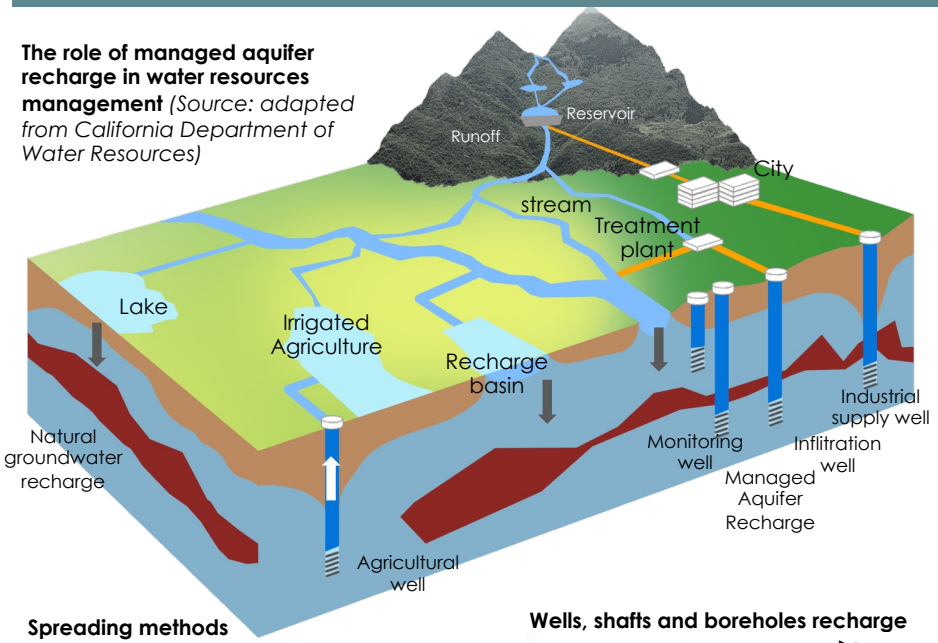
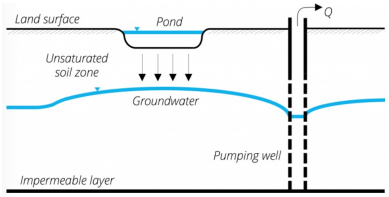
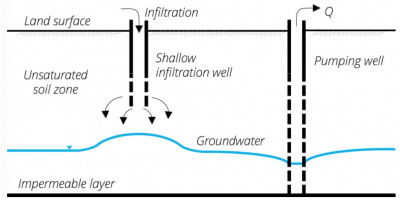
The role of managed aquifer recharge in water resources management *(Source: adapted from California Department of Water Resources)*



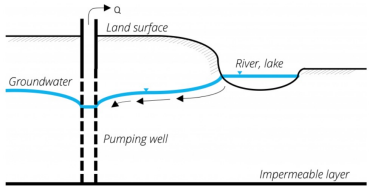
Spreading methods



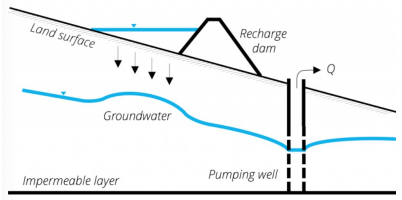
Wells, shafts and boreholes recharge



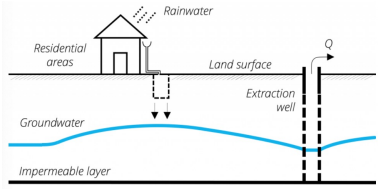
Induced bank filtration



In-channel modifications



Runoff harvesting



Techniques referring primarily to getting water infiltrated and to intercepting the water. *Source: INOWAS (Innovative Groundwater Solutions)*

PROJECT'S CHALLENGES & RISKS

- **Hydrological Uncertainty:** Variability in regional hydrogeology and rainfall patterns can complicate the accurate assessment of recharge potential and long-term effectiveness of MAR systems.
- **Water Quality Risks:** Inadequate monitoring and treatment of water used for recharge may lead to the contamination of aquifers with pollutants or pathogens, affecting water quality.
- **Clogging and Maintenance Issues:** Over time, clogging of recharge infrastructure, such as wells and infiltration ponds, can reduce efficiency, requiring regular maintenance and intervention.

NbS co-BENEFITS AND THEIR INDICATORS

- **Improved Water Security**
  Increased groundwater levels and sustained water supply during dry seasons.
- **Water Quality Improvement**
  Decreased levels of pollutants and improved water clarity in recharged aquifers.
- **Enhanced Agricultural Productivity**
  Increased crop yield due to improved soil moisture availability from groundwater recharge.
- **Coastal Resilience**
  Reduced incidences of saltwater intrusion in coastal aquifers, improving freshwater availability.
- **Flood Mitigation**
  Reduced flood events and damage in areas with MAR interventions like recharge dams and sand dams.
- **Climate Change Adaptation**
  Increased resilience to droughts and extreme weather events as a result of enhanced groundwater storage.

COST ANALYSIS

- **Direct Costs**
  Wells, recharge ponds, and pumps have an average cost range of $100k to $300k per project (depending on scale).
- **Indirect Costs**
  Maintenance costs, monitoring, and long-term management, estimated at $10k to $50k/year.
- **Time Horizon**
  Typical time horizon is 20-30 years, with a discount rate ranging from 3% to 7% based on local economic conditions.
- **Direct Benefits**
  Increased water availability.
- **Indirect Benefits**
  Enhanced agricultural productivity and flood mitigation
- **Risk Assessment**
  Risks of clogging, water quality degradation, and hydrological uncertainty.

REFERENCES:

Vietnam, Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods Project.
Indonesia, The Mara River Basin Groundwater Recharge Project.

IMPLEMENTATION OPPORTUNITIES:

Vietnam, coastal regions, Mekong Delta.
Indonesia, Bali.
Philippines, Mindanao.
Southeast Thailand, Chonburi, Rayong.