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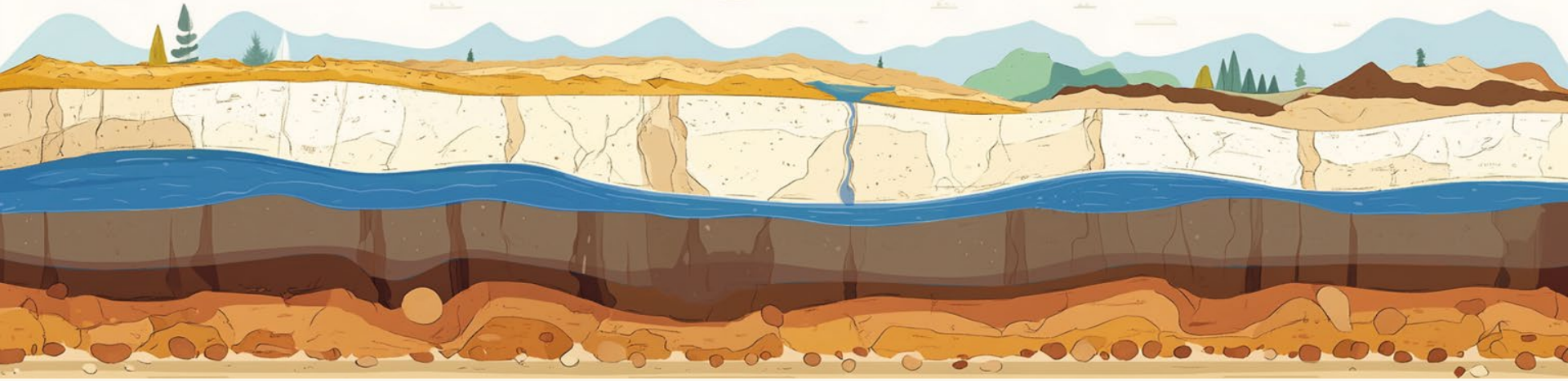

# Governance and conjunctive management of surface and groundwater

RésEAU Learning Journey on Groundwater 2024/2025
webinar 1
6.3.2025

***we are starting soon!***

# Technical housekeeping

**Your microphone is currently off**
If you want to speak, click on the button at the bottom of the screen **to raise your hand.**
**Thank you for opening the mic only upon invitation**.

**If you have questions of understanding** during presentations, please post them in the chat, or wait for the Q&A moment to unmute yourself.
We will do a **Mad Tea Chat** after the presentations to collect your insights and questions.

**If you can't hear or see:** leave and rejoin the meeting, and close other programs



**This event is being recorded** and made available to the online knowledge platform RésEAU.

# Agenda

| | |
|---|---|
| **Introduction to the webinar** | **Dr. Daniel Maselli**, Focal Point water network 'RésEAU', Swiss Agency for Development Cooperation (SDC) |
| **Keynote: Groundwater governance and conjunctive management - relevance and global trends** | **Dr. Alice Aureli**, Vice President of the International Water Resources Association (IWRA) and Governor of the UNESCO Chair on Sustainability |
| Q&A on keynote | |
| **A path towards sustainable use of an over-pumped aquifer: Examples in the Heihe River Basin and the North China Plain** | **Dr. Haijing Wang**, former Project Leader of the SDC "Rehabilitation and management strategy for over-pumped aquifers under a changing climate" project in China |
| **Hydrogeological landscape in Central Asia and the role of conjunctive water resources management** | **Dr. Beatrice Marti**, specialist in water resources modelling and digitalization, partner at hydrosolutions |
| **Approaches to governance and conjunctive water resources management - Groundwater Management Project in the Tajik Syr Darya River Basin** | **Mr. Thijs van der Velden**, WASH & Water Security Advisor & **Mr. Marian Szymanowicz**, Programme Team Leader, HELVETAS Swiss Intercooperation |
| Q&A / Mad Tea Chat, plenary discussion | |
| **Conclusion and closing** | **Dr. Daniel Maselli** |

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Co-Moderation: Frank Wiederkehr, RésEAU backstopper

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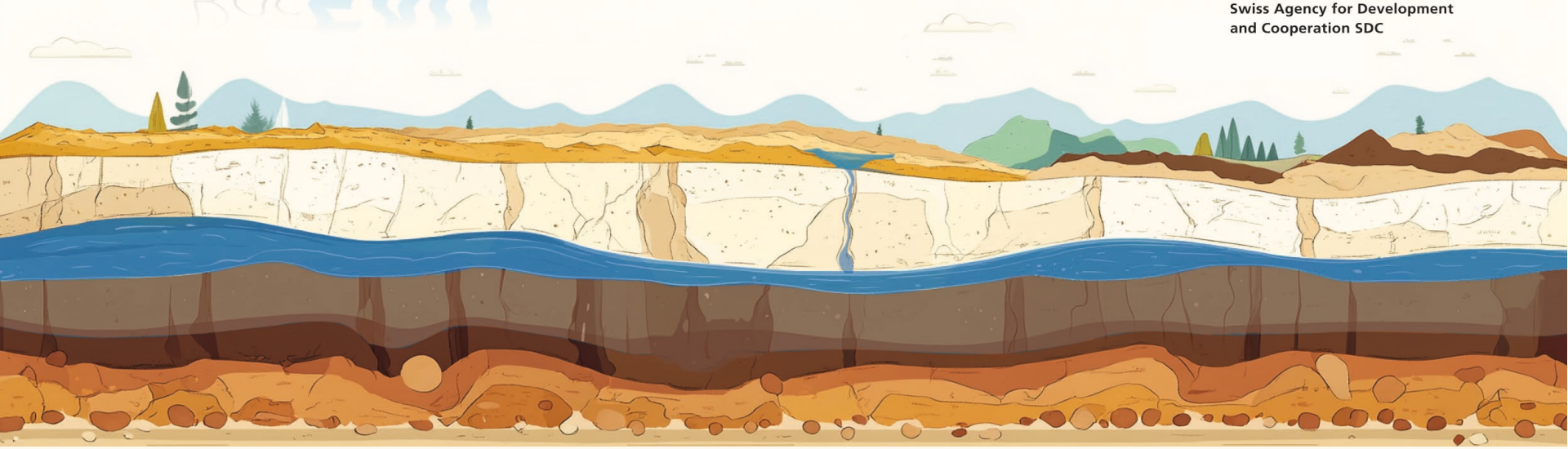
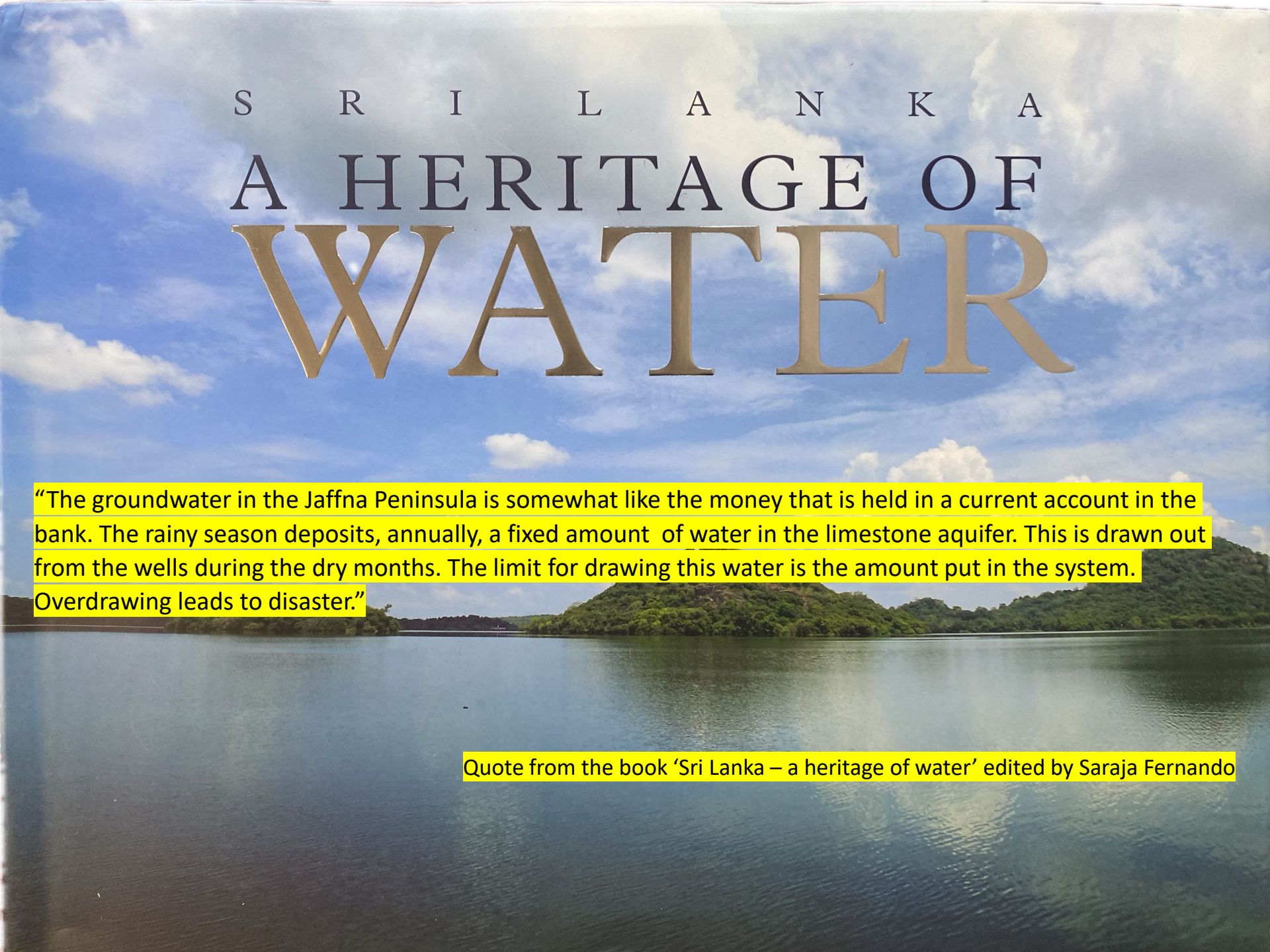


# Introduction

Dr. Daniel Maselli, Senior Policy Advisor for Water & Focal Point water network ‘RésEAU’, Swiss Agency for Development and Cooperation (SDC)




"The groundwater in the Jaffna Peninsula is somewhat like the money that is held in a current account in the bank. The rainy season deposits, annually, a fixed amount of water in the limestone aquifer. This is drawn out from the wells during the dry months. The limit for drawing this water is the amount put in the system. Overdrawing leads to disaster."

Quote from the book 'Sri Lanka – a heritage of water' edited by Saraja Fernando

# What are key challenges in conjunctive management of groundwater and surface water? Answers by Chat GPT ☺

1. Hydrological [& hydrogeological] complexity

2. Institutional and legal barriers [crossing national borders]

3. Data limitations and [climate change induced] uncertainty [reluctance to share data]

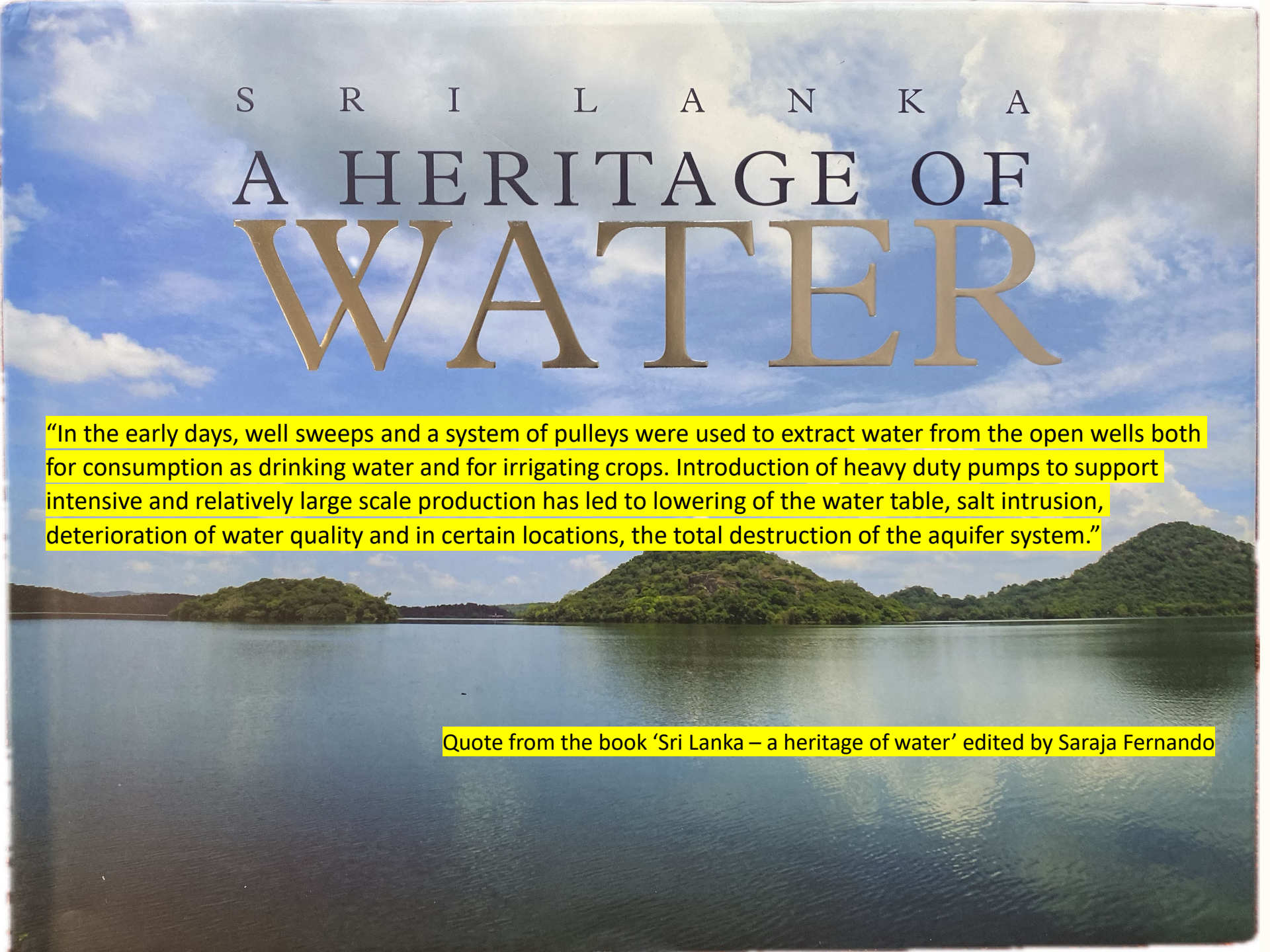
4. [Demanding technical expertise for] Infrastructure and cost constraints

5. Stakeholder conflicts [illegal/free extraction]

6. Climate variability and change [high unpredictability]

# What are main opportunities in conjunctive management of groundwater and surface water? Answers by Chat GPT ☺

1. Enhanced water supply reliability
2. Improved ecosystem health
3. Economic and agricultural benefits
4. [Entry point for] Climate Change Adaptation
5. [Avenues for] Policy and technological advancements
6. Stakeholder collaboration




"In the early days, well sweeps and a system of pulleys were used to extract water from the open wells both for consumption as drinking water and for irrigating crops. Introduction of heavy duty pumps to support intensive and relatively large scale production has led to lowering of the water table, salt intrusion, deterioration of water quality and in certain locations, the total destruction of the aquifer system."

Quote from the book 'Sri Lanka – a heritage of water' edited by Saraja Fernando

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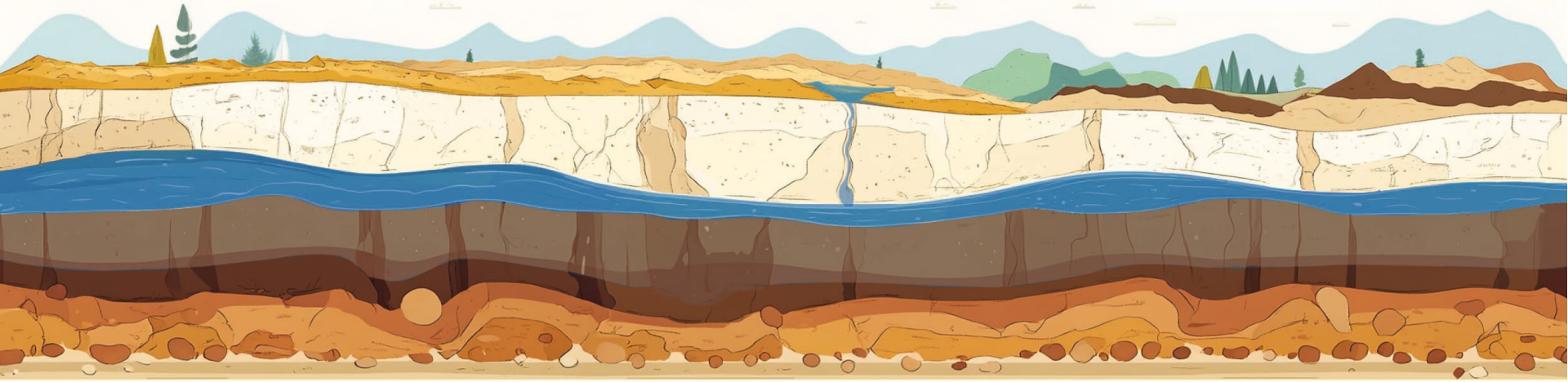

# Groundwater governance and conjunctive management: relevance and global trends

Dr. Alice Aureli, PhD
Vice-President of the International Water Resources Association (IWRA)
Governor of the UNESCO Chair on Sustainability


# GOUNDWATER GOVERNANCE .

Groundwater Governance
A Global Framework for Action

Food and Agriculture Organization of the United Nations

United Nations Educational, Scientific and Cultural Organization · International Hydrological Programme

iah aih

WORLD BANK GROUP

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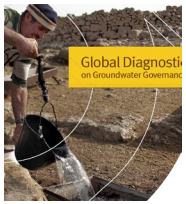
www.theGEF.org




**Global Diagnostic on Groundwater Governance:**

Groundwater Governance: A Global Framework for Action | IGRAC

Failure to give real consideration to groundwater governance


**A Shared Global Vision 2030:**

The vision makes the case for conjunctive management of surface water and groundwater.


**Framework For Action:**

*Policy and institutional guidelines, recommendations, best practices*

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# INTEGRATED WATER RESOURCES MANAGEMENT IWRM

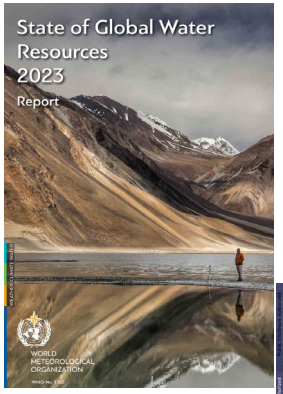
**Target 6.5:** By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.

**Indicator 6.5.1** "Degree of integrated water resources management (IWRM) implementation"

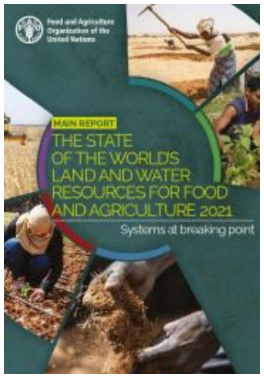
**Indicator 6.5.2** Proportion of transboundary basin area with an operational arrangement for water cooperation

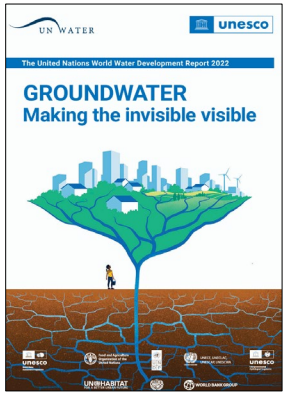
# GROUNDWATER THE INVISIBLE COMPONENT OF THE IWRM

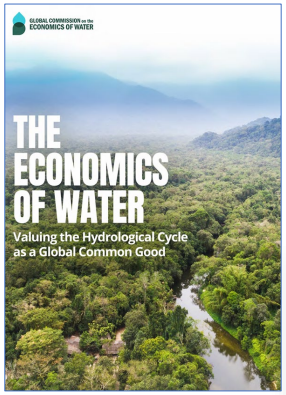
## Recent reports call for groundwater at the heart of integrated water resources management

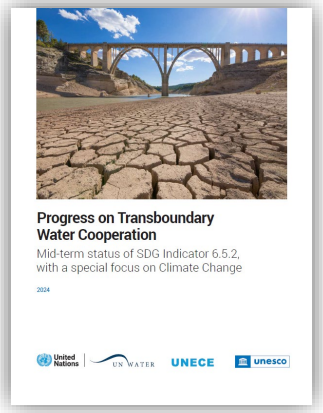




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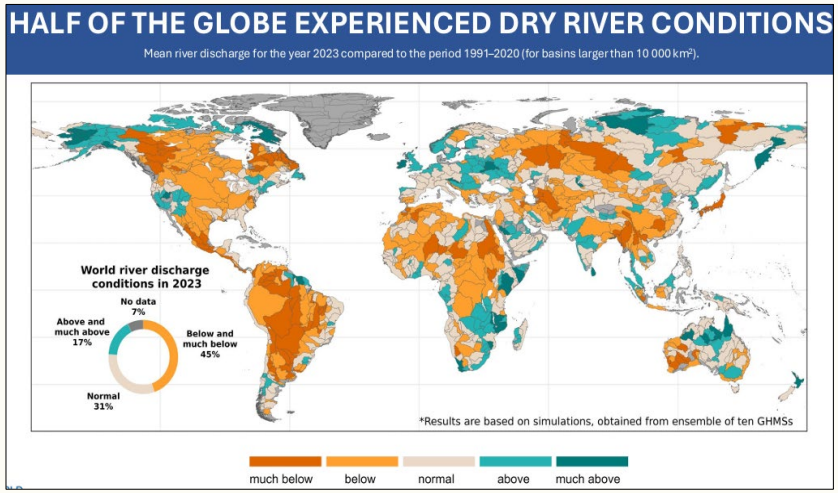
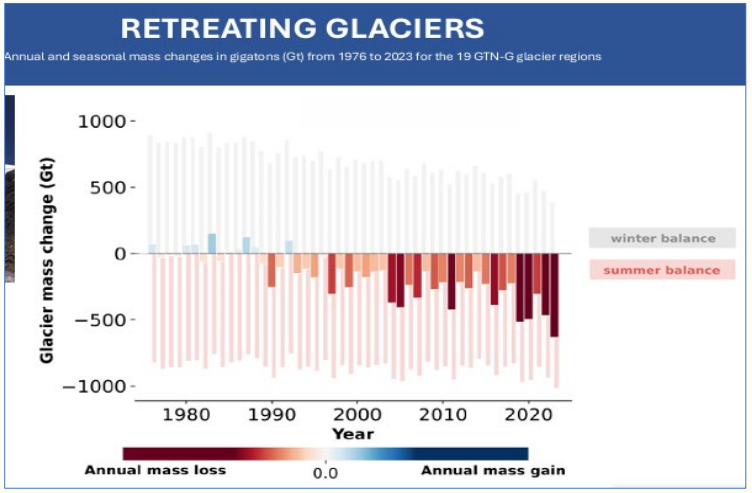
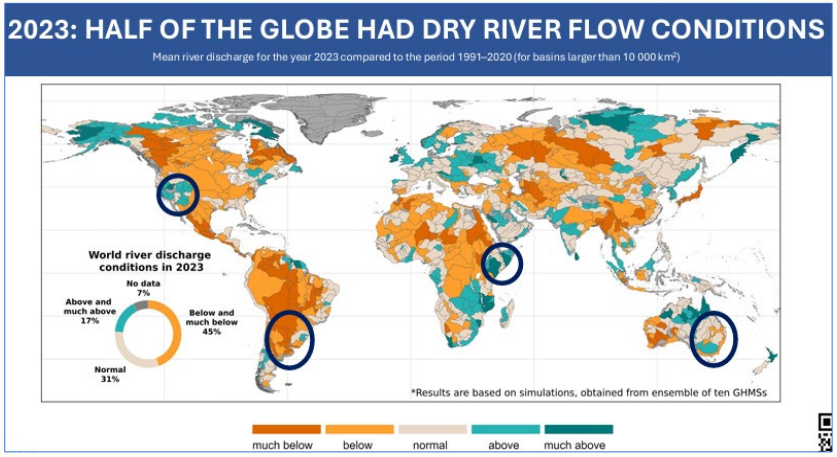
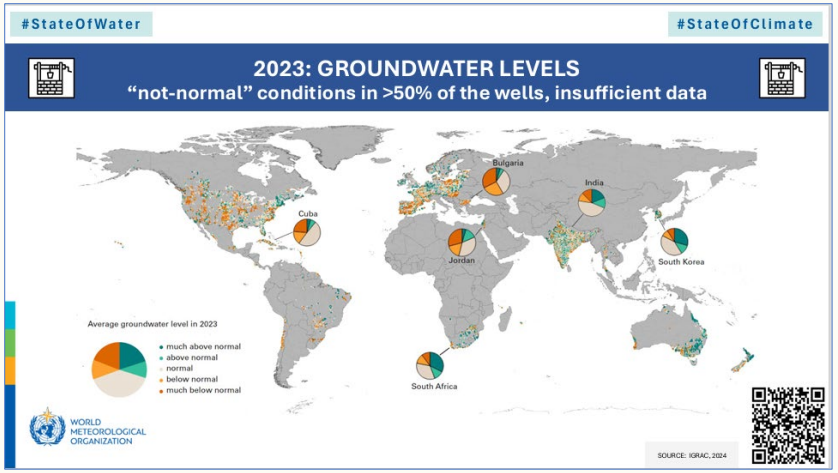
# ACTIONS ARE NEEDED TO REVISE OUR GROUNDWATER AND SURFACE WATERS MANAGEMENT

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# MEETING THE INCREASING DEMAND FOR FOOD AND WATER

Surface water management and groundwater management have historically been managed separately

Lack of groundwater governance

What kind of corrective measures can be taken to improve the current situation?

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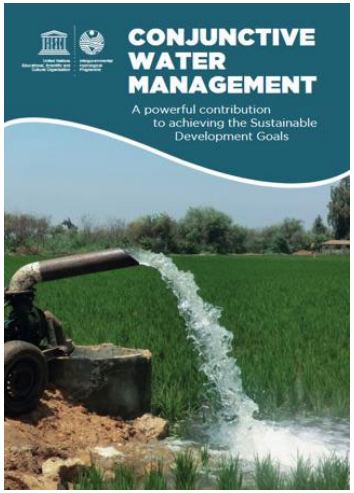
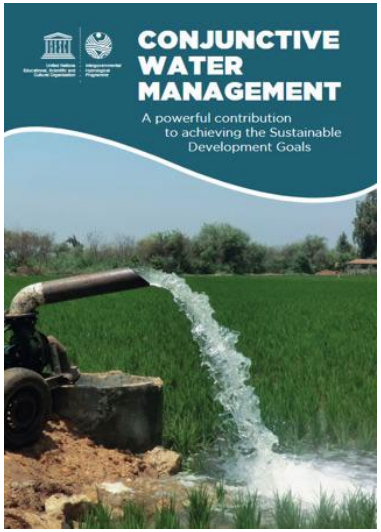


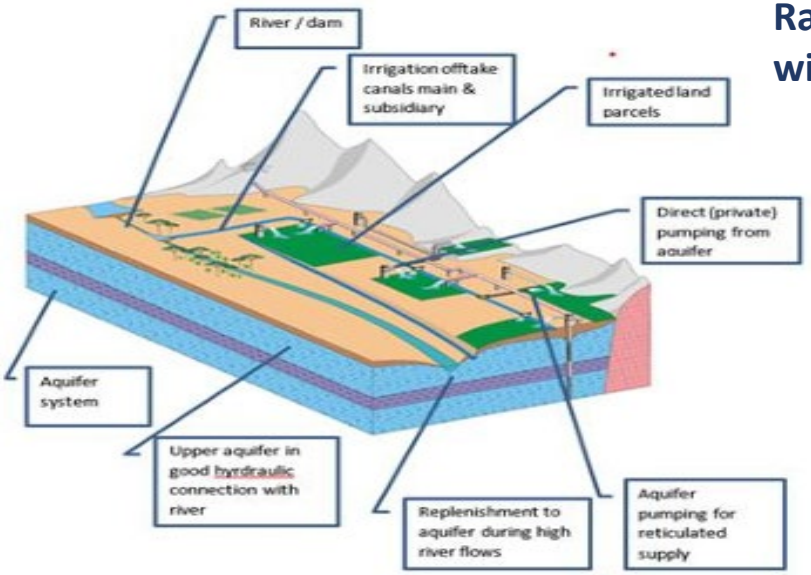
# IWRM → Conjunctive water resources management




Adopting an **integrated water resources management** approach, which includes conjunctive management of groundwater and surface water.

**CWM subset of IWRM**

**Raise awareness of CWM within IWRM.**



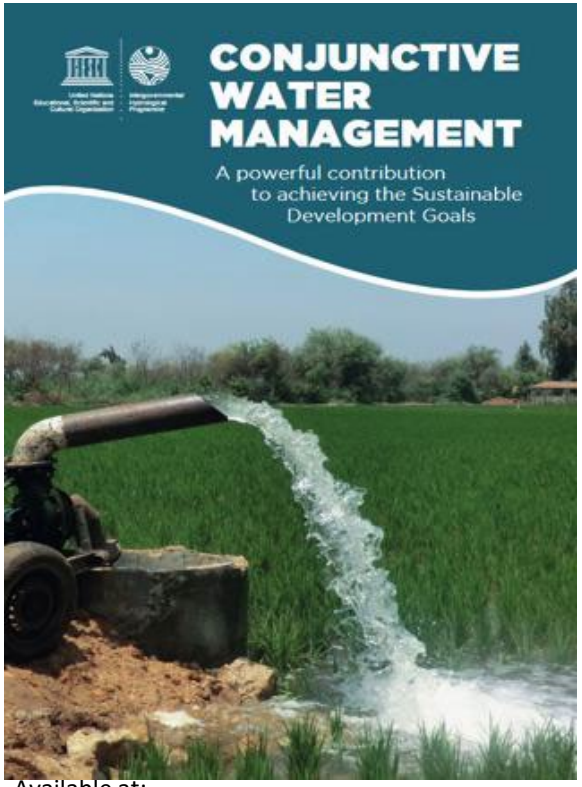
# MAKING IWRM OPERATIONAL

## Conjunctive Water Management (CWM)

**CWM** is an approach to water resources management in which surface water, groundwater and other components of the water cycle are considered as one single resource, and therefore are managed in closest possible coordination, in order to maximize overall benefits from water  at the short and at the long term.

**The concept is not new**

**HOWEVER**




Available at:
https://unesdoc.unesco.org/ark:/48223/pf0000375026

- If examples of  spontaneous conjunctive water use exist
- Examples of planned CWM are exceptional
- Lack of guidelines – What to do ?

# USE, MANAGEMENT & GOVERNANCE

**Conjunctive use** – A specific demand is identified - specific definition of what the water will be deployed for – irrigation, municipal needs, industry, aquatic ecological needs.

Demand identified

**Conjunctive management** – focus on water demand management, not solely fulfilling demand, assess and analyze connectivity of the existing water systems (ex. aquifers dependent ecosystems) and set up a planned management of surface water, groundwater and other components of the water cycle, consider alternative source of water (MAR operation), define required equipment, infrastructure, operational rules.

- Planning is consistent to deliver the required demands

Defines who will do what ex. irrigation operators well owners

**Conjunctive governance** – the set of policies, rules, regulations, rights and obligations are all agreed and adhered to by participating entities.

- Existing plants needs to be modified
- Institutions operating in silos need to reorganise and coordinate in consistent manner.
- Existing legal framework will need to be readjusted / changed
- User associations will need to be further empowered to take local actions – managing their demand and supply
- Adequate financial plans are required.

Provide a common framework for regulators and regulated

# CONVERTING FROM 'SPONTANEOUS CWM USE ' TO 'PLANNED CWM MANAGEMENT '

| TOWARDS A PLANNED CWM MANAGEMENT | | |
|---|---|---|
| **Source** | **Spontaneous** | **Planned** |
| Aquifer | Wells operated irrespective of other sources | Meets peak and emergency demands. |
| River | Base flow demands not met | Meets base flow demands |
| Dam / reservoir | Uncoordinated operating rules | Set operating rules |

**Conjunctive Water Management: Recommended priorities for scaling-up**

**Governance measures:**

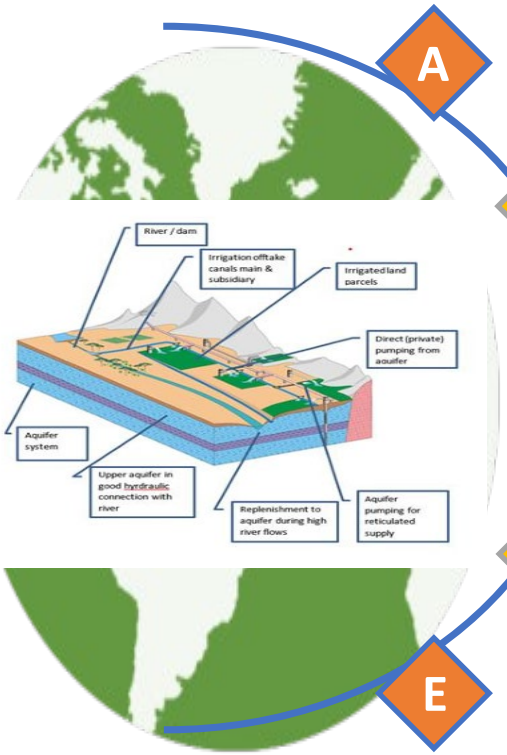
- Creating awareness on CWM and its potential benefits
- Bridging or removing institutional barriers
- Making legal and regulatory frameworks compatible with CWM
- Aggregating knowledge on the local water systems
- Adopting CWM in water resources planning
- Raising funds for CWM interventions

**Priorities for scaling-up at field level:**

- Conjunctive use
- Managed aquifer recharge
- Watershed management
- Desalination
- Wastewater management and recycling

# CONVERTING FROM 'SPONTANEOUS CWM USE ' TO 'PLANNED CWM MANAGEMENT '

## Conjunctive operation management planning ….




**A** **Know your demand**

Well-defined demand – so that financial flows can be put in place … charges, fees, subsidies

**B** **Quantify hydrology**

Flood flows, mean flows, minimum flows, ecological requirements

**C** **Quantify hydrogeology**

Well yields, drawdown distribution, annual recharge, pumping rates, borehole design

**D** **Formulate operational rules**

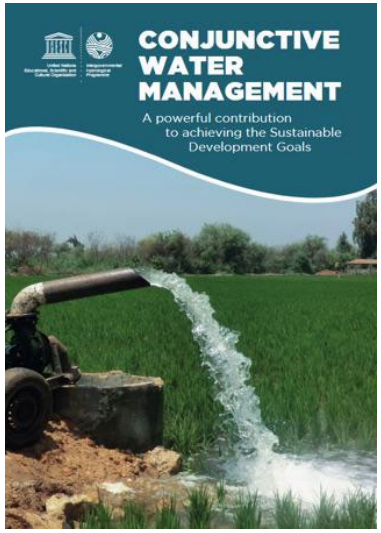
Behavioral science, user needs, socio – economy, willingness & ability to pay

**E** **Ensure Cost recovery**

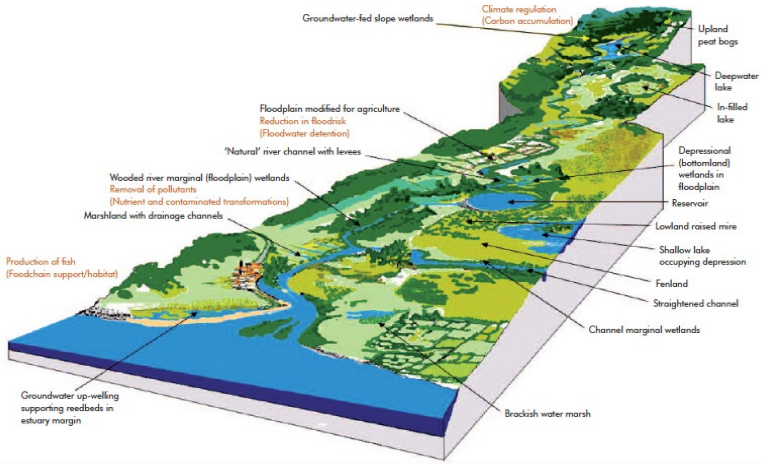
Operation & maintenance, charging system, taxation / subsidy, user organisations

Ref. Shammy Puri presentation at the UNECE Workshop 2023

# CWM BENEFITS




- Optimization of the resources available for use and lower risk of water shortages and contamination
- Water resources sustainability
- Environmental, economic and social benefits (SDGs)
- Elimination of double counting, reduction of planning flaws and errors
- Water security (creating reliable sources of drinking water)
- Contribution to the water circularity
- Reducing the potential for water-associated conflict
- Help adapting to climate change.

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# CONJUNCTIVE WATER MANAGEMENT INTO PRACTICE

## At area-wide planning level

### Incorporating all water components

Exploring and analysing hydraulic connectivity and exchanges of water.

Identifying promising opportunities, like storing/replenishing GW during floods, and preferentially using GW during droughts and emergencies.

Identifying hazards of harmful interactions

### Focus on aquifers

**Aquifers** directly linked with surface water

**Deep Confined aquifers not connected**

**Aquifers** extension within the river basin (Stampriet Aquifer within Orange- Senqu River Basin, EU-WFD…)

**Aquifers** extension do not coincide with river basin extension (BASM, NWSA SASS, Guarani, NSAS…)

## Implementation in the field

### Resource augmentation

Managed aquifer recharge (MAR)

Watershed management

Desalination of brackish and saline water

Recycling treated wastewater

Water from DAMS

Controlling water demand

Reducing evapotranspiration from agriculture

Fighting water pollution

### Environmental control

Water level control in polder / low-low-lying and reclaimed areas

Groundwater level control in surface water irrigated zones

Restricting groundwater pumping to control surface water environmental flows

Managing wastewater

Published in 2020, © UNESCO 2020

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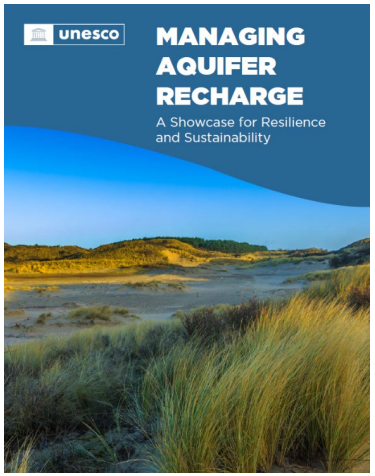
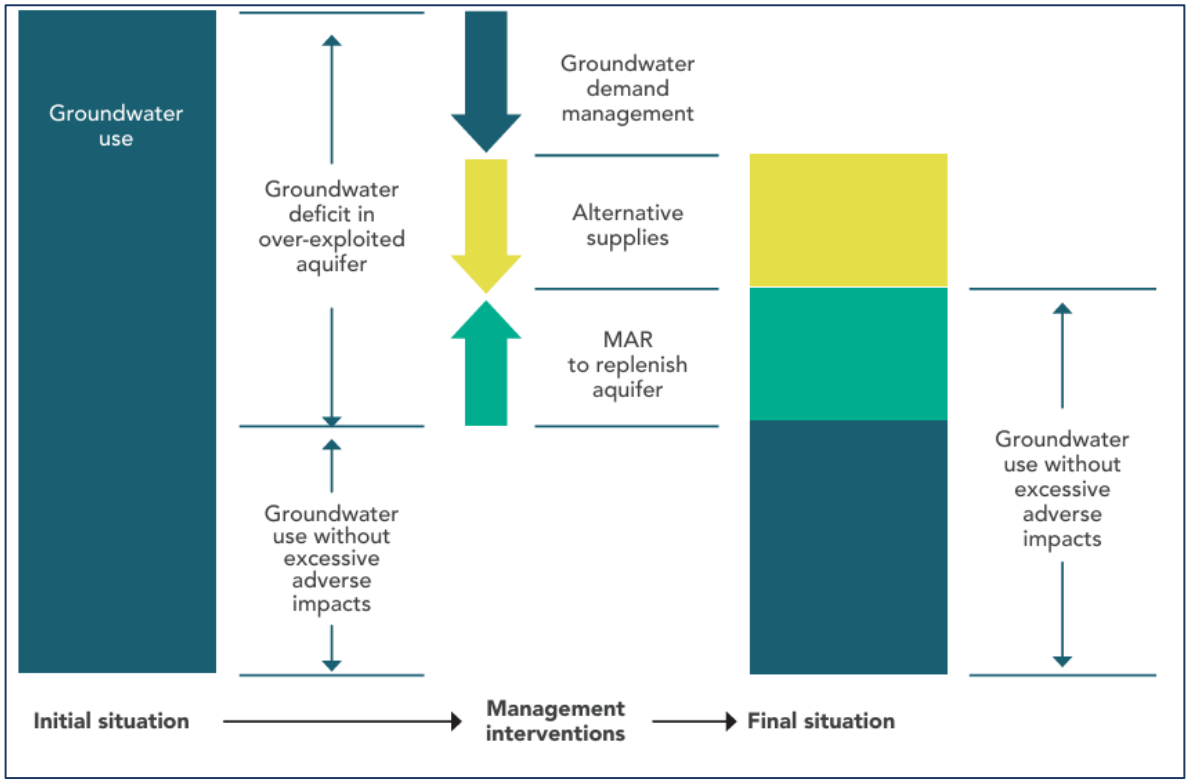
# MANAGED AQUIFER RECHARGE (MAR)

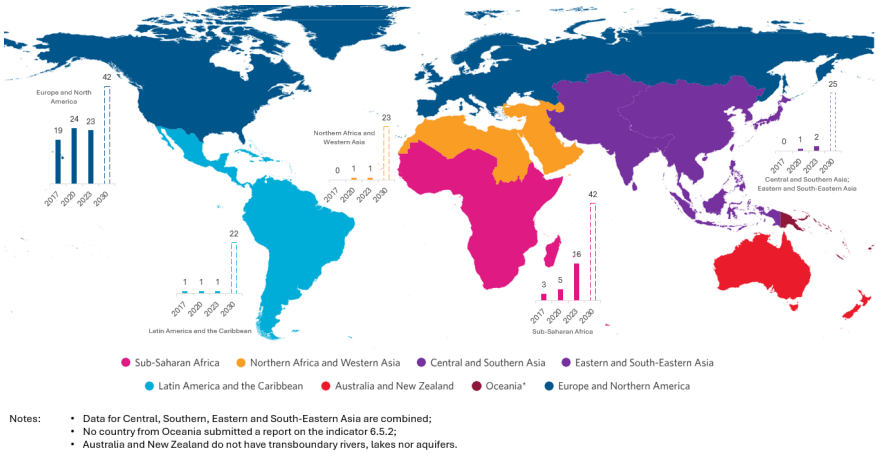


# ENHANCE CONJUNCTIVE WATER MANAGEMENT IN TRANSBOUNDARY CONTEXTS

## 3rd reporting exercise on SDG 6.5.2: results from 2023 data drive

- **60 countries** have 90% or more of their **river and lake basin area** covered by operational arrangements in 2023
  - vs 58 countries in 2020
- **Only 37 countries** state that 90% or more of their **transboundary aquifers** are covered by operational arrangements in 2023
  - vs 28 countries in 2020
- **More than 20 countries** have no operational arrangements in place for any of their transboundary waters
- **Insufficient knowledge on groundwater –** indicator 6.5.2 provides **an unprecedented opportunity for countries to consider their transboundary aquifers**




Notes:
- Data for Central, Southern, Eastern and South-Eastern Asia are combined;
- No country from Oceania submitted a report on the indicator 6.5.2;
- Australia and New Zealand do not have transboundary rivers, lakes nor aquifers.

**150 countries**

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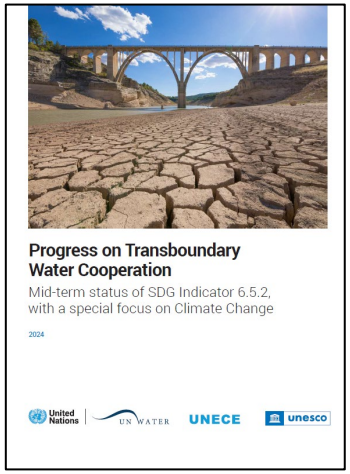
# ENHANCE CONJUNCTIVE WATER MANAGEMENT IN TRANSBOUNDARY CONTEXTS

## Report 2024- SDG 6.5.2 Water Cooperation Monitoring -Challenge




Water treaties globally are surface water orientated

River basin organizations seldom contemplate groundwater, partly due to a lack of knowledge and capacity in aquifer assessment.

**Few transboundary water agreements** integrate conjunctive management in an in-depth manner.

Joint bodies, bringing together technicians and political/administrative representatives of each party, can play a crucial role in advancing conjunctive water management in a transboundary context.

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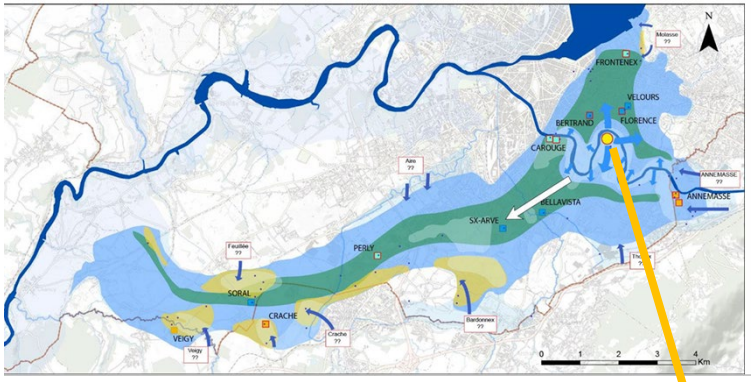
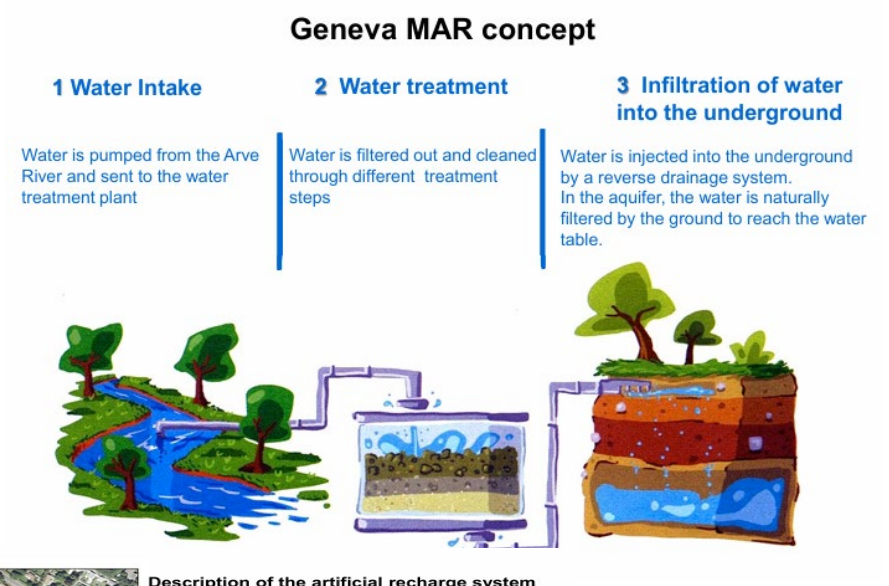
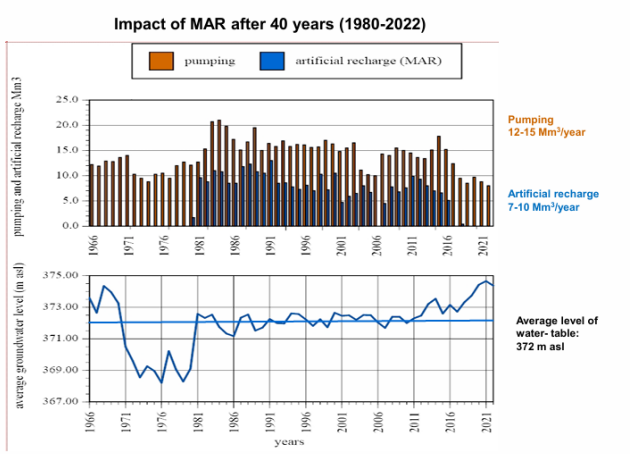
# EXAMPLES

## Cooperation - CWM in the Genevese aquifer management

The Geneva aquifer constitutes a common strategic water reserve on both sides of the border





**Description of the artificial recharge system**

5 Underground infiltration area
(perforated pipes-length 5000m)

4 Pipe to the infiltration area
(length 700m)

3 Water treatment plant

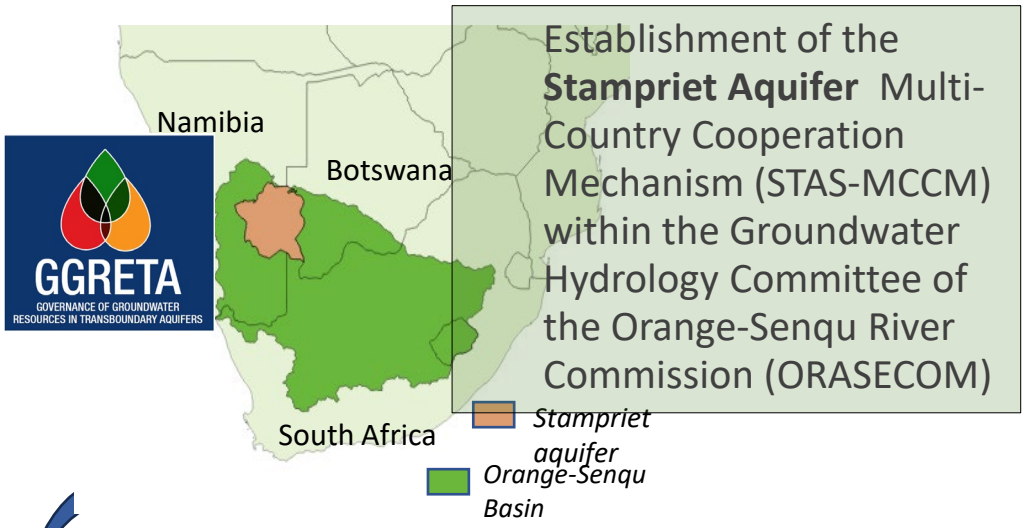
2 Pipe to the plant (length 340m)

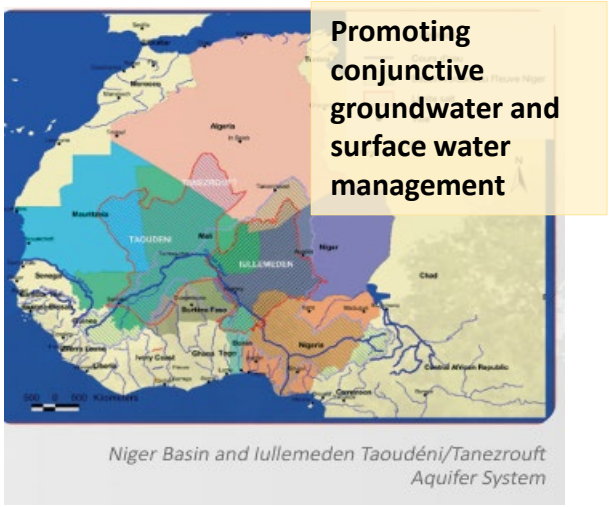
1 Water-intake structure

From: Dr. Gabriel de los Cobos

# EXAMPLES

## Example of integration and CWM / aquifer - river basin organization

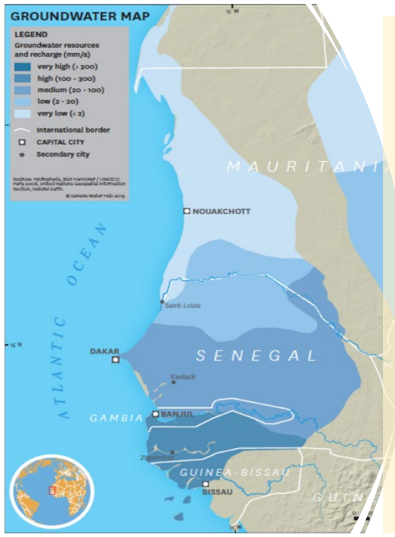



- The **Limpopo Watercourse Commission** (LIMCOM) set up the **Limpopo Groundwater Committee** (LGC) in 2019, with a special mandate for TBAs: the Ramotswa Aquifer, the Tuli Karoo Aquifer and the Limpopo Aquifer Basin.
- More activities also in the **Zambezi and Cuvelai river basins**, with instrumental support of the ***SADC Groundwater Management Institute.***

# EXAMPLES

## Senegalo-Mauritanian Aquifer Basin




**The regional dialogue is supported by the UNECE Water Convention secretariat, the World Bank, the Geneva Water Hub, the International Groundwater Resources Assessment Centre and OSS/UNEP, with funding from the SDC, EU and GEF.**

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**INTERNATIONAL WATERS LEARNING EXCHANGE & RESOURCE NETWORK**

# PROMOTING CONJUNCTIVE MANAGEMENT OF TRANSBOUNDARY SURFACE WATERS AND GROUNDWATERS

**Water Convention** can support conjunctive water management through **relevant provisions**, **guidance development** and **facilitating the exchange of best practices**.

***Objective:*** *Promoting conjunctive water management of surface waters and groundwaters by increasing understanding of its benefits and supporting transition from spontaneous to planned conjunctive use and management in transboundary basins.*

**Activities**

- Formation of an **expert group** to develop **policy guidance** on conjunctive management of surface waters and groundwaters, with a focus on transboundary basins.
- Analysis of **best practices** in the application of conjunctive water management in transboundary and domestic settings.
- Inputs at **regional workshops and trainings**.

Builds on the **Global Workshop on Conjunctive Management of Surface Water and Groundwater** (Geneva, 16-17 October 2023). Conclusions available here.

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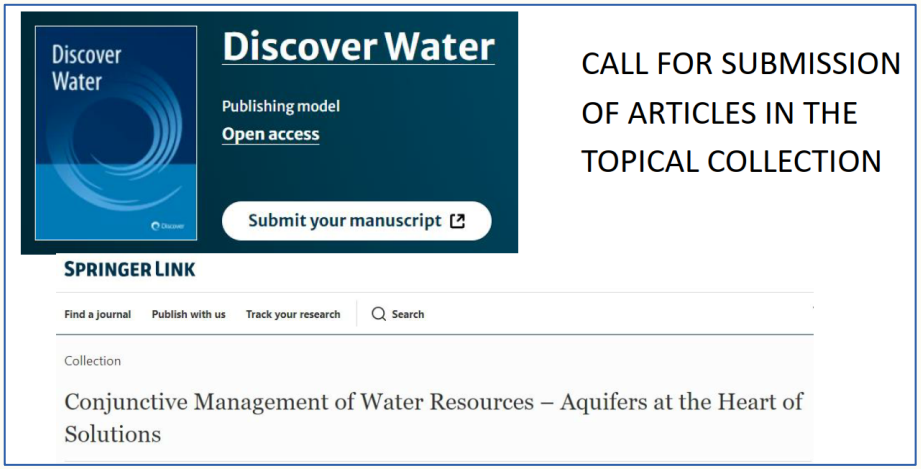
## RECOMMENDATIONS – NEXT STEPS TO ADVANCE CWM

1. Alignment of groundwater and surface water monitoring, assessment, and management, at national and joint/transboundary level
2. Co-development of legal and other guidance frameworks related to conjunctive management of water resources in IWRM, at national and joint/transboundary level
3. Collating and sharing existing experience in CWM
4. Further advocacy for CWM - and identifying opportunities/low-hanging fruits and piloting in prospective contexts
5. 2026 UN Conference on Water- Call for Groundwater Water Cooperation and CWM

**2024 @Alice Aureli and Karen Villholth**

# Thank you




CALL FOR SUBMISSION OF ARTICLES IN THE TOPICAL COLLECTION

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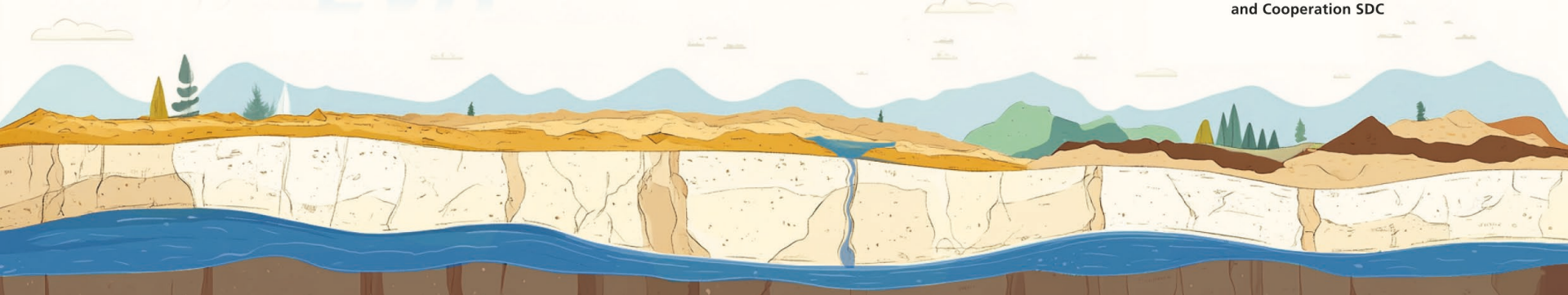

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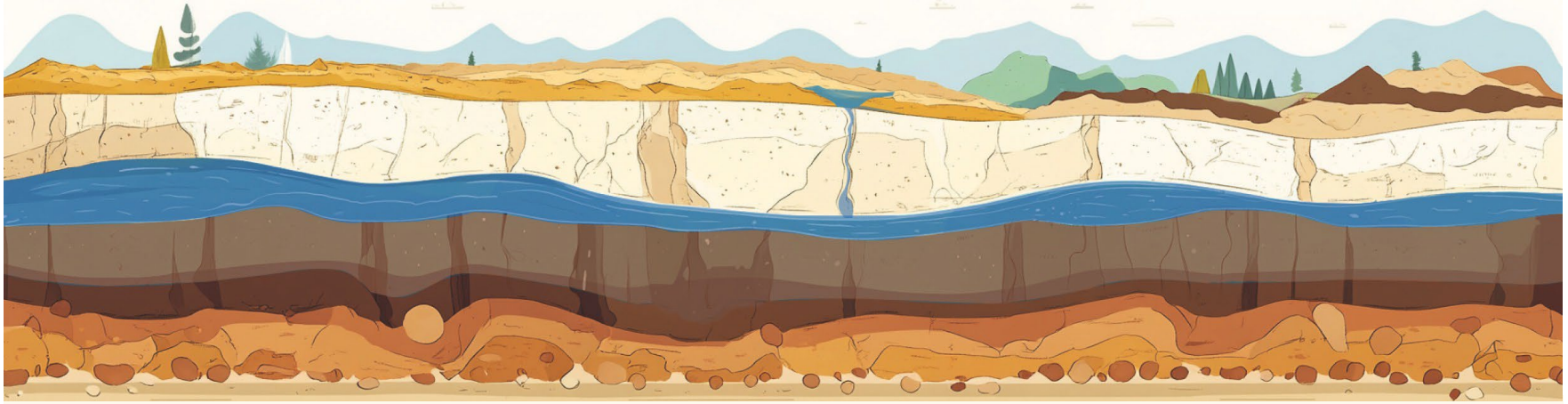

# A path towards sustainable use of an over-pumped aquifer Examples in Heihe River Basin and the North China Plain

Haijing Wang, PhD
Independent Expert in Water, Climate Change and Sustainability, former Project Leader of the SDC “Rehabilitation and management strategy for over-pumped aquifers under a changing climate” project in China

# A path towards sustainable use of an over-pumped aquifer Examples in Heihe River Basin and the North China Plain

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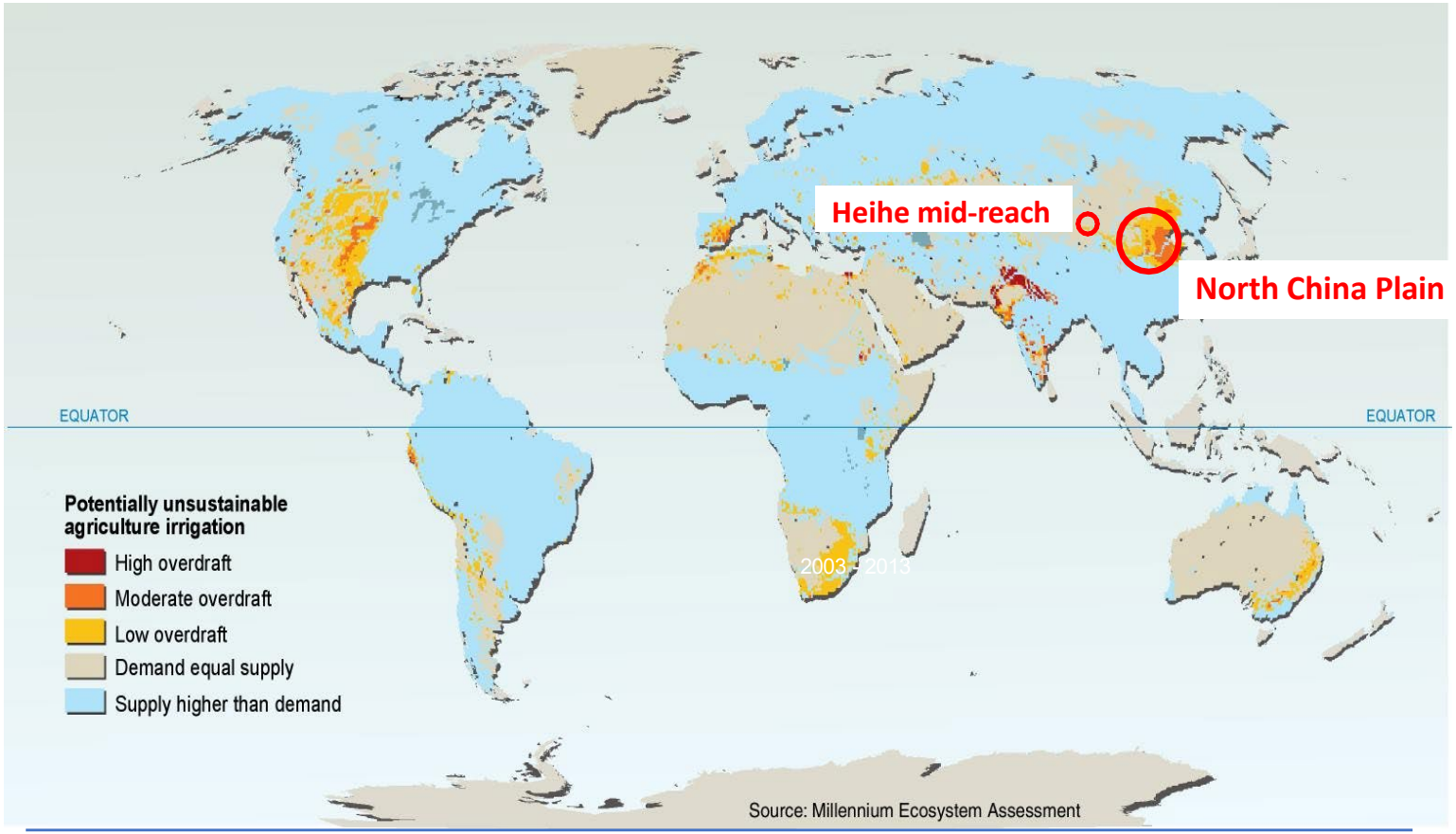
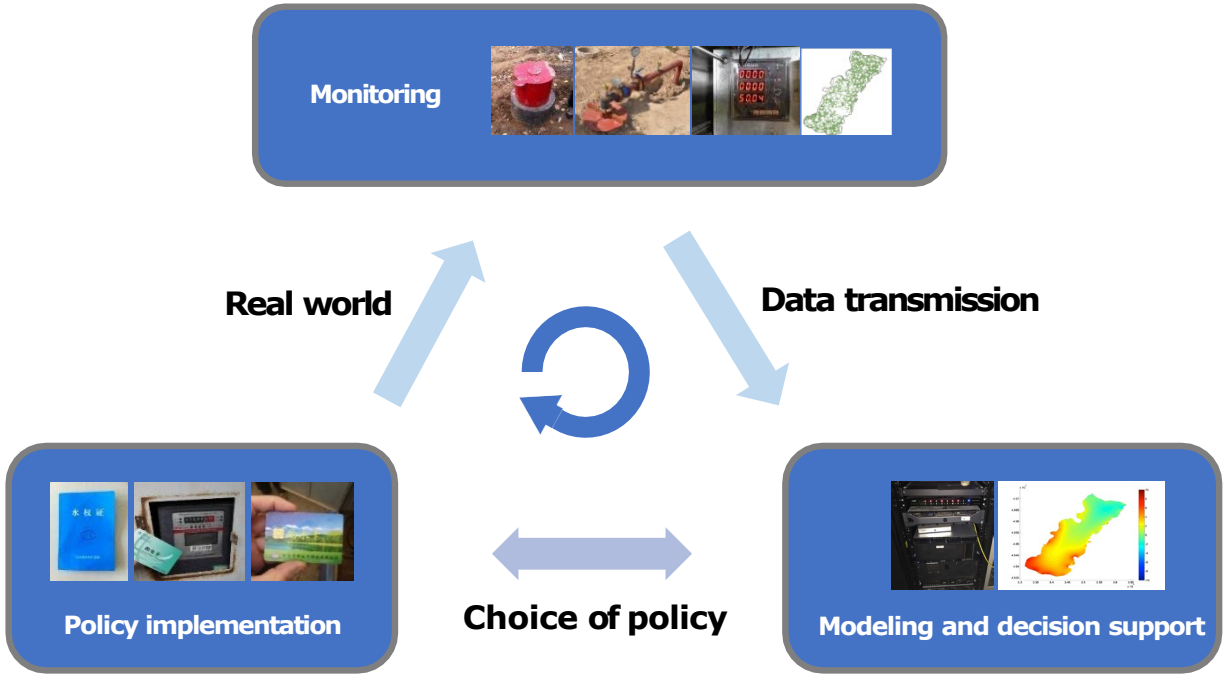
# Overpumping of aquifers

About one quarter of annual groundwater abstractions is not sustainable.

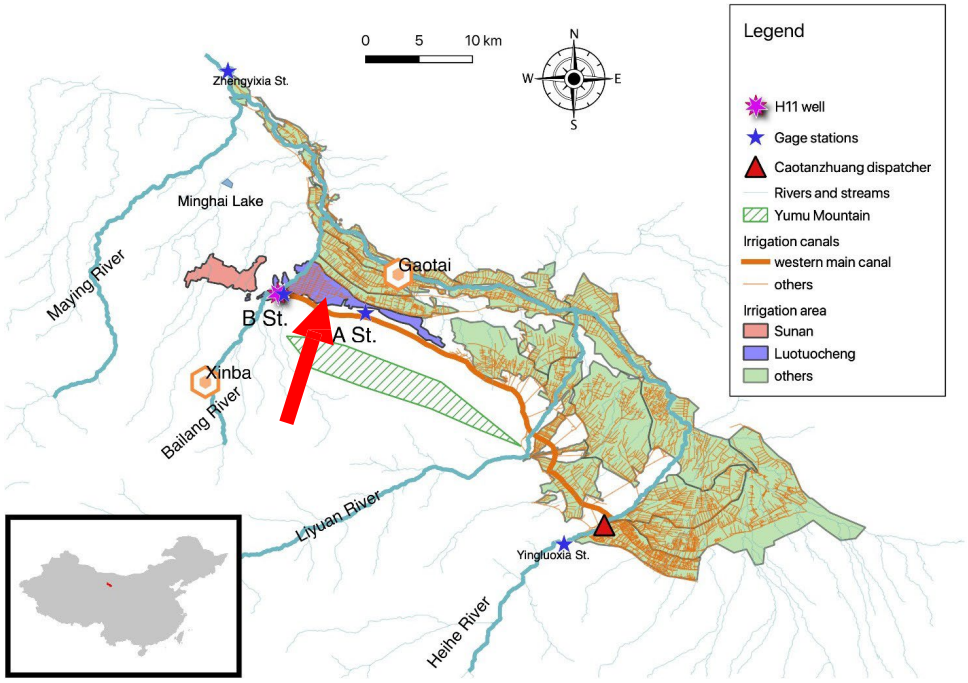


# Integrated GW Governance System

**— based on monitoring, modelling and control**



# Example in Heihe mid-reach




**Similarity to Central Asia:**

- Arid climate, annual rainfall 150mm
- Full irrigation by river water and groundwater

**Problems:**

- Reduction of river flow by abstractions for irrigation hurts downstream ecosystems and farms
- "97 Plan" reduced surface water irrigation, but replacement by groundwater led to **large cones of depression** near Luotuocheng and Daman irrigation districts
- Replacing river water by groundwater overlooks their connections

**Solution:**

- Reduce groundwater abstraction
- Optimizing surface water allocation

# Policy Implementation in Heihe

- Collection of **water fees** through smart meters and swipe cards
- **Legislation** to protect water meters
- Allocation of **subsidies** for water saving irrigation equipment
- Encourage conjunctive use of **surface water**

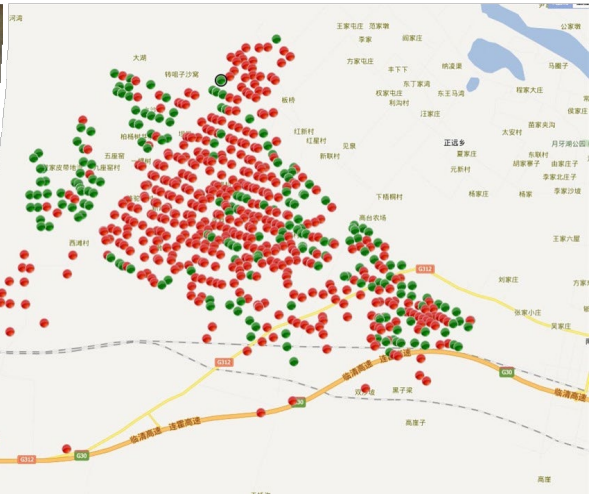
Smart meter installation on irrigation wells

Surface water channel and monitoring

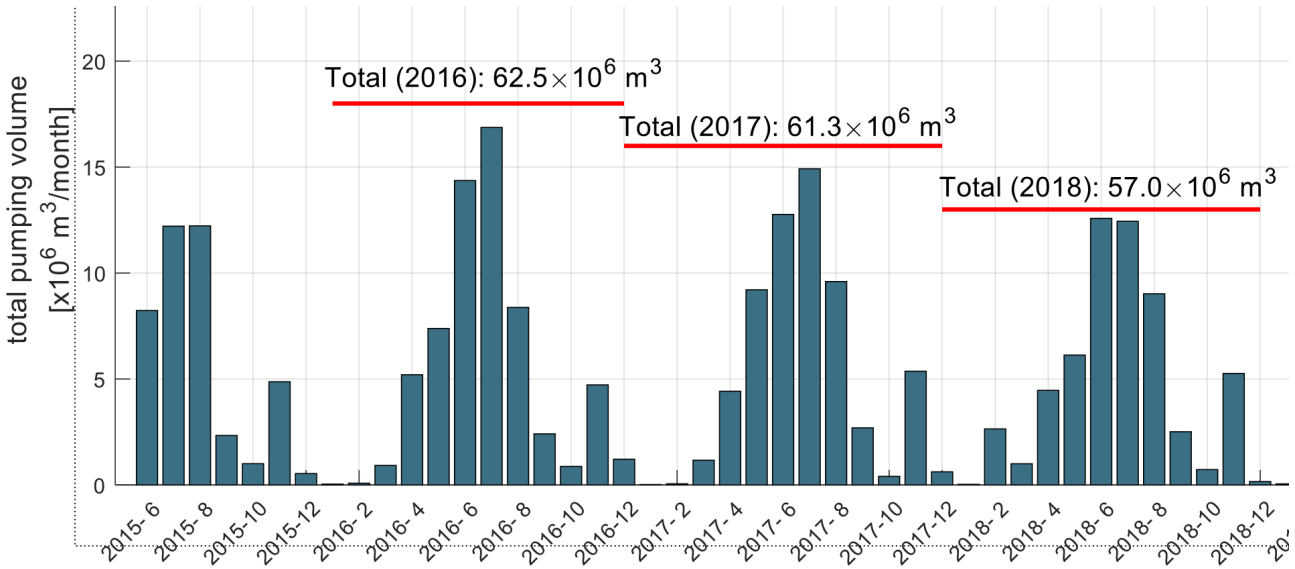
## Successful measure: Smart meters for water fee collection

- Smart water meters were installed on 718 wells through PPP (public private partnership)
- Cost per well ≈ 10’000 CNY (incl. meter and installation)
- Operation by prepaid swipe cards
- Private firm contracted is in charge of fee collection and maintenance

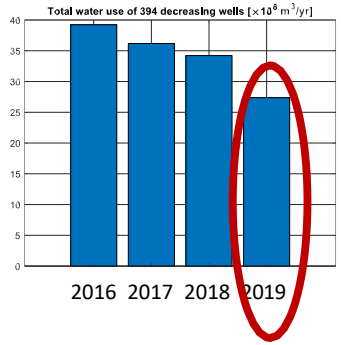
1 CNY = 0.11 CHF

# Results of overpumping control in Luotuocheng

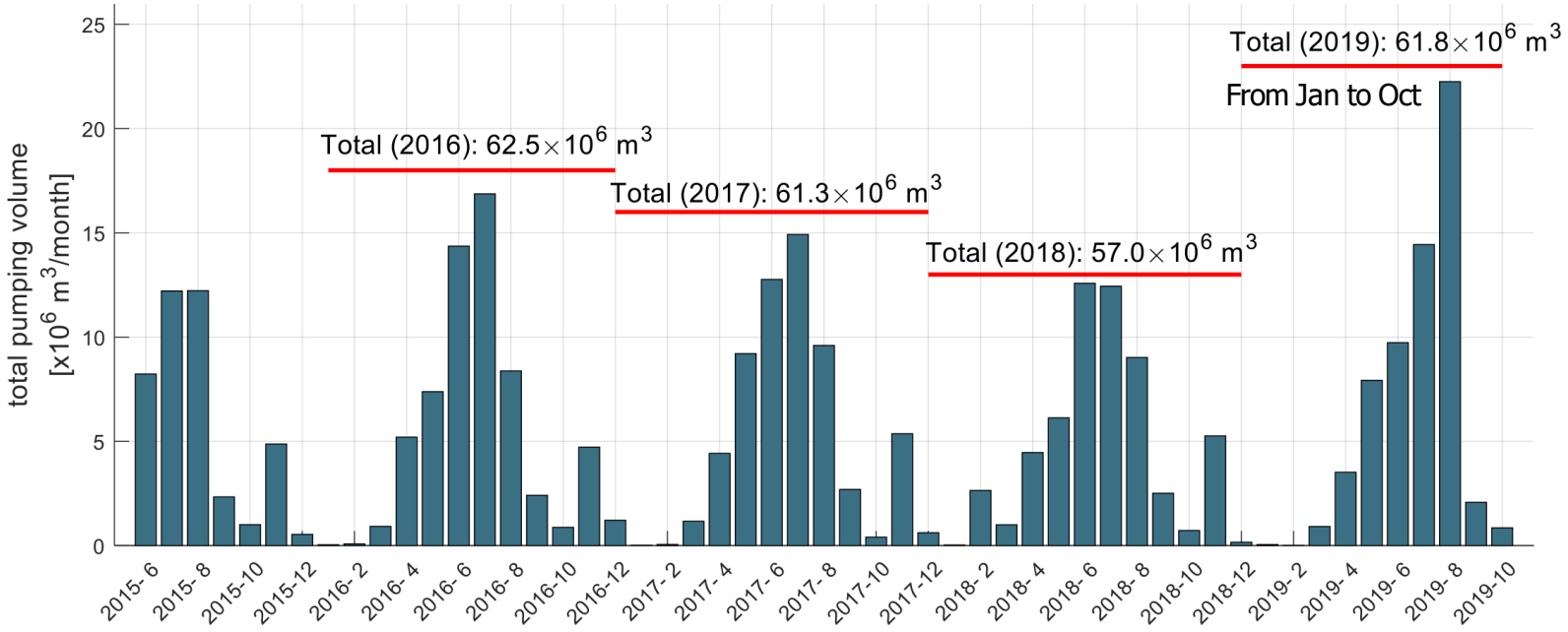



Savings effect of about 30% at 394 wells, where data is available from 2016-2019



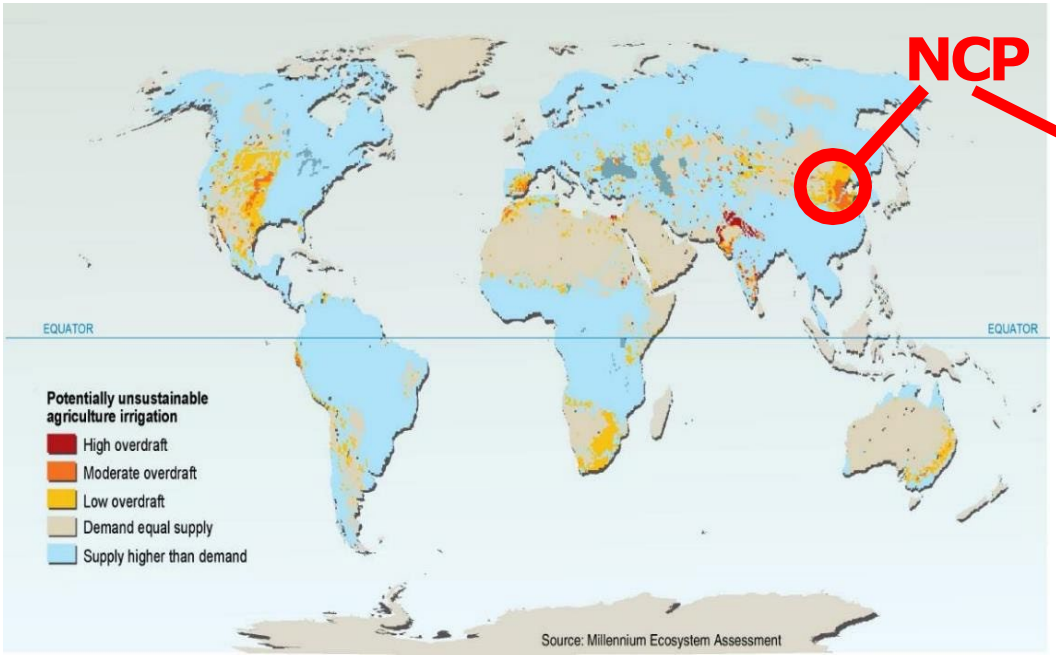
# Results of overpumping control in Luotuocheng

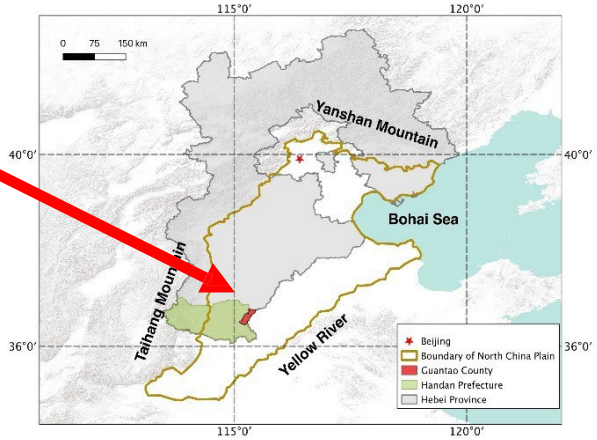
Rebound effect in 2019: Increase of irrigated area of 8'061 ha by **1'100 ha**, regardless the government rule of no increase of irrigation area after 1986.



# Example in North China Plain (NCP)

**Overpumping in NCP is mainly due to irrigation needed for growing double cropping of winter wheat and summer maize**




**Undesirable consequences**

- Streamflow reduction
- Soil subsidence
- Increase of pumping cost
- Seawater intrusion
- Storage depletion ➡ less resilience against droughts
- …

# Guantao, a typical county in NCP

Double cropping system

**Water Consumption:**

**400 – 450 mm**

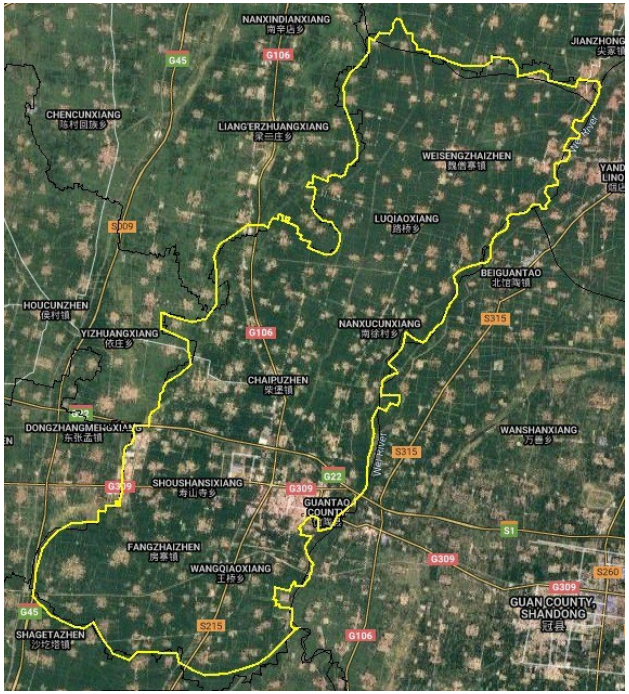
**300 – 400 mm**

**Average annual rainfall:**

**450 – 550 mm (mainly in summer)**

**Average irrigation required:**

**200 – 400 mm (mainly for winter wheat and mainly from groundwater)**

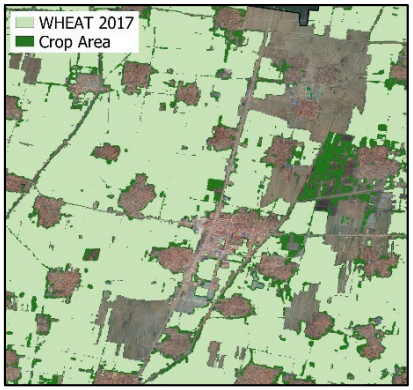



- Semi-arid climate
- Supplementary irrigation mainly GW
- Irrigated area 300 km$^2$
- Total area 456 km$^2$

**Task: How to reduce groundwater abstraction?**

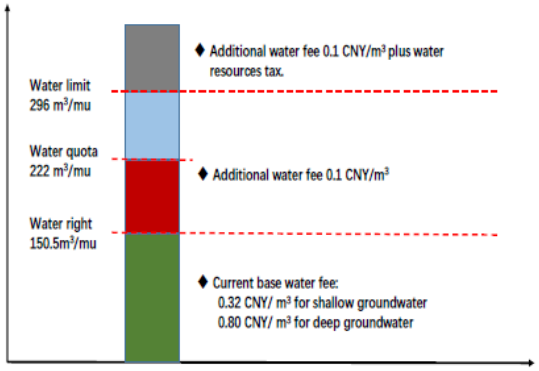
# Policy Implementation in NCP

- Allocation of **subsidies** for wheat fallowing and water saving irrigation
- Collection of **water fees** according to tiered scheme
- Conjunctive use and **surface water** import
- **Artificial recharge** of groundwater through ponds, pools and dried riverbeds.




Winter wheat fallowing
(Subsidy: ≈1000 CHF/ha)

Subsidy for water saving:
Only effective for big farms and green houses



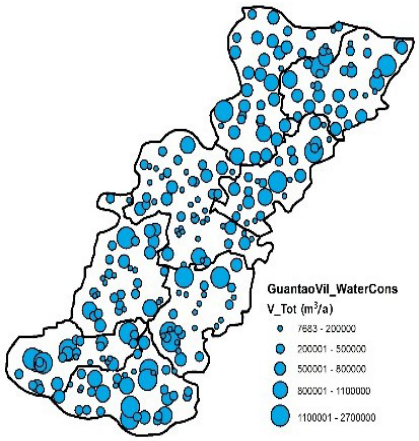

Tiered quota and fee scheme

# Why smart metering did not work in NCP

| | Luotuocheng in Heihe | Guantao in NCP |
|---|---|---|
| Crop area per farmer (ha) | 0.8 | 0.08 |
| Average capacity of well ($m^3$/year) | 100’000 | 10’000 |
| Water fee (excluding electricity cost)<br><br>Calculated (($RMB/m^3$) Paid ($RMB/m^3$) | Starting from the first $m^3$ pumped<br><br>0.1<br>0.1 | Only for volume exceeding water right (within no water fee) 0.1<br>0 |
| Organization of smart metering | PPP<br>• Private partner invests for installation<br>• Part of fees going to private partner for maintenance and operation | Single investment by the state<br>• No funds for repair and maintenance<br>• Of 2000 meters installed by local water authority, only 6 were still working after 2 years |
| State of smart metering | Successful | Failure |

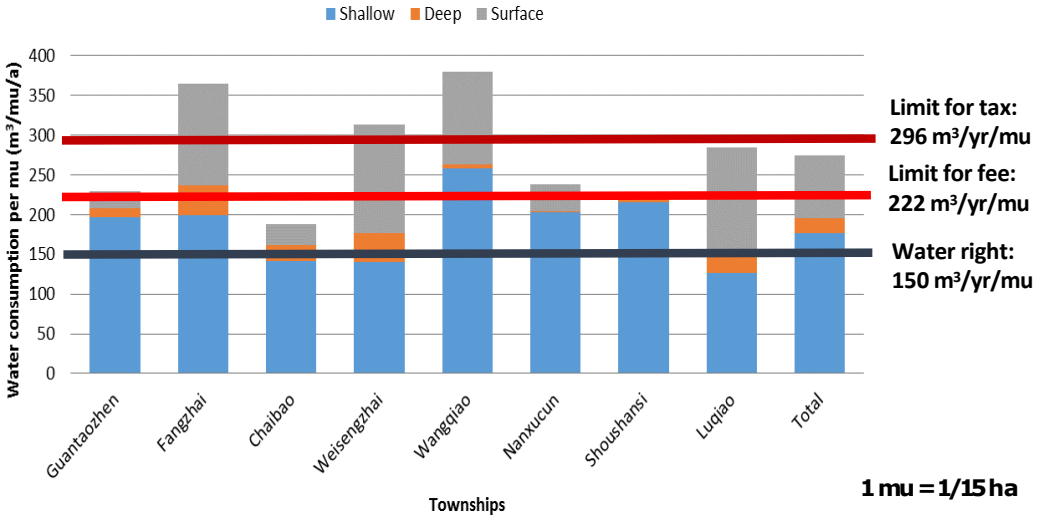
# Successful measure: Electricity meters for monitoring GW pumping in NCP

For the first time comprehensive data are available, allowing fee collection on the level of villages




Total irrigation water used by villages in Guantao

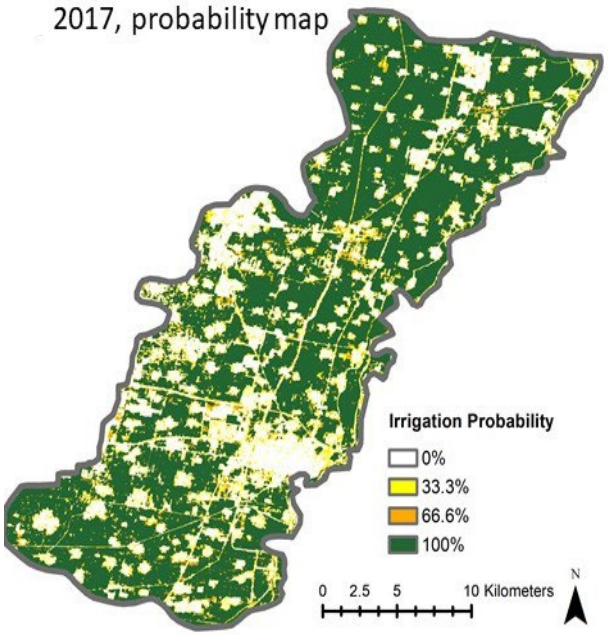
Conjunctive use of irrigation water per mu for different townships in Guantao




Without smart meter system, the human labor needed to collect water fee makes it an impossible task.

# Successful measure: Winter wheat Fallowing

- Subsidy for fallowing of winter wheat is generally welcomed by farmers as income from wheat is very low (often lower than subsidy).
- Fallowing can be monitored by remote sensing.
- Subsidy of 500 CNY/mu/season corresponds to about 2.5 CNY/$m^3$ of water saved (in comparison: subsidy for high-end water saving 2 CNY/$m^3$).
- Amount of subsidy available is the limiting element (4'000 ha in Guantao/ 100'000 ha in the whole of Hebei, water saved respectively 11/285 Mio. $m^3$/a).
- With decreasing population and food demand, reducing winter wheat planting by 10% in NCP can be foreseen in near future to reach GW balance.



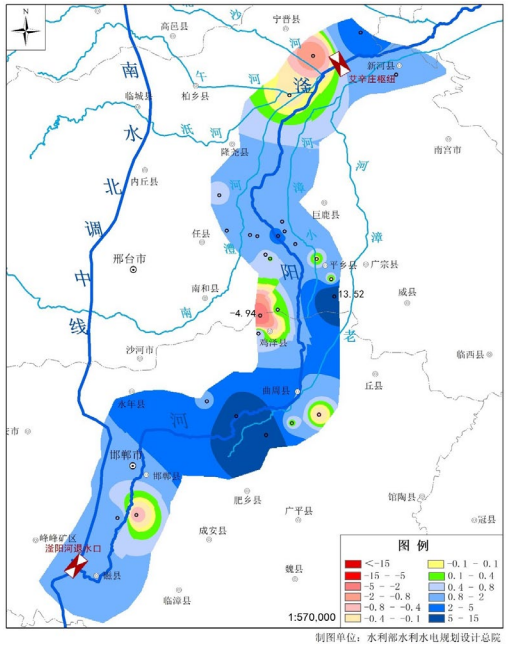

**1 mu = 1/15 ha = 0.03 acres**

# Successful measure: surface water import and managed aquifer recharge

Infiltration basins Guantao


- Net infiltration of lake of 35’900 m$^2$ area: 110’000 m$^3$ per filling.
- Low efficiency, but at point of use

Infiltration in riverbeds: Example Fuyang River



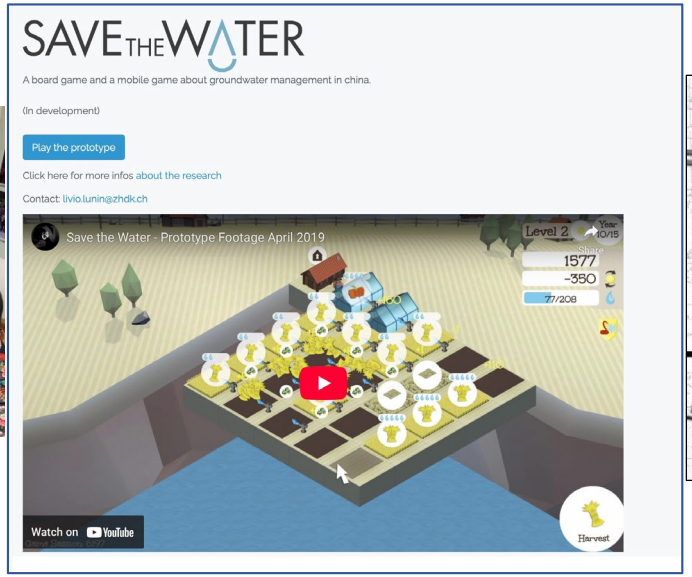

Source: MWR, 2019

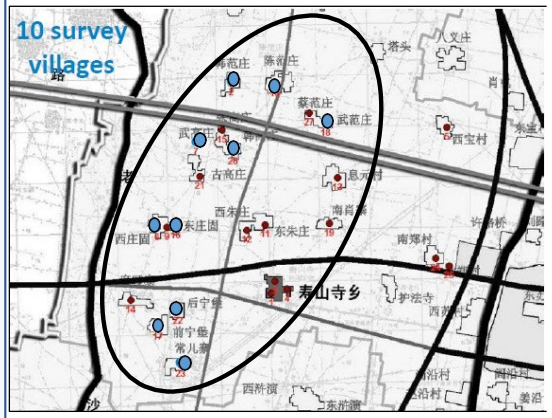
- Using water transferred from NSWT and upstream.
- High efficiency, but only in vicinity of river

# Farmers survey and GW game

https://savethewater-game.com

Board game




Farmer household surveys

# Acknowledgments

Support through the Swiss Agency for Development and Cooperation, the Chinese Ministry of Water Resources and the China Geological Survey is gratefully acknowledged.

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Chinese Ministry of Water Resources

China Geological Survey

More detailed results of the project are summarized in the open access book "Groundwater overexploitation in the North China Plain: A path to sustainability", Springer, 2021

https://link.springer.com/book/10.1007/978-981-16-5843-3

# Thank you

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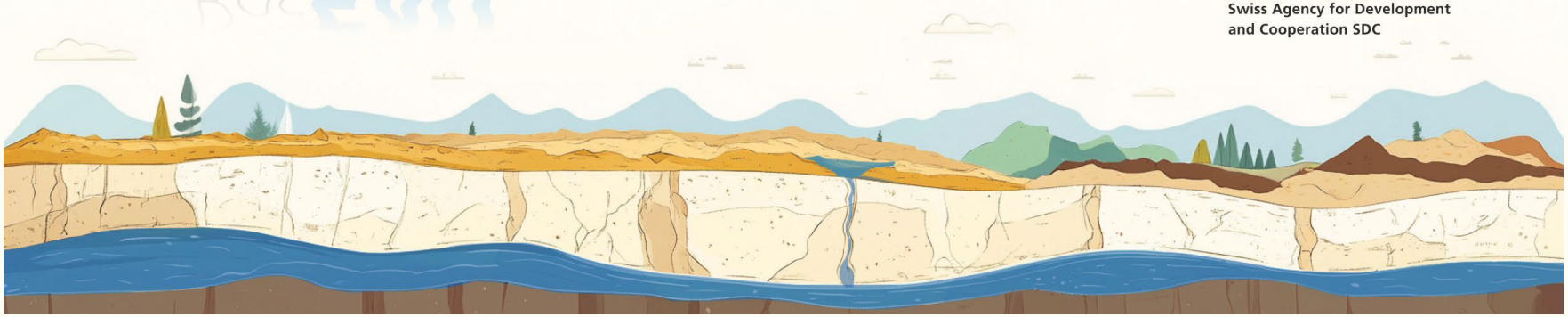
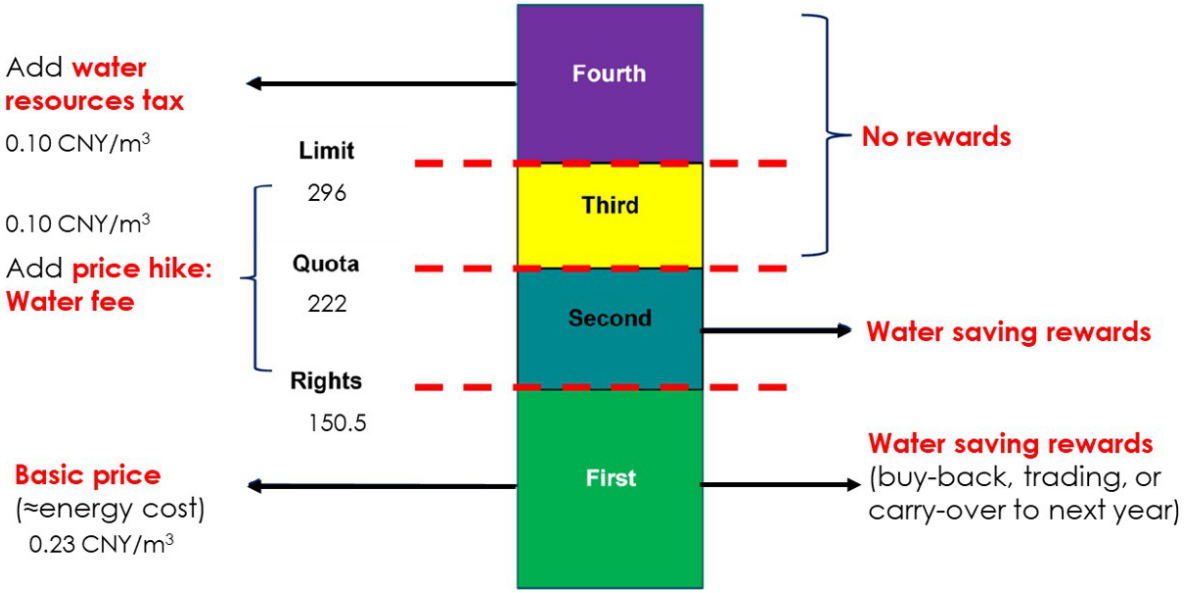


# Groundwater fees and tax design in Guantao

Tiered scheme for collecting groundwater fees




Fees only to be collected for volume exceeding basic water right. Water right was too high. Therefore, total fees were so small that they could not even pay the administrative effort of collecting them. Therefore, fees were not collected. Monitoring had only an informative effect, but no effect on consumption

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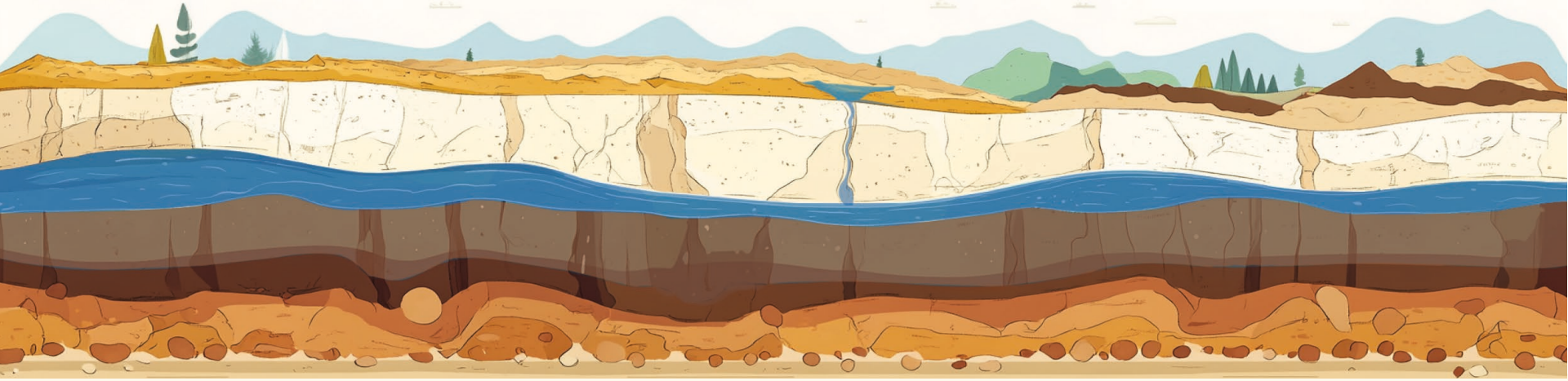

# Groundwater & Surface Water Interactions in Central Asia

Dr. Beatrice Marti (left), Partner, hydrosolutions GmbH
Dr. Tobias Siegfried (right), Partner, hydrosolutions GmbH

hydrosolutions

# The big picture

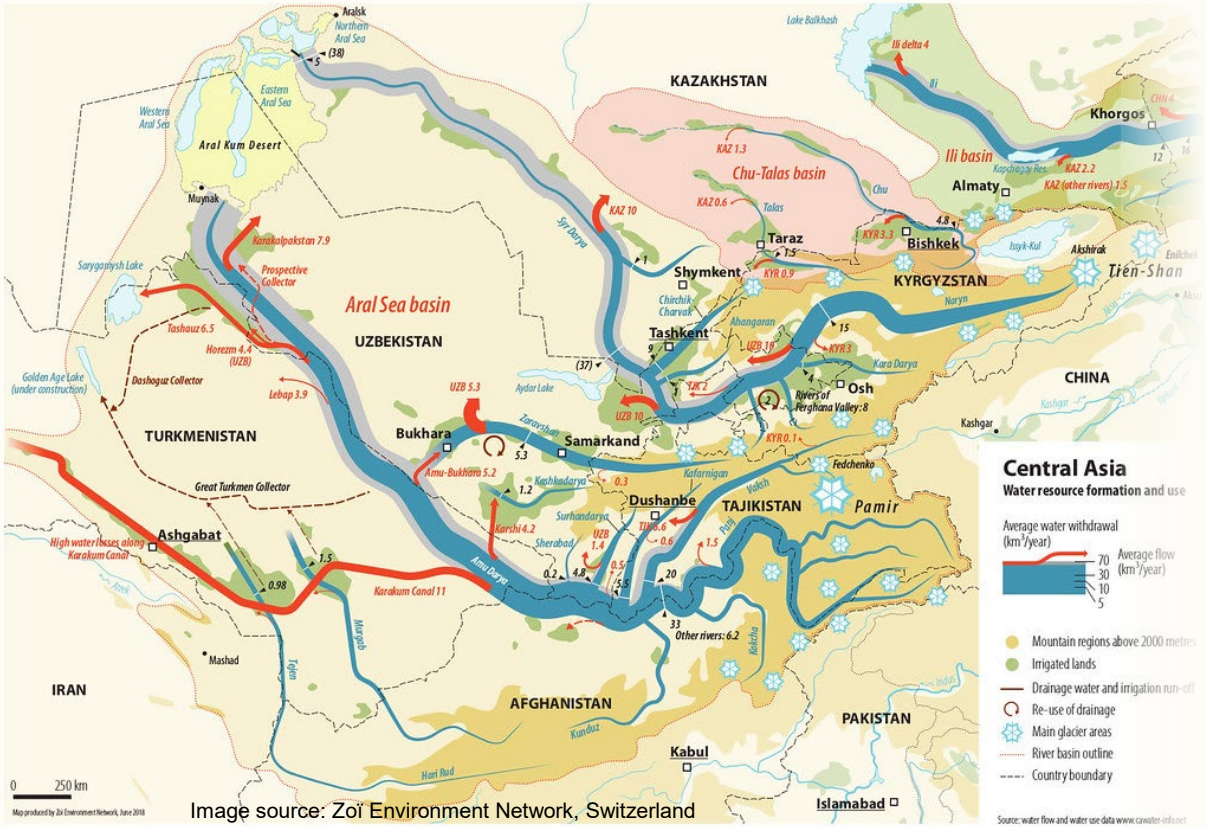

Image source: Zoï Environment Network, Switzerland


**Irrigation oasis**:

- **Hot spots** for **population** density & **GDP** production
- **Largest groundwater resources** along main rivers
- For **>60 mio people**, groundwater is **main drinking water source**

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# Plain aquifers
## Challenges & Opportunities

Formed by **meandering rivers**, **significant reservoirs** of up to hundreds of meters of thickness.

- **Freshwater lenses** in brackish groundwater
- **Massive** underground water **storage**
- Shallow groundwater tables (close to soil surface)

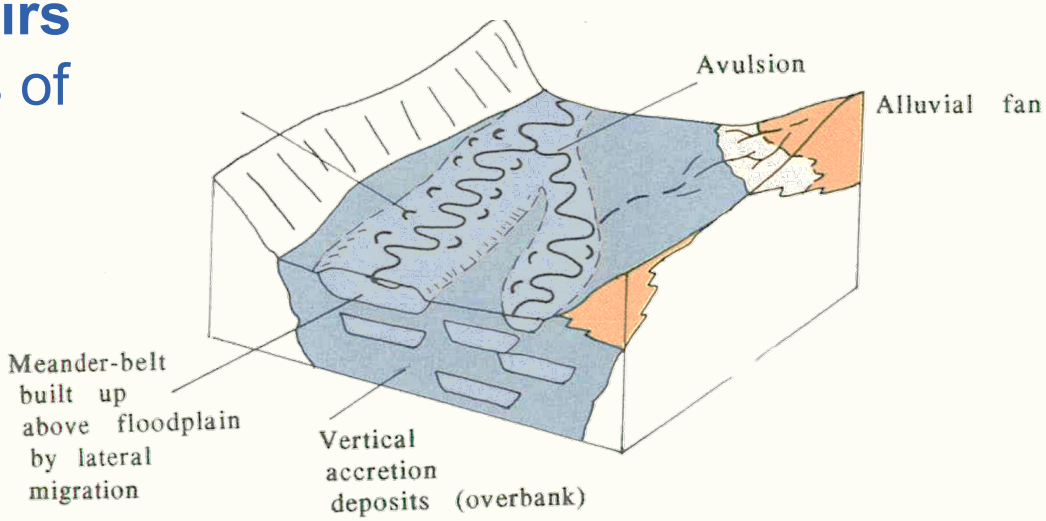
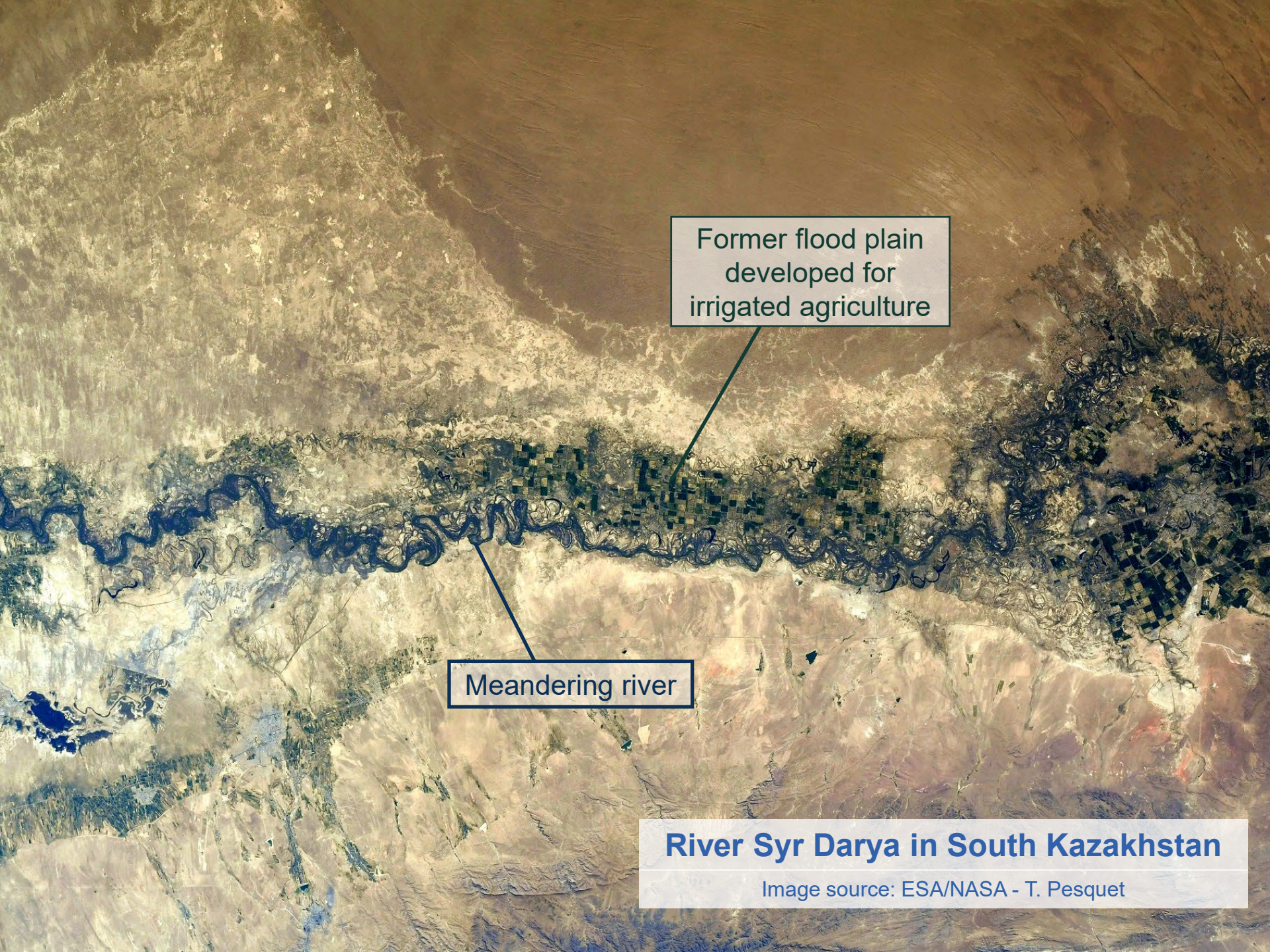



Image source: Mathers S and Zelasiewicz J., 1993.



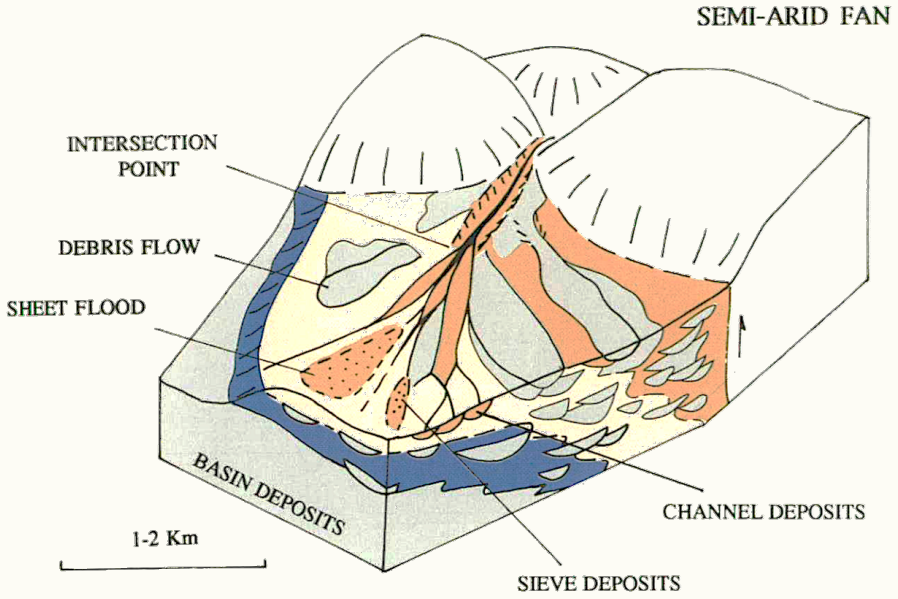

**River Syr Darya in South Kazakhstan**

Image source: ESA/NASA - T. Pesquet

# Fan aquifers
## Challenges & Opportunities

**Complex interlay of sediments** of various permeability (ability to conduct water)

- Deep groundwater tables at top of fans -> high pumping costs
- High infiltration capacity
  - High potential for aquifer recharge but not necessarily storage
  - High potential for aquifer pollution
- Shallow groundwater tables at bottom of fans -> **natural springs** and water logging
- Typical location for **Kariz** / **Qanat** (few left in Central Asia)

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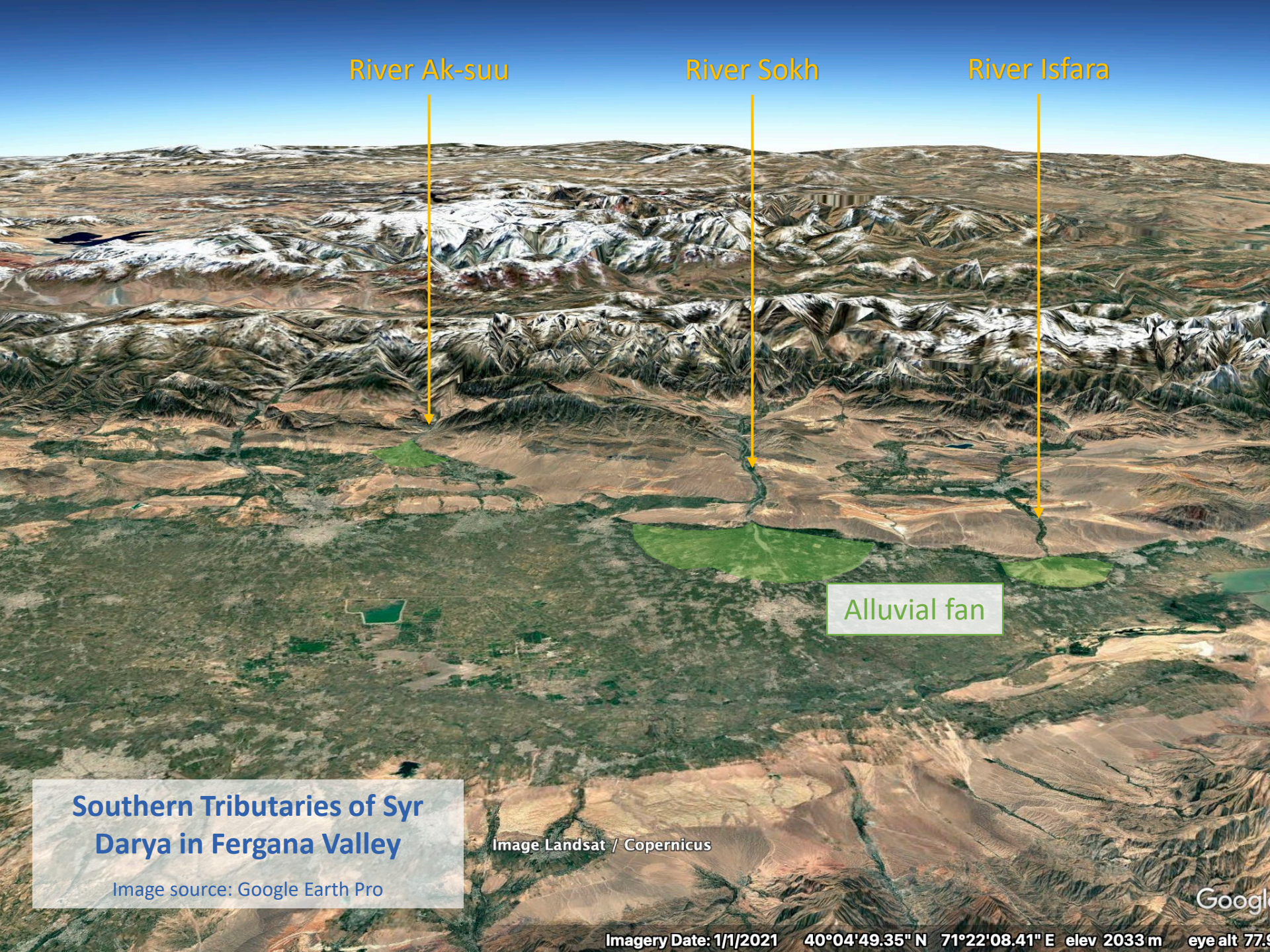



**Southern Tributaries of Syr Darya in Fergana Valley**

Image source: Google Earth Pro

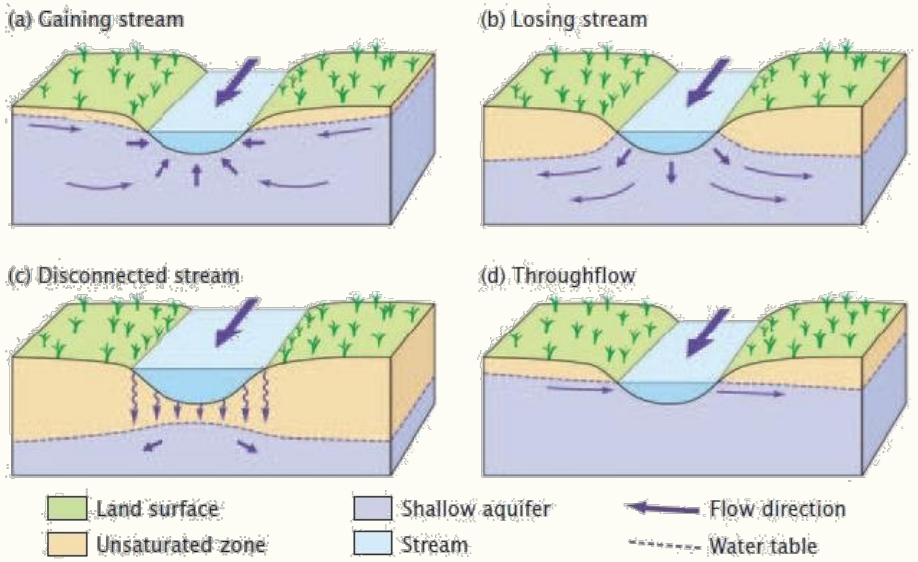
# Surface water – groundwater interactions

One single resource!

Hyporheic zone (region beneath and along a river where surface water and groundwater mix)

- Biogeochemically highly active
- Water **quality** improvements, hydrological **regulation**, **ecological** benefits

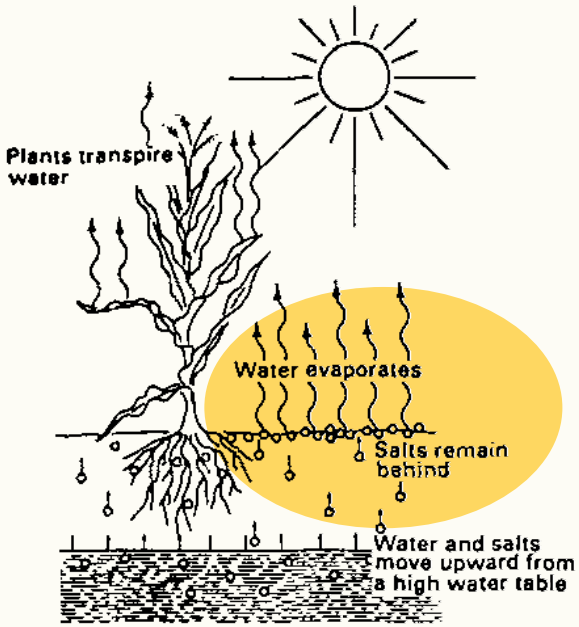
Applies to irrigation & drainage canals!




Sources: Winter et al. 1998, Ground Water and Surface Water – A Single Resource;

# Irrigation & groundwater in semi-arid irrigation oasis

- Conjunctive use is not new!
- Challenge: **Salinization**
  - High evaporation rates
  - In downstream: Reuse of drainage water

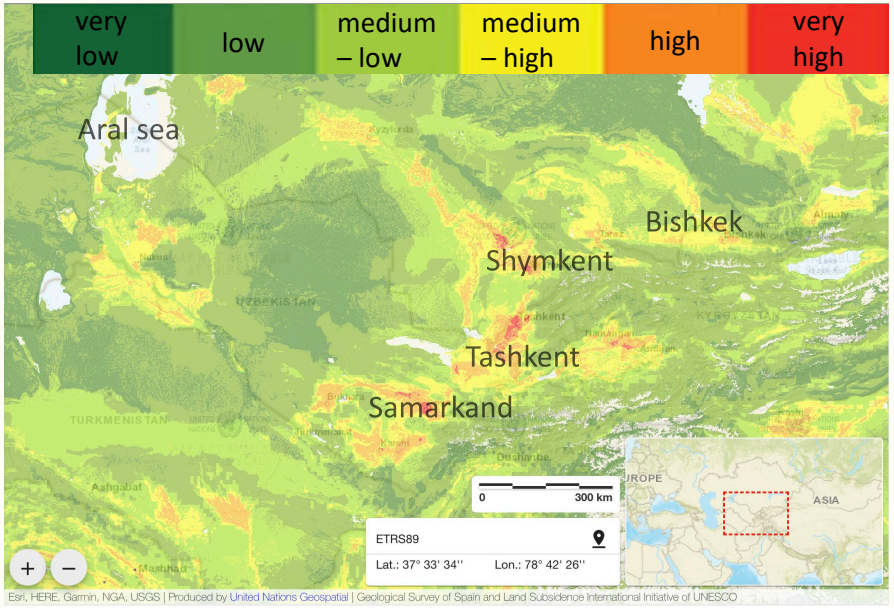



Source: Introduction to Irrigation, 1985, FAO (https://www.fao.org/4/r4082e/r4082e00.htm#Contents)

# Irrigation & groundwater in semi-arid irrigation oasis

- Conjunctive use is not new!
- Challenge: **Salinization**
  - High evaporation rates
  - In downstream: Reuse of drainage water
- Impact on groundwater
  - **Salt accumulation** in shallow groundwater
  - **Over-extraction** of deep groundwater
  - **Land subsidence**

Risk of subsidence




Map by Herrera-Garcia et al. 2021 (Science). https://www.landsubsidence-unesco.org/maps/

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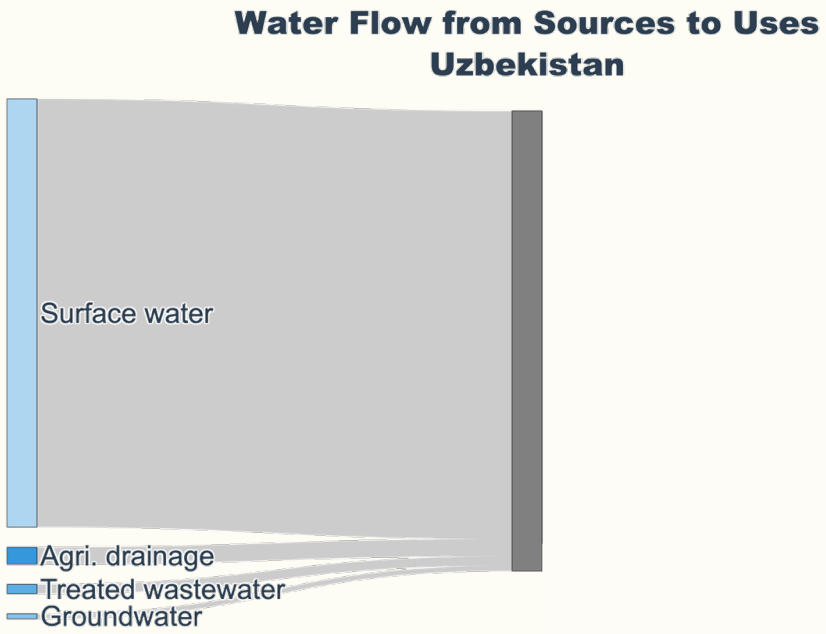
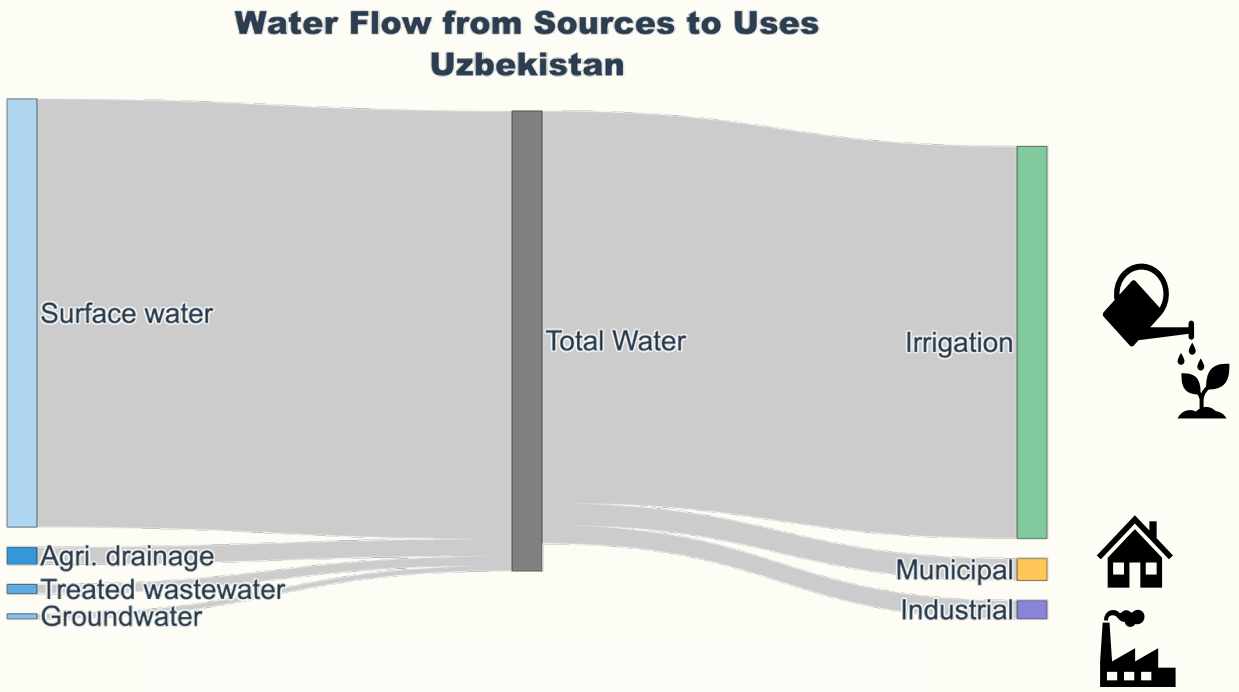
# How much groundwater is used?



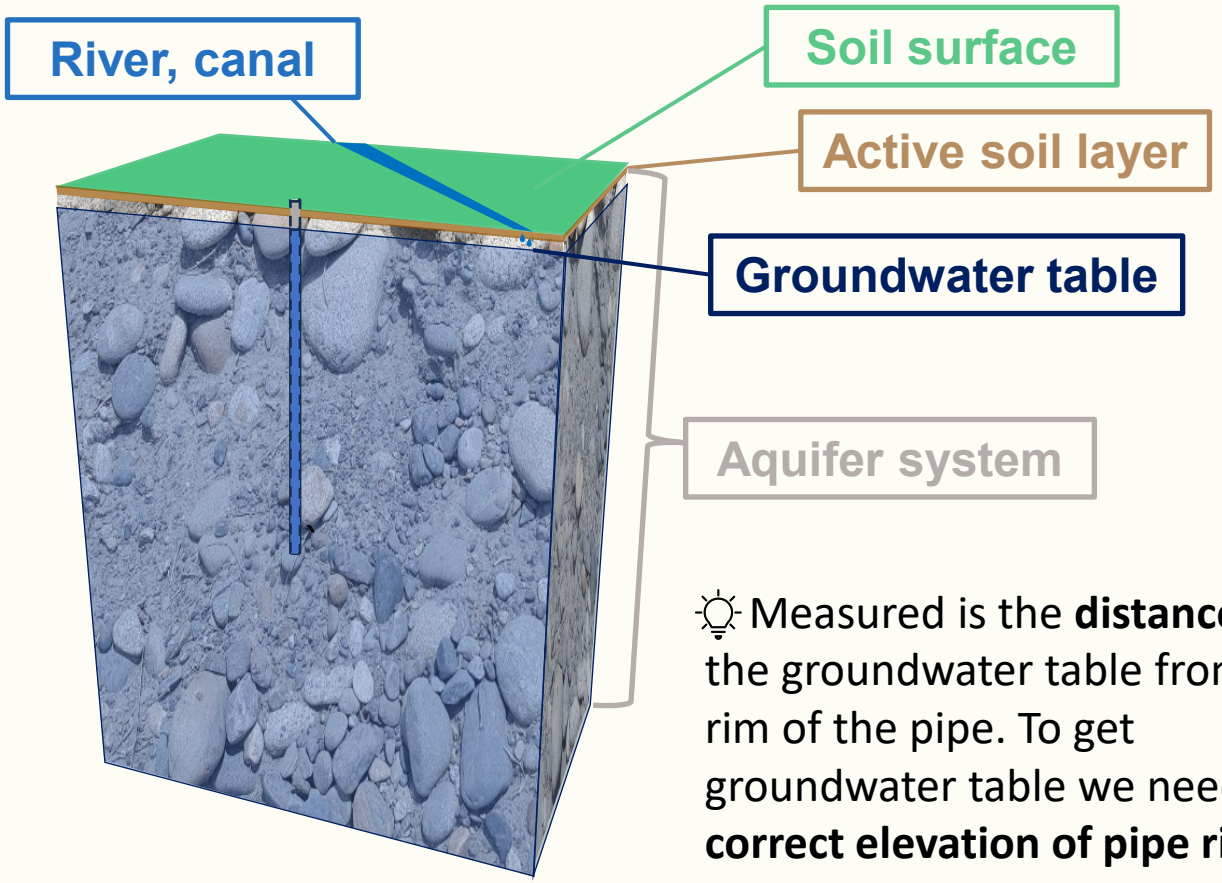

Data source: FAO AQUASTAT, data for 2021, accessed February 8, 2025.

# Where is the water used?



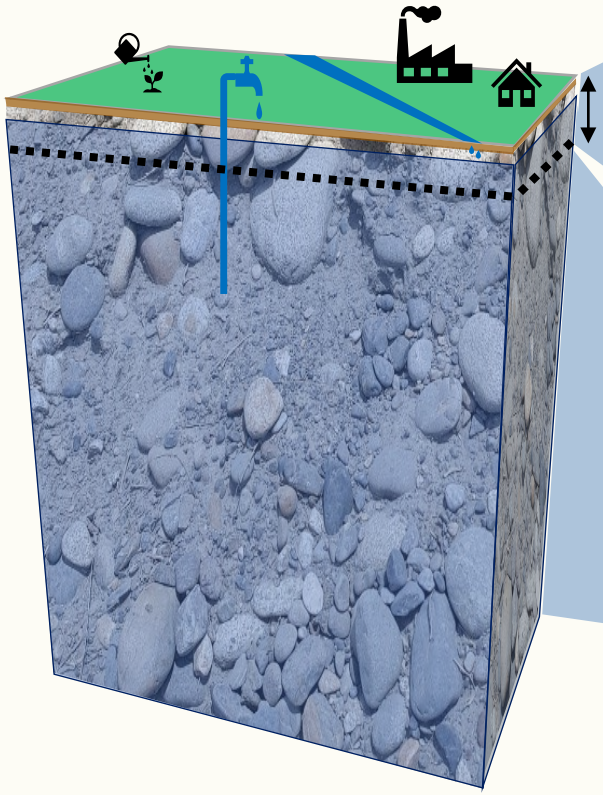

Data source: FAO AQUASTAT, data for 2021, accessed February 8, 2025.

# Peek into the underground




Measured is the **distance** of the groundwater table from the rim of the pipe. To get groundwater table we need **correct elevation of pipe rim**.

# Legacy-based separation of shallow and deep groundwater




Hydrogeological **amelioration** (improvement of soil conditions for agriculture)

**"Ministry of Water Resources"**

**Strategic** resource for fresh water

**"Ministry of Geology"**

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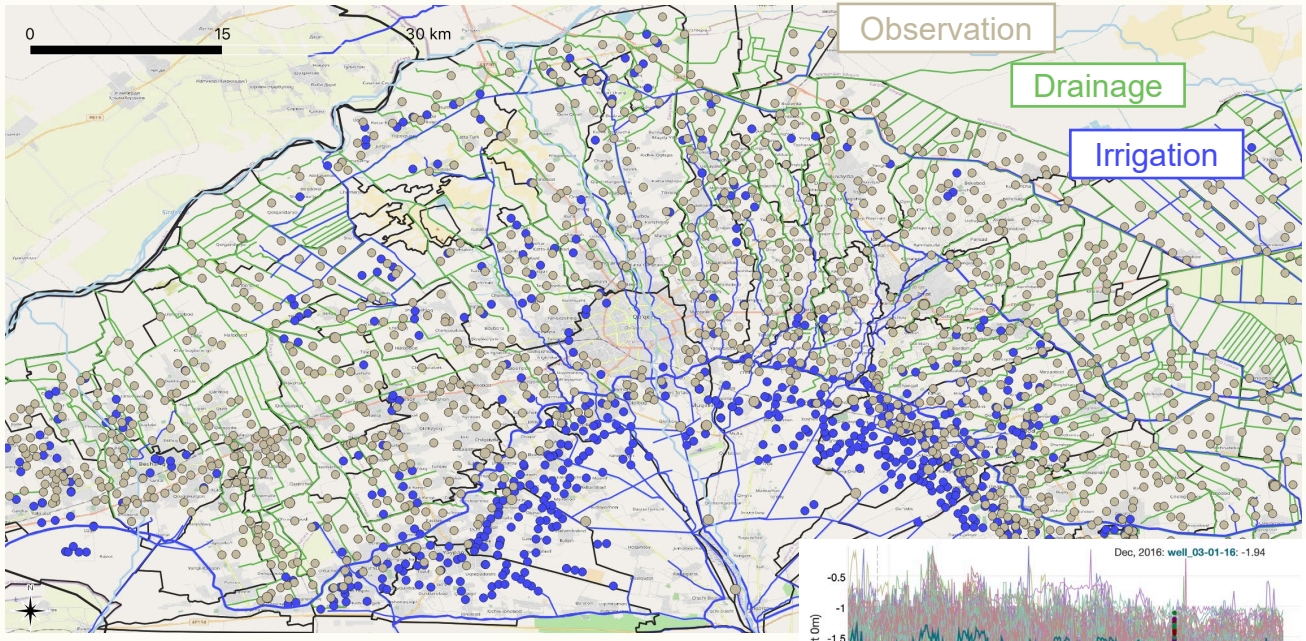
# Building on existing resources

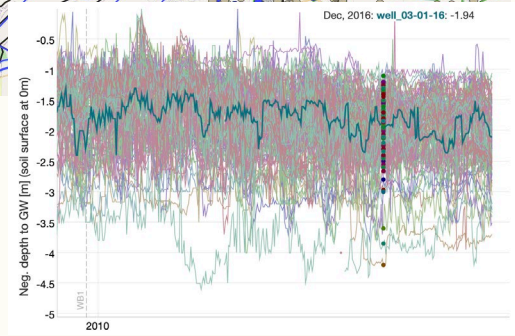
Use **smart** technologies

- **Water balancing**
- Forecasting
- Impact & risk assessments


Groundwater management circle
Adapted from Kinzelbach et al., 2022




Data source: BISA Fergana, UzHydroEnGeo

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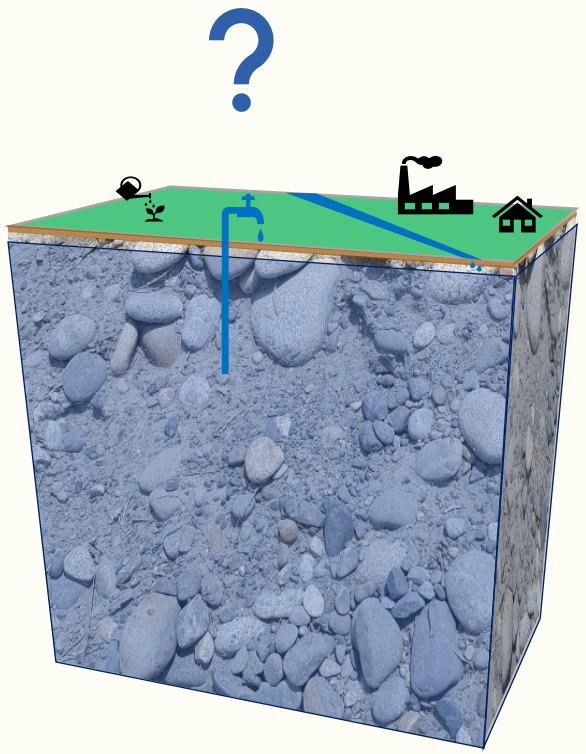
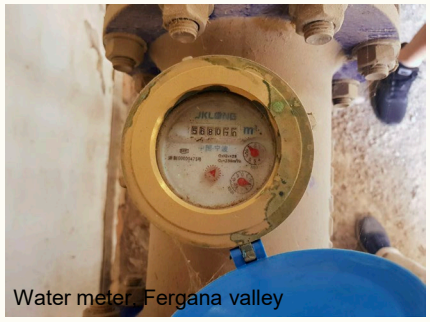
# Monitoring abstractions

- Groundwater abstractions are notoriously **difficult to monitor & regulate**
  - Access to wells
  - Costs for meters
  - Vandalism



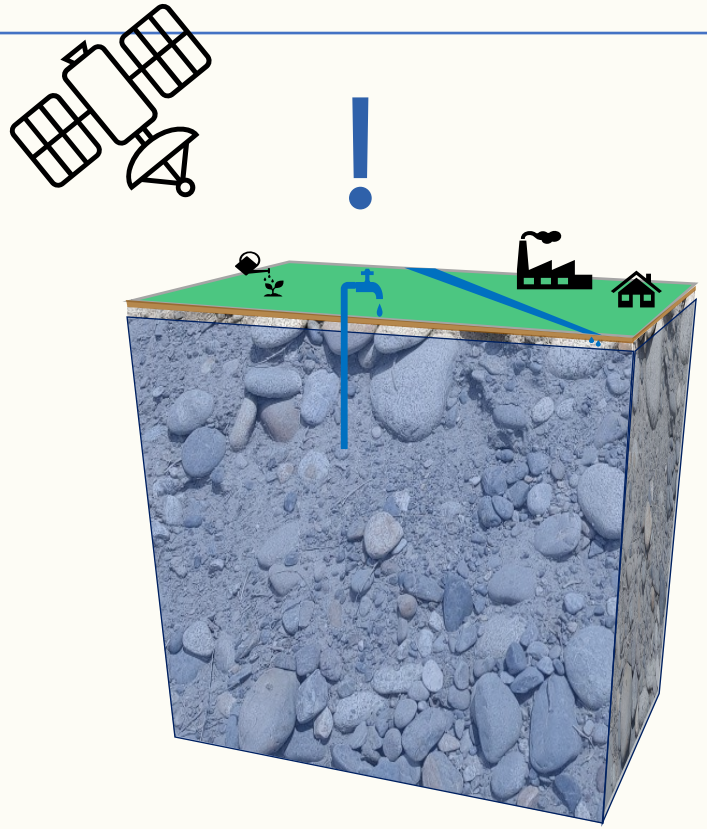


Water meter, Fergana valley



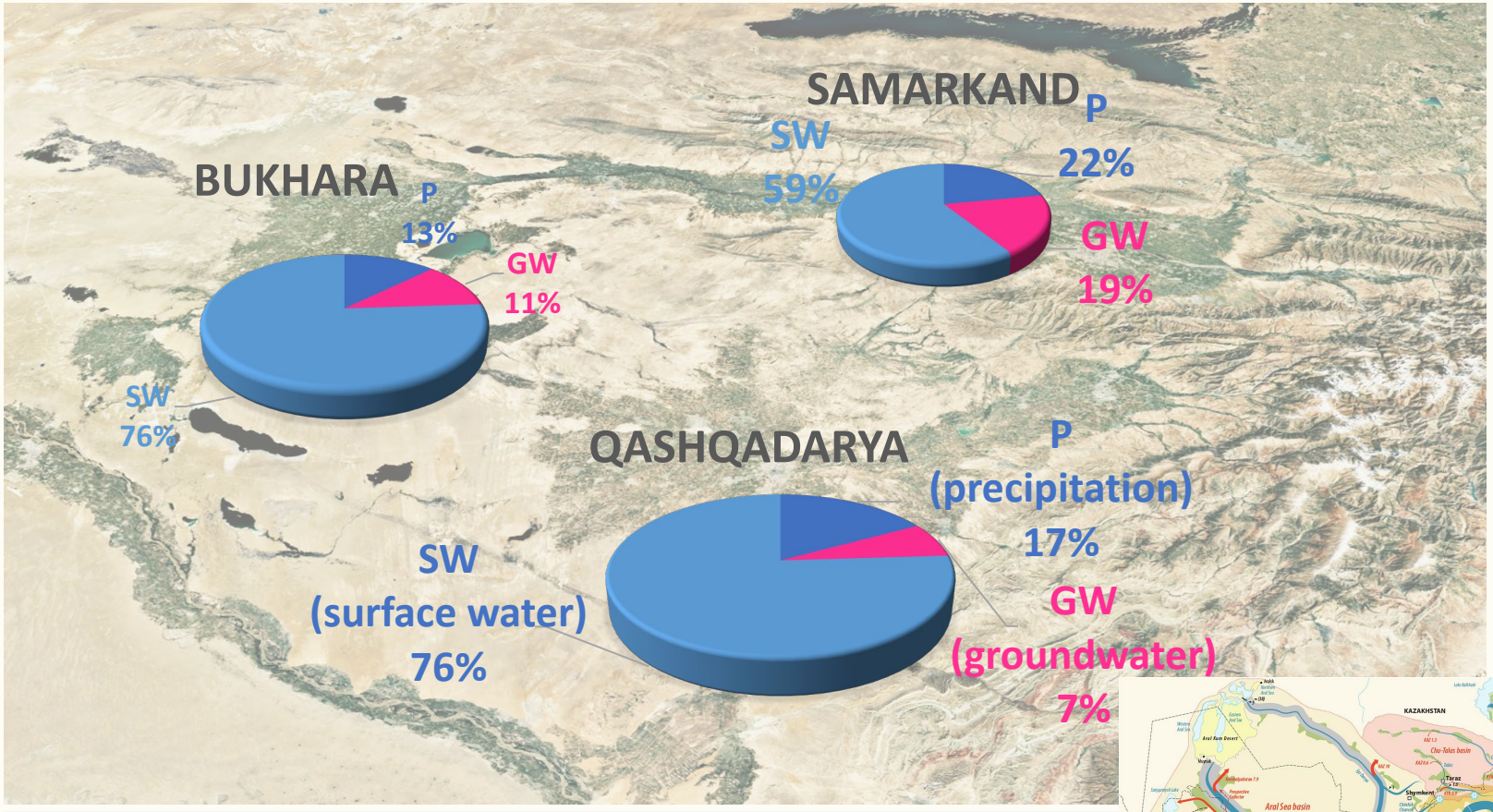
Pumping wells in North China Plain

# Monitoring abstractions

- Groundwater abstractions are notoriously difficult to monitor & regulate
- **Use complementary**, publicly available **data** types, e.g. **remote sensing** data
- Regionally **consistent**, **scalable** monitoring at **monthly scale**



# Agricultural Water Supplies




# Thank you

Any questions, discussion points:
please contact me at

marti@hydrosolutions.ch

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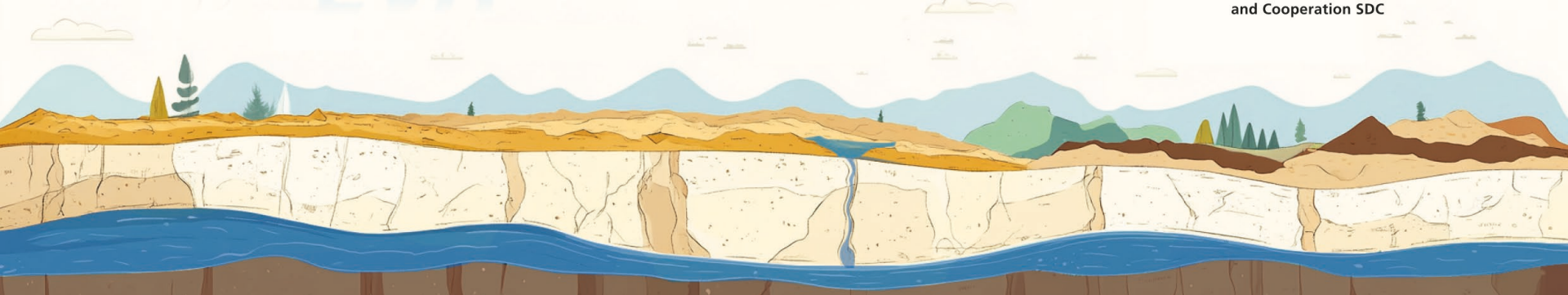

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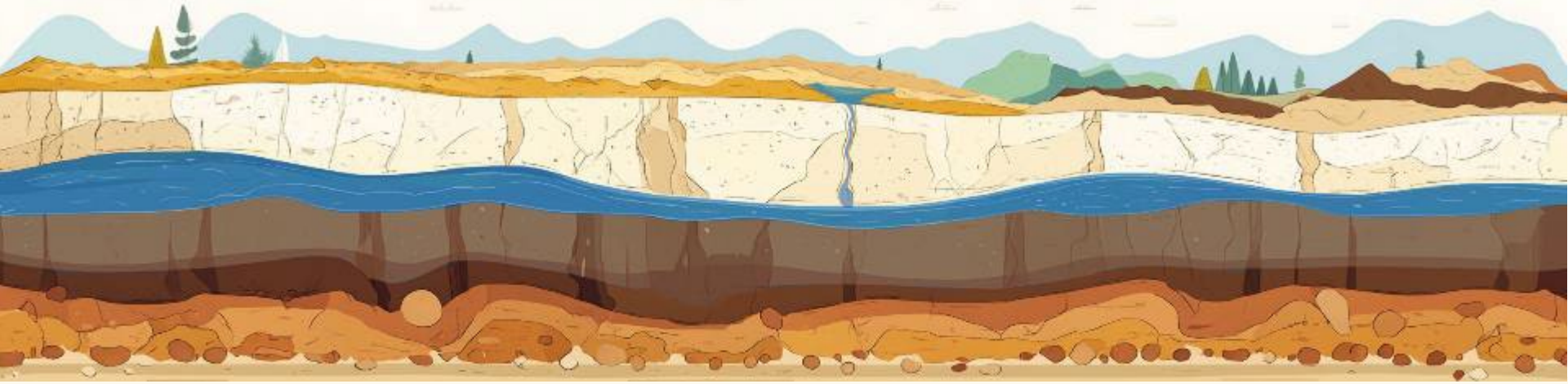


# Groundwater Management Project in the Tajik Syr Darya River Basin - Approaches to Groundwater Governance and Conjunctive Water Management

Implemented by:

HELVETAS Swiss Intercooperation

Switzerland

Implemented in partnership with:

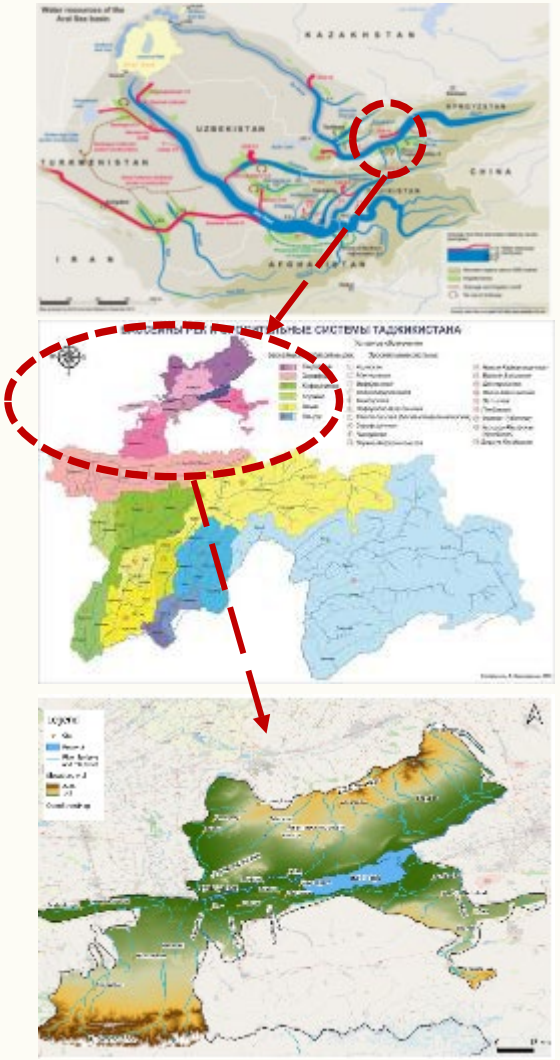
IGRAC

IHE DELFT Institute for Water Education

Marian Szymanovicz & Thijs van der Velden
HELVETAS Swiss Intercooperation

# Project description

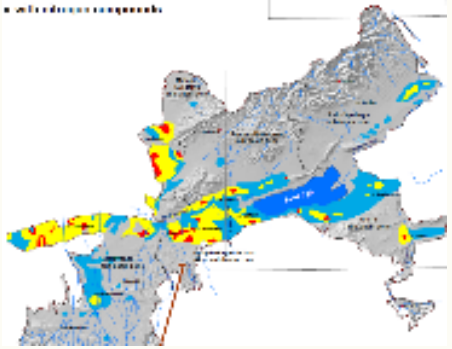
| Project name | Groundwater Management in Sughd, Tajikistan |
|---|---|
| **Donor** | Swiss Government / Swiss Cooperation Office |
| **Phase 1** | 2025-2028 |
| **Budget** | 4,877,190 CHF |
| **Implementing agency** | Helvetas Swiss Intercoopertation |
| **Main implementing partners** | IGRAC and IHE Delft |
| **Primary national partners** | MEWR, MDG, CEP |
| **Project area** | Sughd Oblast, Tajik Syr Darya Basin Zone |
| **Pilot aquifers** | Kamishkurgan and Nau-Ispisar |
| **Beneficiaries** | Population of Sughd Oblast |




**2024 Inception phase:** Stakeholder engagement, Assessments
**February 2025:** Validation of Project document, Pilot aquifers

## Background – Sughd region

- 90% of water used in irrigation, obsolete systems operate only partially, shortage of surface water. The situation is aggravated by impacts of climate change
- Farmers increasingly use groundwater to compensate for the lack of surface irrigation water.
- No effective regulation and unplanned use causes groundwater depletion, and extensive use of fertilisers in agriculture pollutes groundwater.

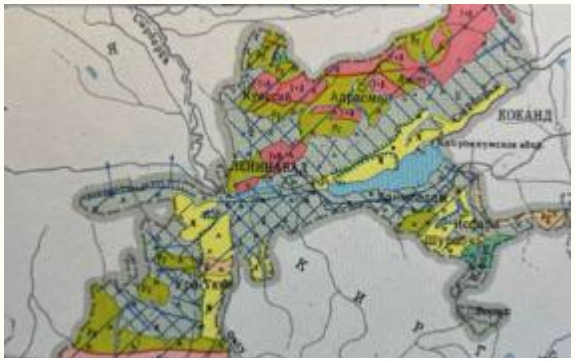


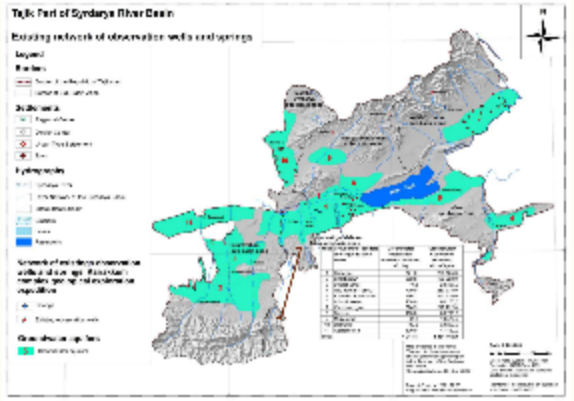
## Background - Context

- Water Sector Reform Program 2015-2025 introducing basin management and IWRM.
  - River Basin Organisations & River Basin Councils
  - River Basin Management Plans
- The recently adopted National Water Strategy up to 2040, calls for improved groundwater monitoring and study of groundwater reserves.
- Despite the progress in reforming the water sector, water governance is still a relatively new concept.

## Background - Challenges

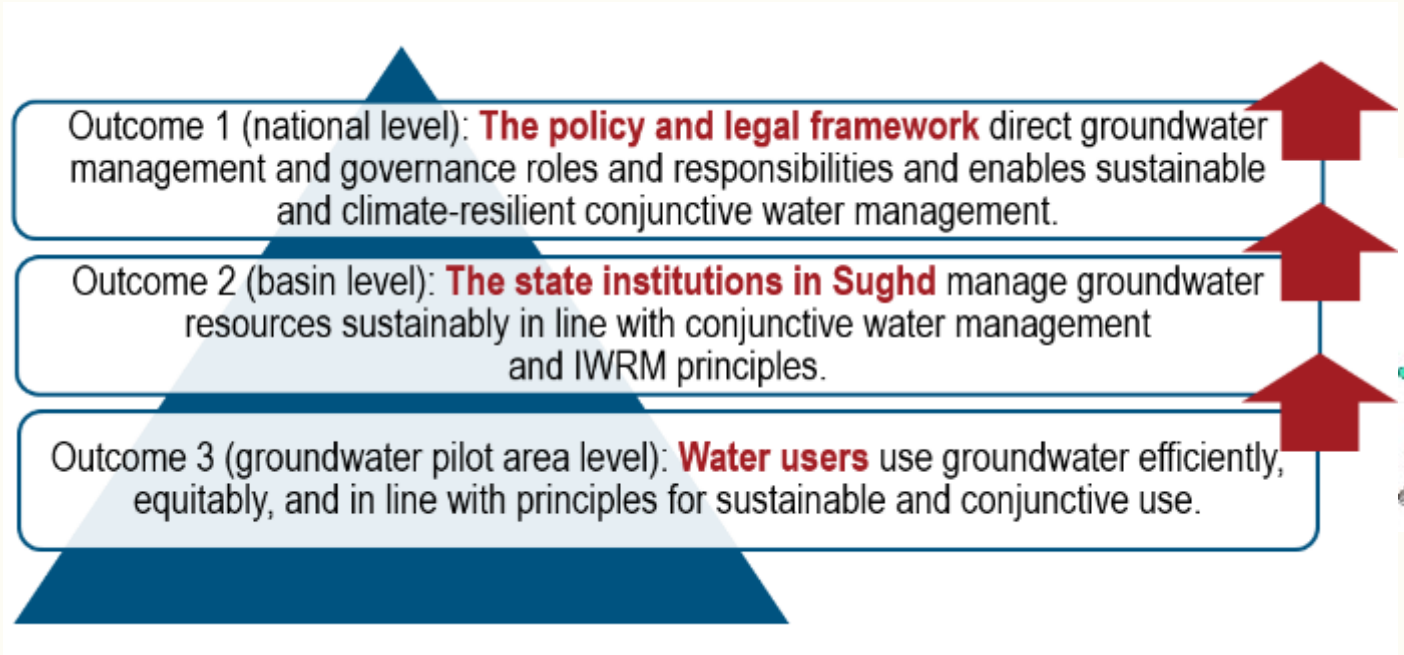
- Responsibilities for GW are scattered and institutions operate with little coordination, and with limited exchange of data
- Poor GW knowledge base, outdated information, and groundwater monitoring network shrinking
  - 3 out of 11 aquifers monitored in Tajik Syr Darya Basin Zone
- Proliferation of unregistered wells hampering control of groundwater abstraction
  - Est 4,000-6,000 wells in TSDBZ
- Local socio-economic development programs not coordinated with basin management plan
- Groundwater education/curriculum outdated
- Awareness about groundwater governance and management is weak
- Lack of prioritization and investment

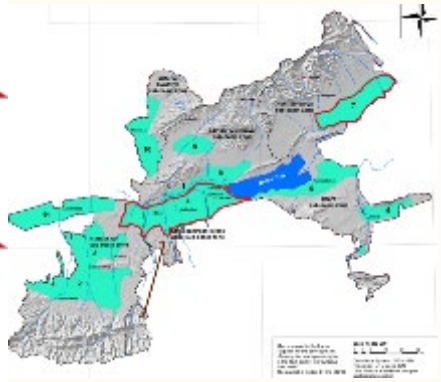




# Project Objectives & Intervention Strategy

National and sub-national state institutions ensure sustainable and equitable use of groundwater resources while safeguarding the health of their ecosystems and enhancing climate resilience through **conjunctive water management and participatory governance** in the Tajik Syr Darya Basin Zone.

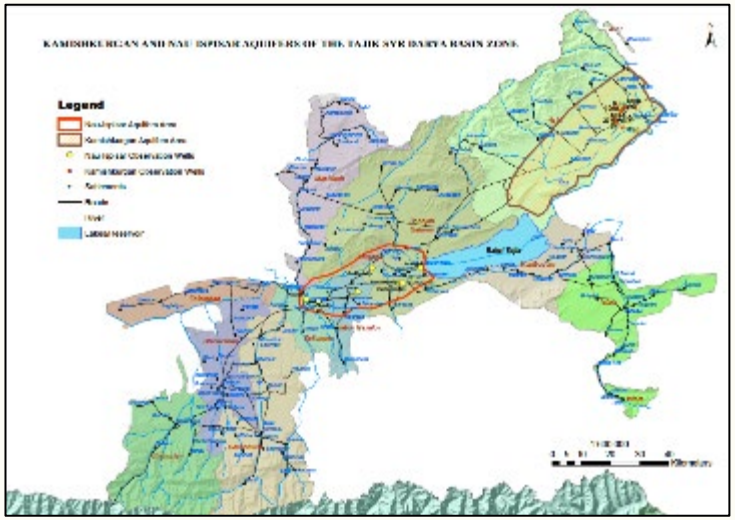


**Pilot aquifer projects**

# Aquifer/local level

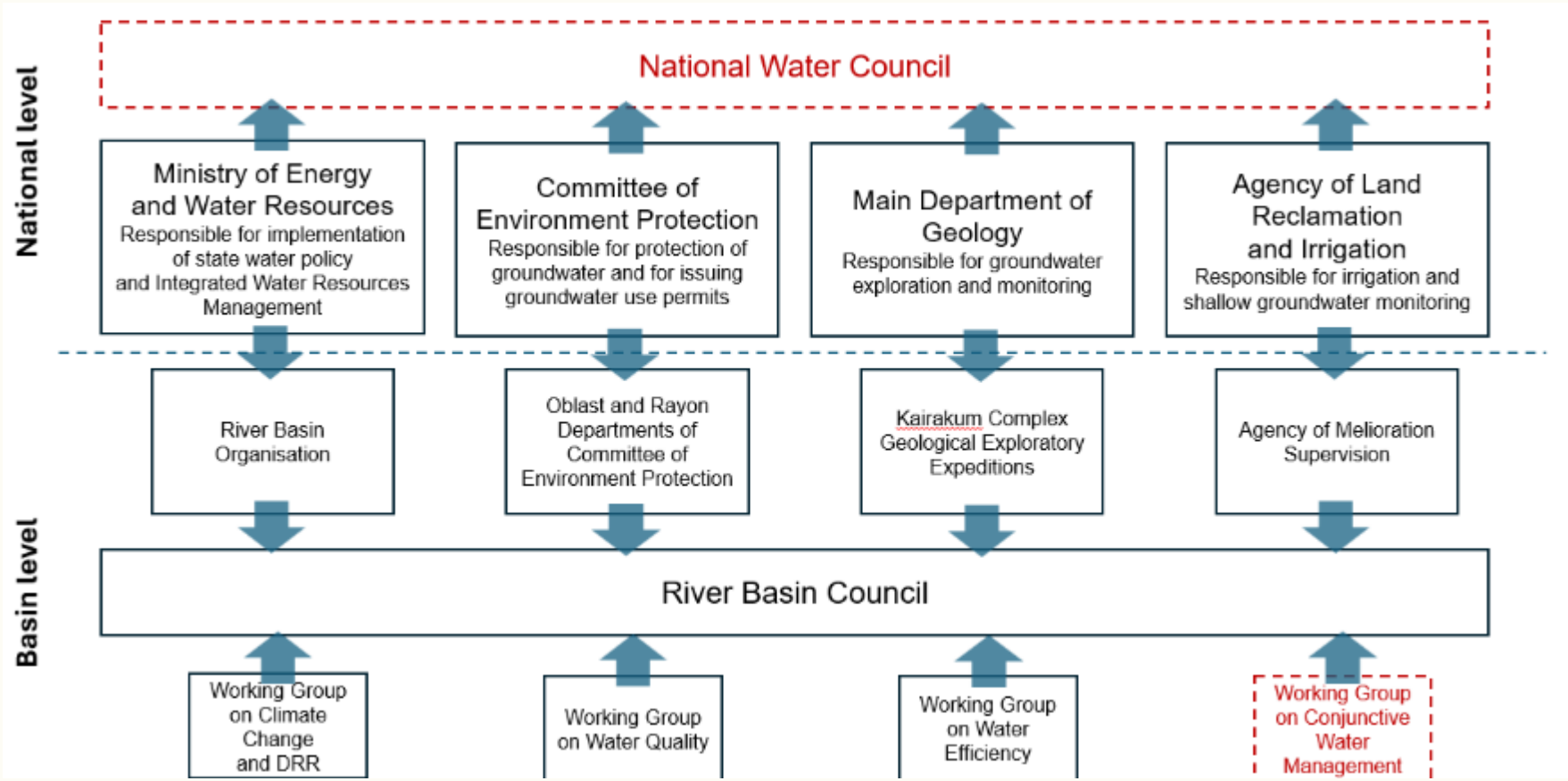
- Start interventions in two selected pilot aquifers/groundwater deposits and subsequently replicate in other locations.
  - Hydrogeological studies
  - Improve groundwater monitoring system
  - Digitalization of existing basin groundwater data
  - Support National Groundwater Management Information System (as part of National Water Information System)
  - Promoting data sharing with all groundwater management institutions.
  - Bring best international practice and adapt to local conditions by local implementing partners



# Basin level

- Awareness raising campaign on groundwater management issues and initiate dialogue on basin groundwater management plan.
- Create Working Group on Conjunctive Water Management within framework of the TSDBZ River Basin Council
  - serving as platform for debate
  - participatory process of developing the Basin Groundwater Management Plan as part of the River Basin Management Plan.
- The local and basin experience in groundwater management and governance will be the basis to initiate the national policy dialogue on groundwater management and governance.

# Groundwater governance framework



# National level

- Establish national policy dialogue on GW management and governance leading to common vision that will guide the clarification of roles and responsibilities of groundwater management institutions.
  - studies of best international practices
  - analysis of the current Tajikistan legal and institutional framework.
  - A starting point analysis of the groundwater permitting system.
- Strengthened groundwater education for sustainability of GW sector development.
  - Developing knowledge-sharing partnerships Tajik - international institutes.
  - Update of groundwater curriculum of academic and training institutes.
- Enhancing transboundary groundwater cooperation.
  - As an entry point, international best practices in transboundary groundwater cooperation will be presented with recommendations for Tajikistan.
  - Good transboundary cooperation with Uzbekistan offers a window of opportunity.
  - Leverage recent Tajikistan-Kyrgyzstan transboundary water dialogue for GW cooperation

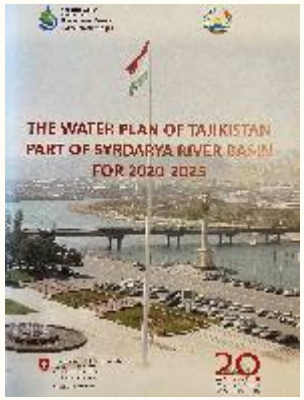
# Approach to conjunctive water management

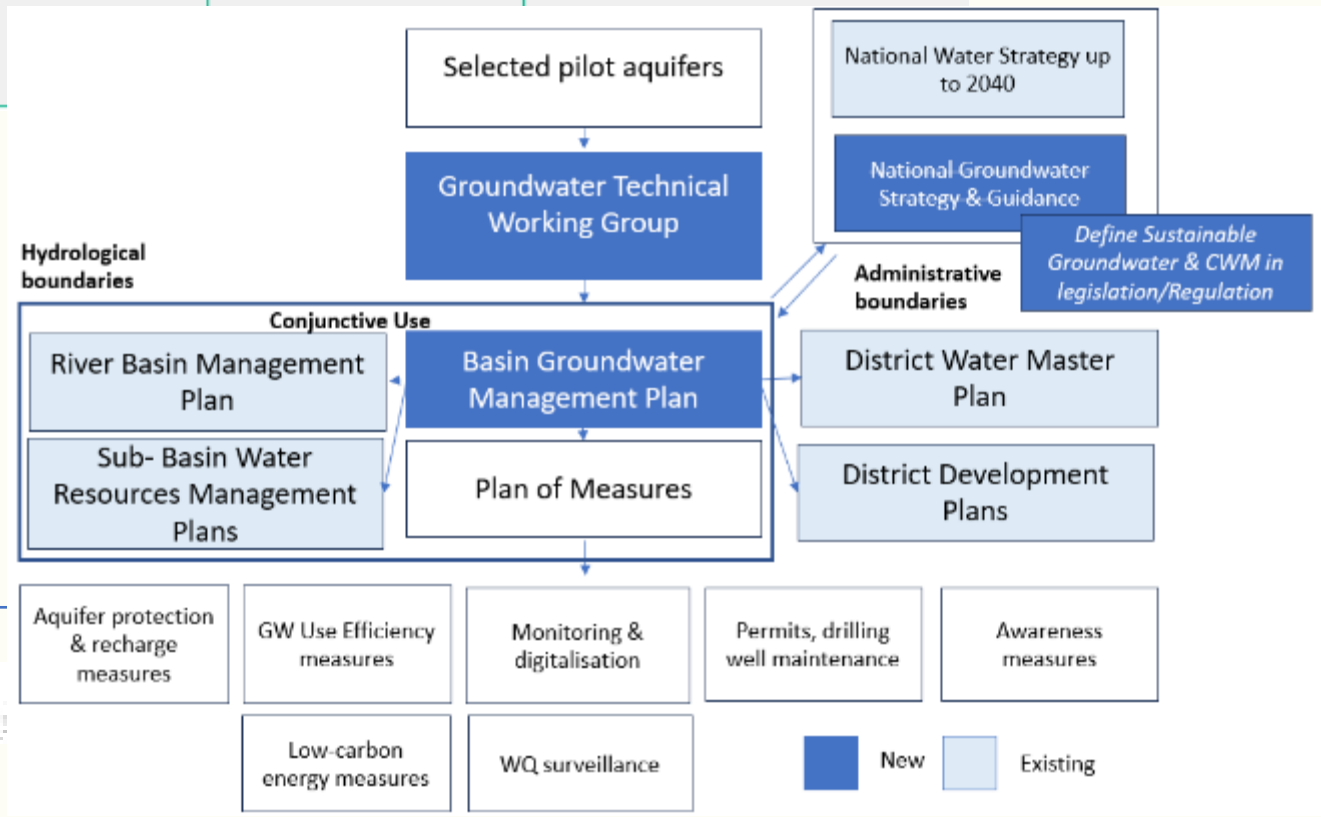
- **GWMP integration**: CWM concept fully aligning with the IWRM principles (sub-set of actions/activities/techniques)
- **GWMP context**: transformation of the opportunistic (spontaneous) use of groundwater into a more planned and complementary management in coordination with surface water, therefore leading to more sustainable management of aquifers.
- Key aspects of CWM **prioritized in Phase I** of the project:
  - hydrogeology should be fully understood in quantitative terms
  - institutions adopt science-based understanding of water resources
  - guidelines for water use permits, extraction limits, and abstractions.
  - water users are capacitated and appreciative of the need to adopt new methods of water use
- Linking to basin approach: hydrology, demand, planning, cost recovery

GWMP context: transformation of the opportunistic (spontaneous) use of groundwater into a more planned and complementary management in coordination with surface water, therefore leading to more sustainable management of aquifers.

# Conjunctive management – Interventions

| At area-wide planning level | Activities and techniques at the level of implementation in the field | | |
|---|---|---|---|
| **Incorporating all water components** | **Optimal selection of source of supply** | **Resource augmentation** | **Environmental control** |
| ▪ Exploring and analysing hydraulic connectivities and exchanges of water<br>▪ Preventing 'double counting'<br>▪ Identifying promising opportunities<br>▪ Identifying hazards of harmful interaction | ▪ Conjunctive use of surface water and groundwater | ▪ Managed aquifer recharge (MAR)<br>▪ Watershed management | ▪ Water level control in polder / low-low-lying and reclaimed areas<br>▪ Restricting groundwater pumping to control surface water environmental flows |

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# Learning from/informing global (best) practice

- 2025: Start of pilot aquifer projects
- Long-term engagement
- Regional/transboundary GW dimension to be explored
- Connect TJ GW sector to global community of practice

# Thank you!


Contact:

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Thijs.vandervelden@helvetas.org


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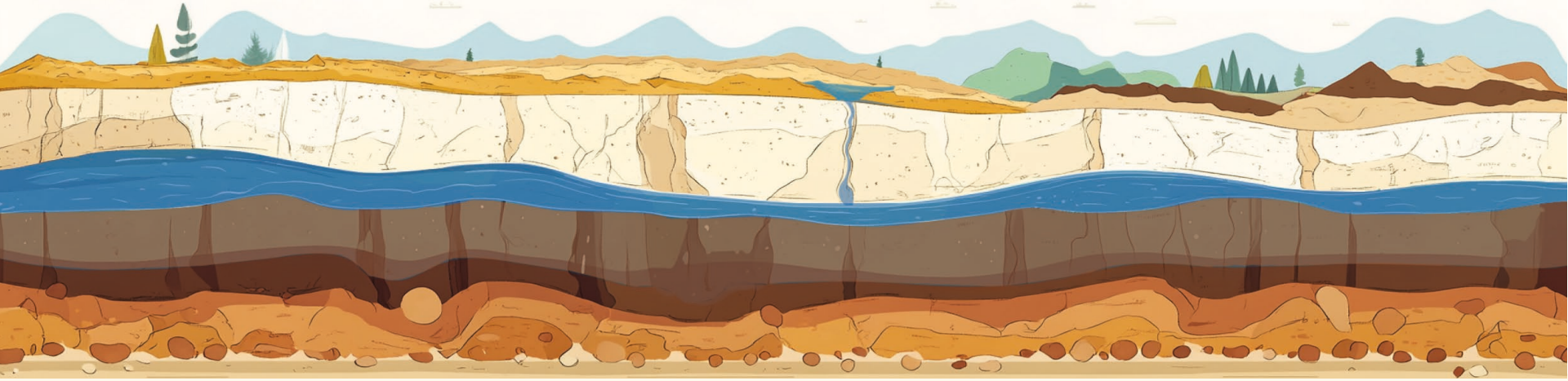
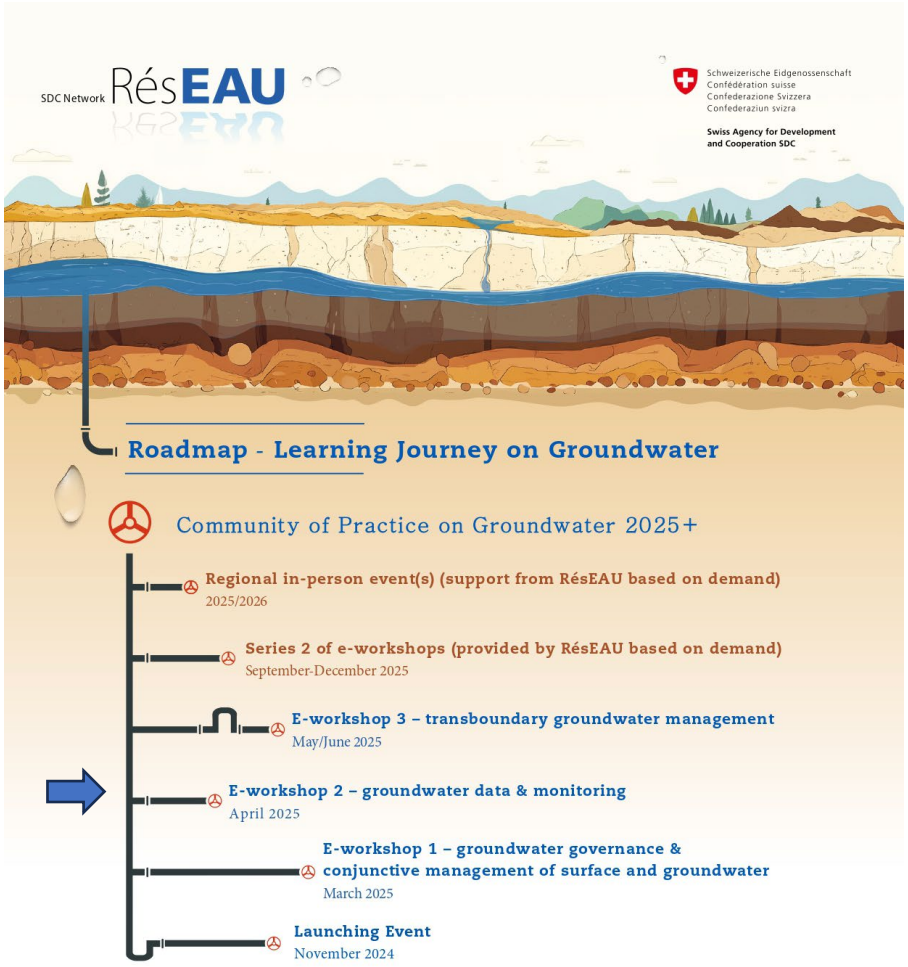


# Concluding words

Dr. Daniel Maselli, Senior Policy Advisor for Water & Focal Point water network ‘RésEAU’, Swiss Agency for Development and Cooperation (SDC)

# Up next

**13 May 2025, Groundwater Data and Monitoring**



# Thank you

For follow-up questions about this webinar, please contact frank.wiederkehr@skat.ch

Don‘t forget to join the RésEAU community to stay up to date about this Learning Journey and other news & activities: https://dgroups.org/sdc/reseau

This event has been recorded and will be made available on https://www.sdc-water.ch/

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