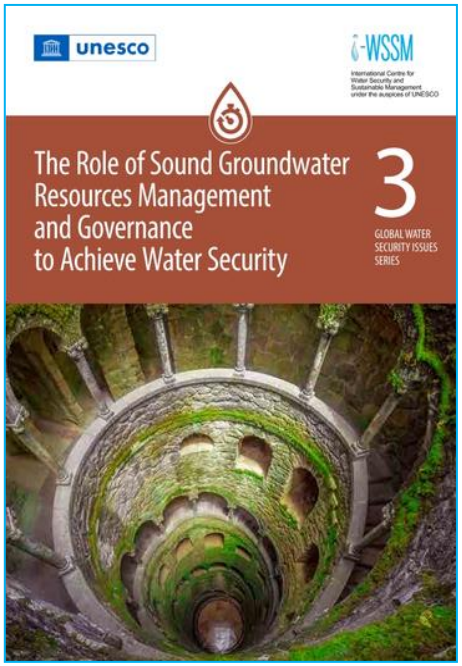
Co-managed Aquifer Recharge (CO-MAR): Evolution of the concept due to Spanish and Peruvian stakeholders´ participation



https://unesdoc.unesco.org/ark:/48223/pf0000379093

Introduction. Co-MAR key concepts

What is Co-MAR?

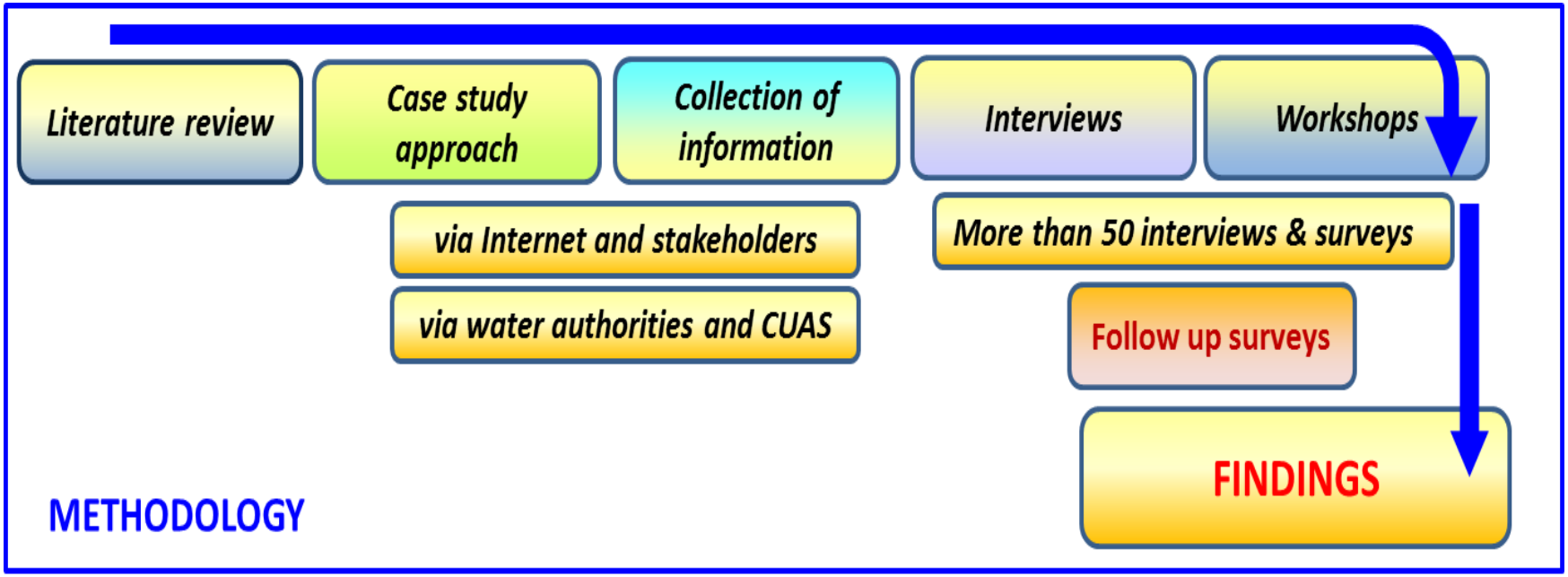
The term co-managed aquifer recharge (Co-MAR) is an innovative ***procedure that includes stakeholders in decision making on aquifer recharge, thus helping to implement IWRM. Co-MAR is related to multi-level governance, with a bottom-up approach and scaling up.*** *It is also useful for other related aspects like optimizing design, finding additional ways to finance MAR systems, and by enhancing applied research and capacity building of all involved.*

- **Collaborative Governance.** Governing arrangement where one or more public agencies directly engage non-government stakeholders in a collective decision-making process that is formal, consensus-oriented, that aims to make or implement public policy or manage public programs or assets (Ansell & Gash, 2008).
- **Space for collaboration or space of trust**. Environment created based on trust, and on the fair use of (ground)water resources. It is also based on strong functional organizational structures, ... These spaces become the basis for new governance arrangements that are better suited, and are more responsive to the collective interest.
- **Public-Private Partnership (PPP).** Public–private partnership (PPP, 3P, or P3) is a "*cooperative arrangement between two or more public and private sectors, typically of a long-term nature*" (Hodge and Greve, 2007).
- **Public-Private-People Partnership (PPPP).** New term based on PPP, including people in the equation, to increase the scope of governance and water security.

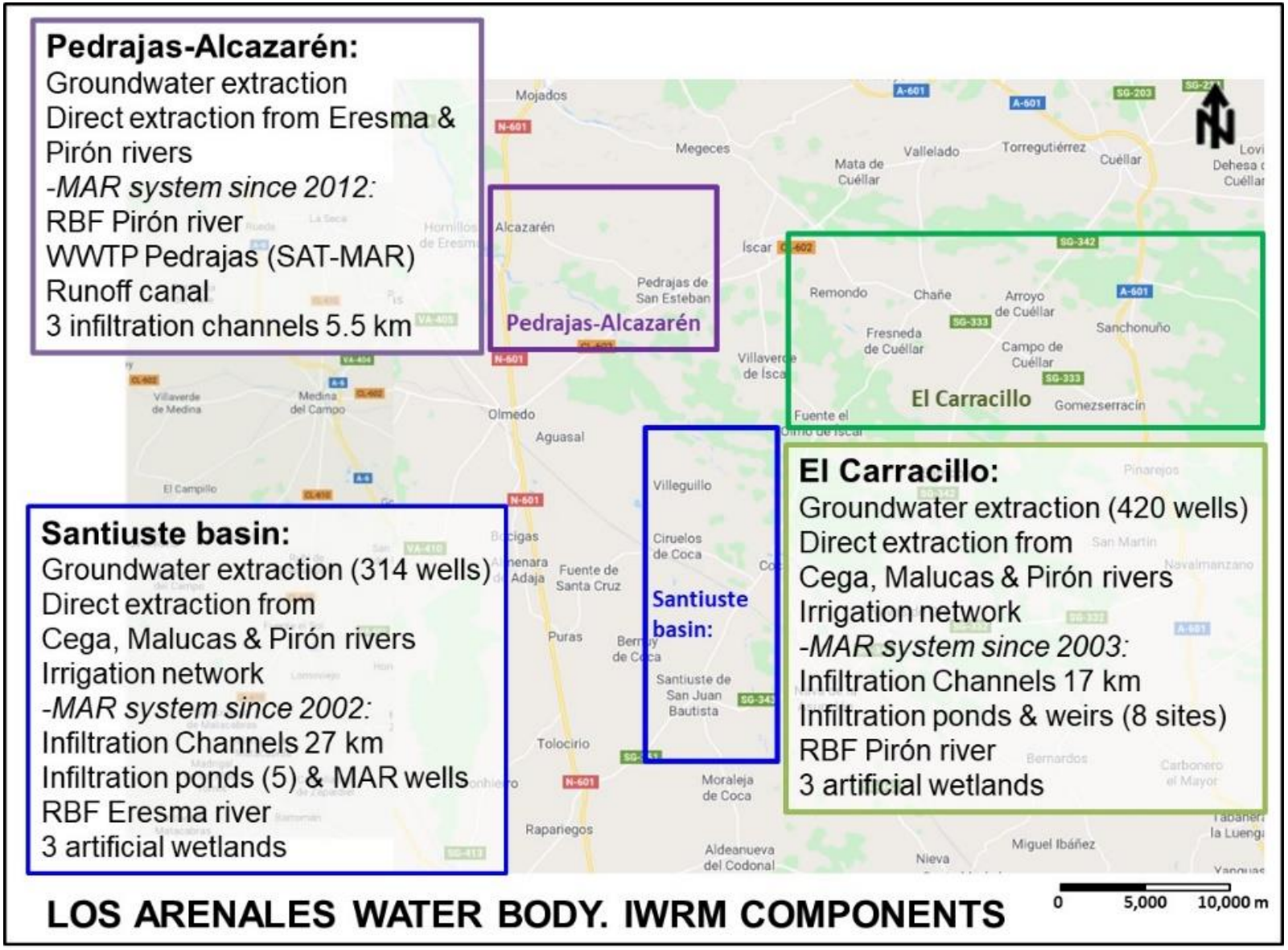
Co-MAR´s methodology

- **MAR and stakeholders** are basic components of the Co-MAR concept, and **entry points to understand the whole system.**

- The **methodological approach** for Co-MAR combines a **4-stage method**: **i)** literature review, **ii)** case-study analyses, **iii)** primary data treatment from interviews and surveys (over 50 in the examples), and **iv) capacity building activities in rural areas**.



Case 1. Los Arenales Aquifer, Castile and Leon, Spain.



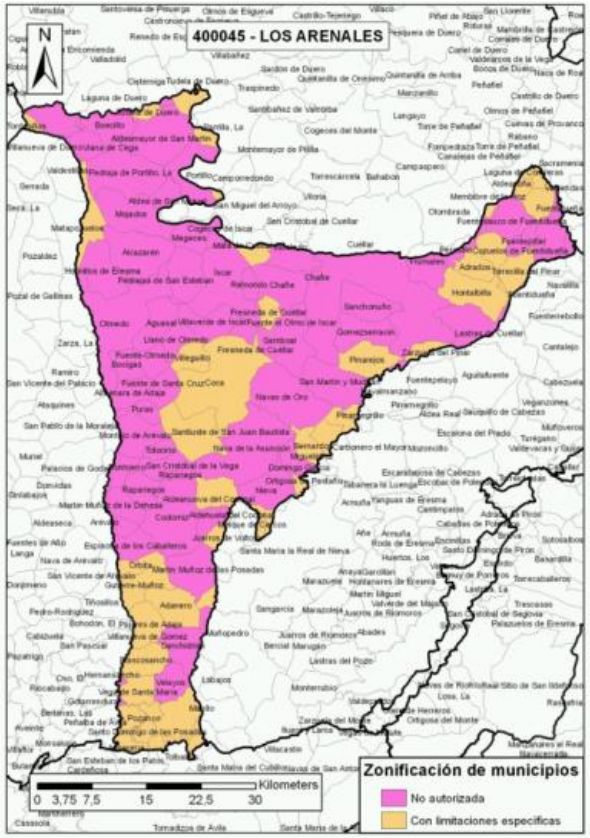
Case 1. IWRM main components at the Los Arenales Aquifer, Spain.

Overexploitation at the Los Arenales Aquifer

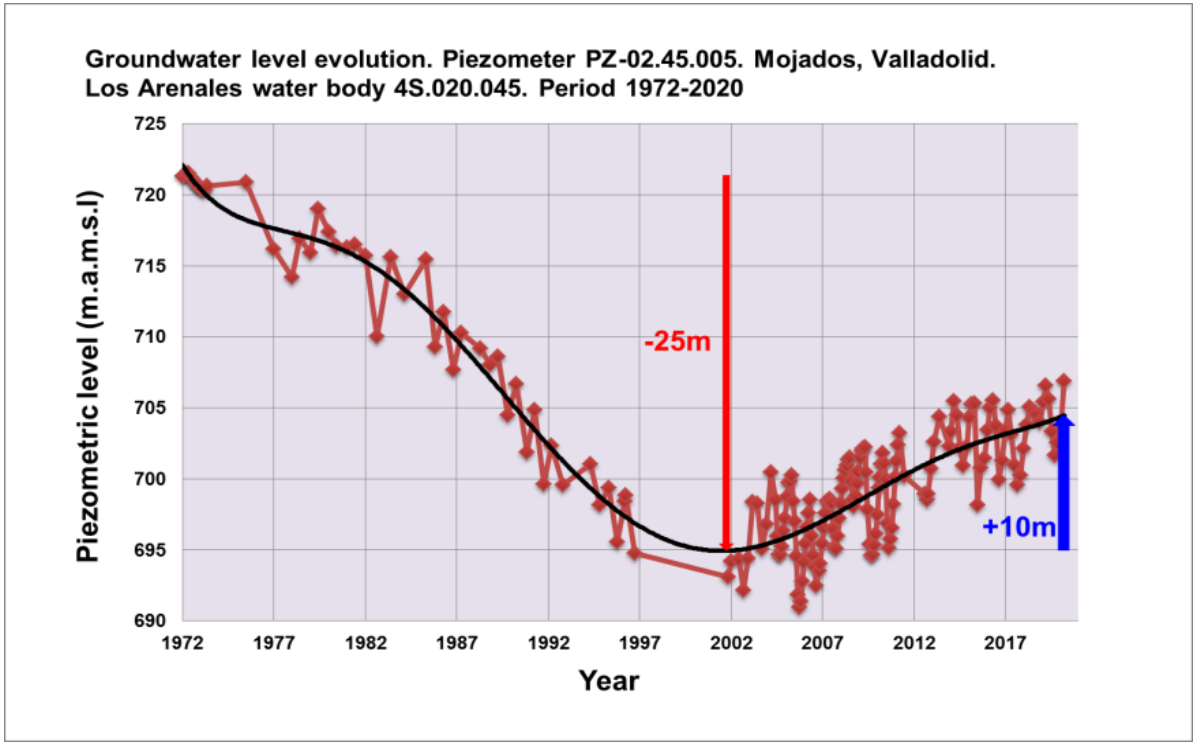
-Los Arenales water body (a). Groundwater level evolution between 1972 and 2020.

-Between 1972 and 2002, a **25 m groundwater decline** was registered in the aquifer.

-Since 2002 to now, the groundwater level has **raised about 10 m thanks to MAR**.



7.754,4 km^2



Case 2. Co-MAR in the Ica aquifer, Ica region (Peru)

-The Ica aquifer is located in the southern region of Peru, with a **high level of agro-industrial development, dependant on groundwater irrigation**.

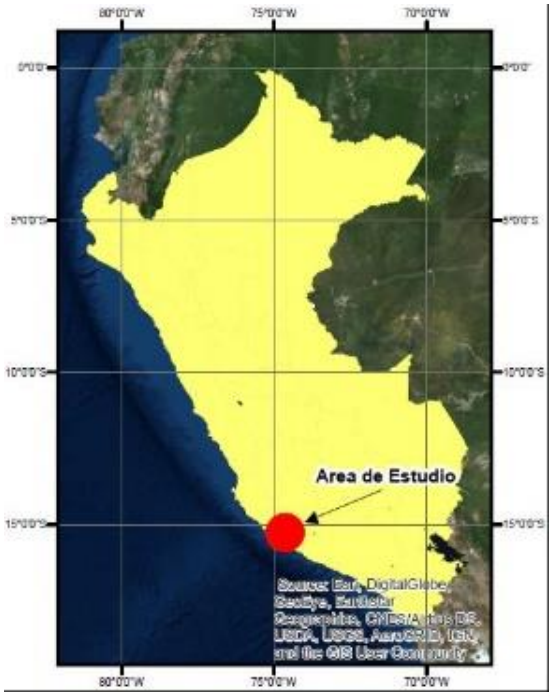
-Main driving force in the region and supports the livelihood of hundreds of families.

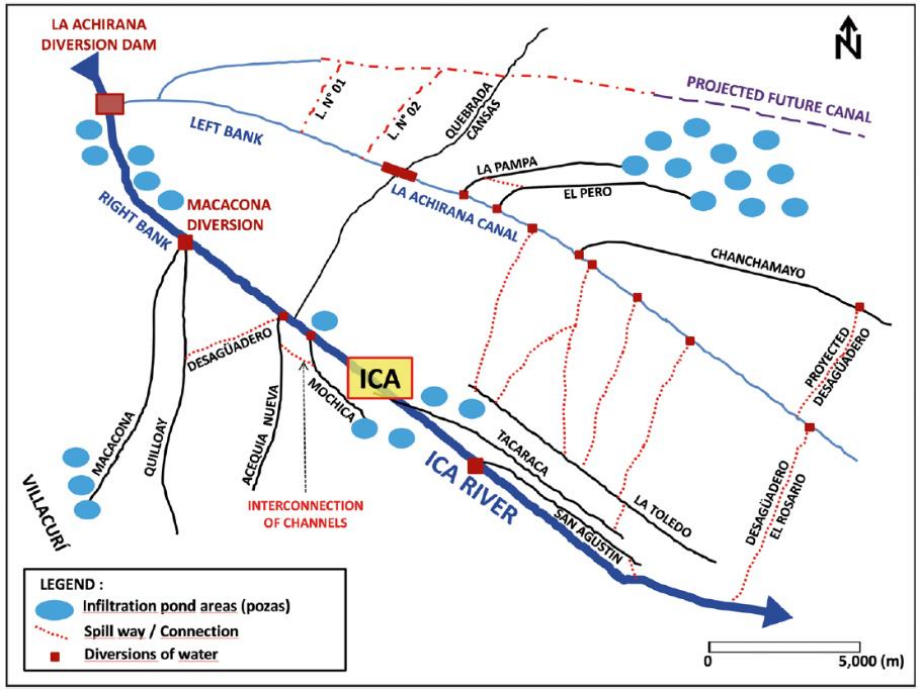
-The number of **hectares irrigated with groundwater is close to 33,000 out of 68,000**.

-Alternative sources of water, like **canals and surface reservoirs**, are also used.

-In 2012, MAR began, which required forecasting the aquifer's response.

-O+M work included the coordination and communication among all those involved.

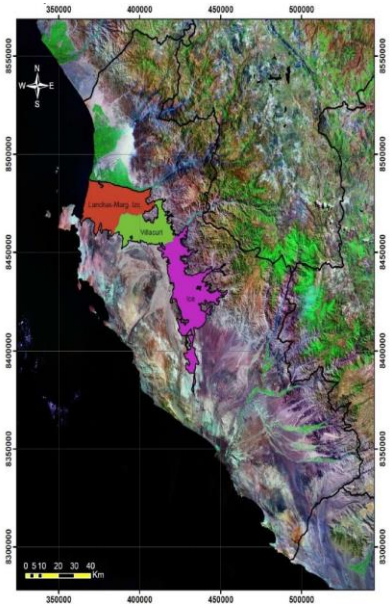


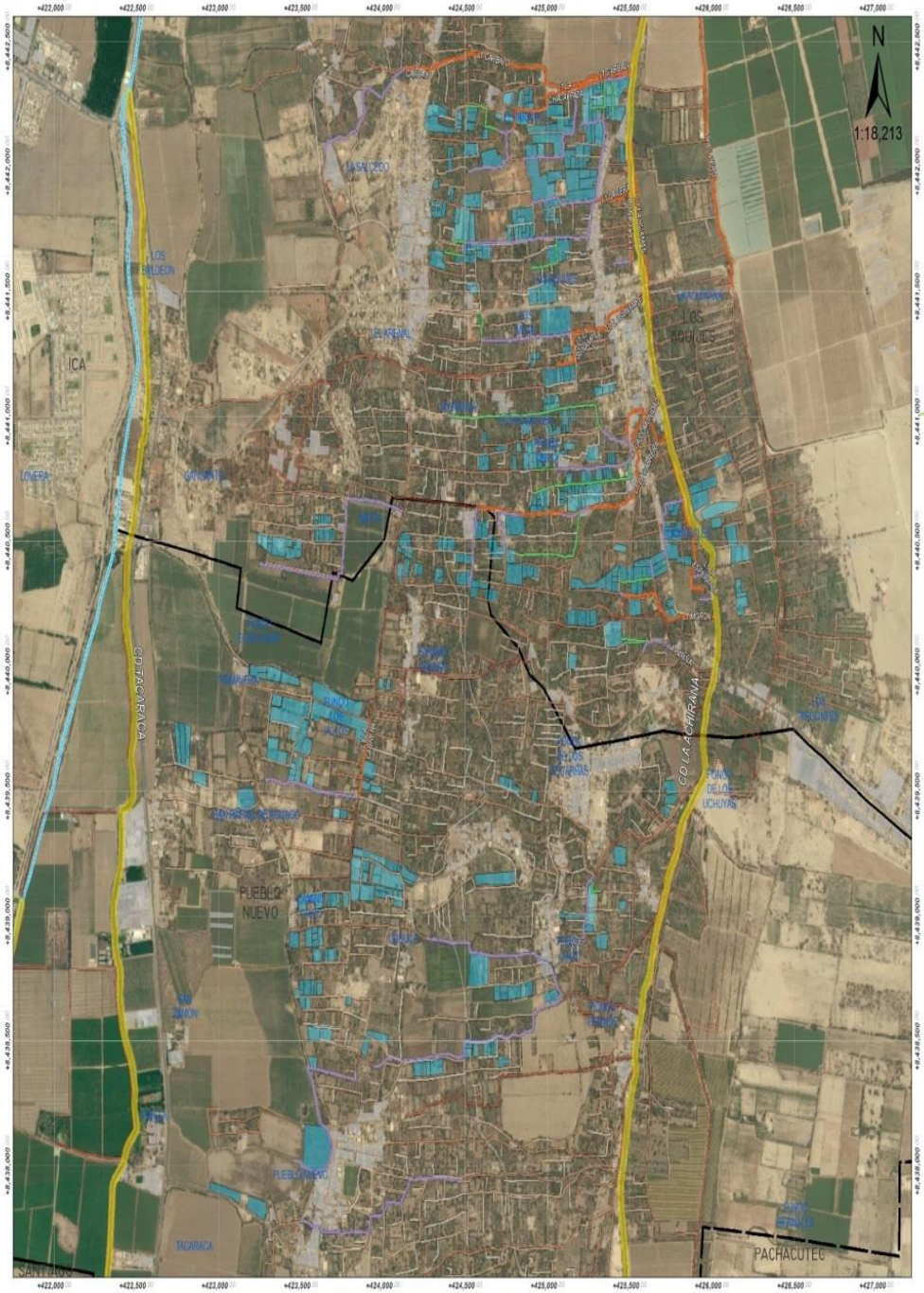


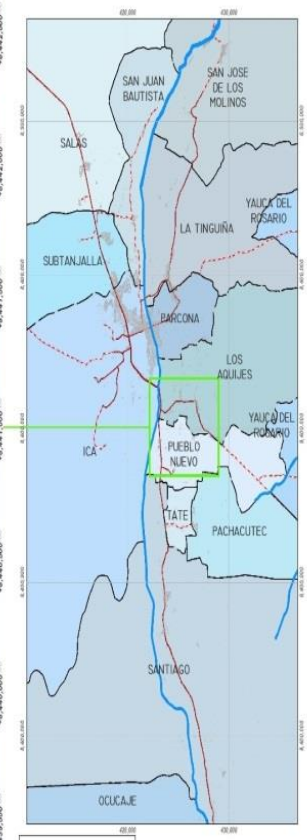
Case 2. IWRM main components in Ica aquifer, Peru

Overexploitation in the Ica Aquifer

- The maximum exploitable rate of the aquifer is about 252.3 Mm^3/year.
- The legally granted allowances have already reached 225.44 MCM/year.
- **Overexploitation** is about **350 Mm^3**
- In the rainy season of **2017**, 16.96 million m^3 were derived from the Ica River, and the infiltrated volume into the aquifer was **16.7 Mm^3** (insufficient compared to the overexploited volume) > **palliative technique.**
- The volume intentionally infiltrated is increasing helped by **stakeholders** who are aware of the importance of aquifer recharge, becoming **active participants** **(Co-MAR)**, by **lending private plots for temporary MAR.**







LEYENDA

TIPO DE CANALES

- CD
- L1
- L2
- L3
- Pozas de Infiltración
- Hidrografía
- Limite Distrital
- Curvas de nivel
- Poblados
- Zona Urbana
- Lagunas IGN

0 375 750 1,500 Metros

PLANO DE UBICACIÓN DE POZAS DE INFILTRACIÓN: III - SUB SECTOR DE RIEGO LA ACHIRANA

Plano: Ubicación del Área de Estudio

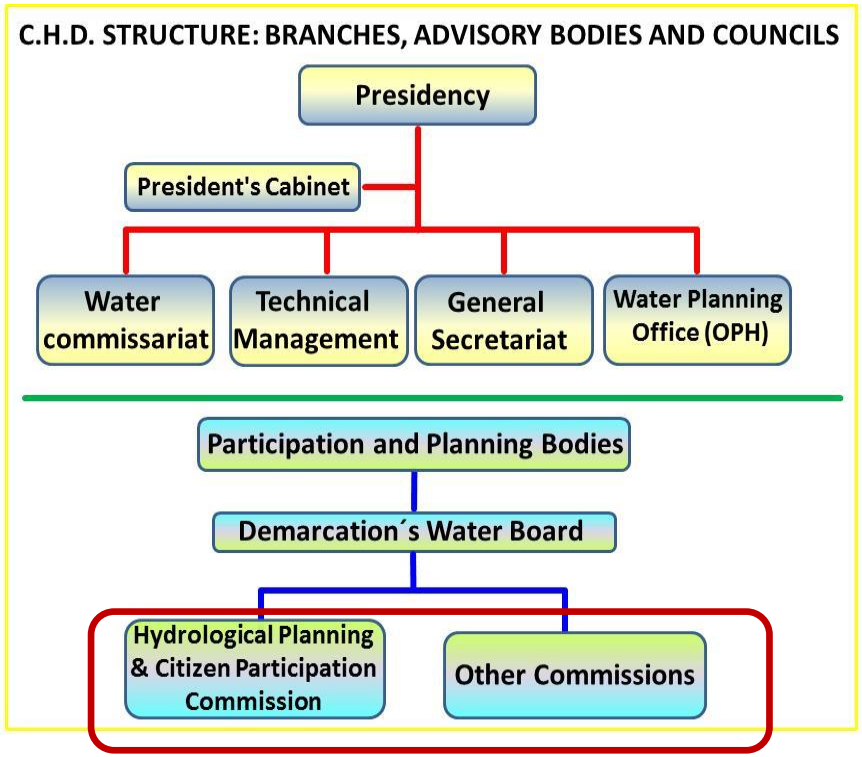
Sector:	Distrito:	Provincia:	Departamento:	
-	Los Aquijes	Ica	Ica	U-01
Datum UTM	Escala	Fuente:	Fecha:	
WGS-84	1:18,213	IGN, COFOPRI	Septiembre del 2015	

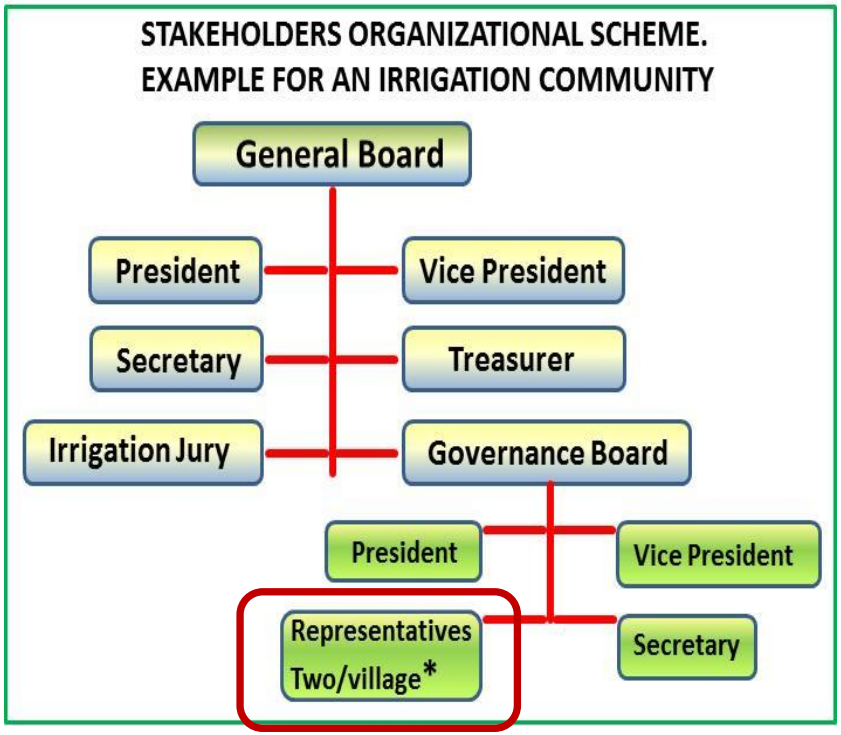
Results

- Changes in the stakeholders´ structure thanks to legal "improvement"

-Special **attention to water quality**, promoting user/citizen participation.

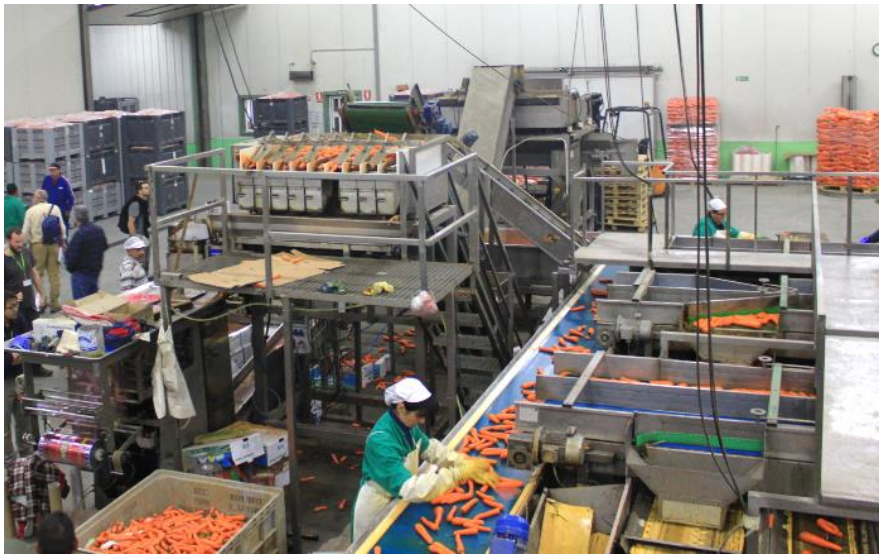
-**Governing schemes have included groundwater users´ associations (brown rectangles).**





CHD structure, advisory bodies, and councils. Modified from Duero River Basin Plan, or PHD (CHD, 2016) (a). Irrigation communities´ structure (b). Orange squares: formal end users´ participation in decision-making.

Results (2). What else can do Co-MAR for an Aquifer?



Los Arenales MAR system and agroindustry example.

-**Changes in regulation** facilitate a **deeper participation of stakeholders in IWRM.**

-At the **local level**, **Co-MAR exhibits benefits after MAR for the farmers.**

-Groundwater users organize and **cooperate in the wise use of water**.

-Environmental improvements in the aquifer are not long in coming.

Stakeholders and performance of these MAR systems

-The **space of collaboration and trust includes authorities and end-users**.

-End users´ associations were created and organized to communicate with the Water Authorities.

-The communities of water-users count on MAR facilities providing between 22 and 25% of the total water used for irrigation in the Spanish case, whilst in the Peruvian case it barely reaches 5%.

Stakeholders' capacitation at the Los Arenales aquifer, Castile and Leon, Spain.

Stakeholders' meeting to constitute the HIDR-Ica WG, Ica, Peru.

Social Behavioral changes in both systems

-Both systems have **created a platform for building an environment of trust, and thus, collaboration.**

-**Bidirectional exchange of information between the water authority and farmers.**

-**The Decision Support System (DSS) for all stakeholders adds people to the PPP equation,** becoming public/private/people partnerships (PPPP). **Authors have proposed** a slight modification: **people/public/private partnerships (PPPP´), giving people the crucial importance they deserve.**

Technicians, civil servants and stakeholders capacitation. Course on MAR, Ica 2022, organized by the ANA.

Conclusions & recommendations

-**Co-MAR is an example of PPPP´.**

-It is **key to improve the IWRM mechanisms** at both sites.

- The **bottom-up approach is a "more socially inclusive"** scheme.

-**Economic indicators** have **increased after Co-MAR.**

-The **spaces of collaboration and trust are becoming the basis for new governance schemes, more sensitive for the users´ collective interest.**

-Soft and hard **measures are backed by NbSs.**

-The new MAR deployments are causing "**contagion effect**".

-The **response to the overexploitation of the aquifer** begins working.

-**Key vulnerabilities identification persists in both Co-MAR areas of study.**

iah.org/education/professionals/technical_insight_series

HOME ABOUT GROUPS EDUCATION PUBLICATIONS EVENTS NEWS JOIN US DONATE Join Login

Regulation	Compound
U.S. EPA (Interim updated Health Advisory)[16]	PFOA
	PFOS
	PFBS
	'GenX chemicals'
U.S. state level (example of Illinois)[16]	PFOA
	PFOS
U.S state level (example of Massachusetts)[16]	Six PFAS substances combined (PFOA, PFOS, PFHxS, PFNA, PF
European Commission Drinking Water	PFAS

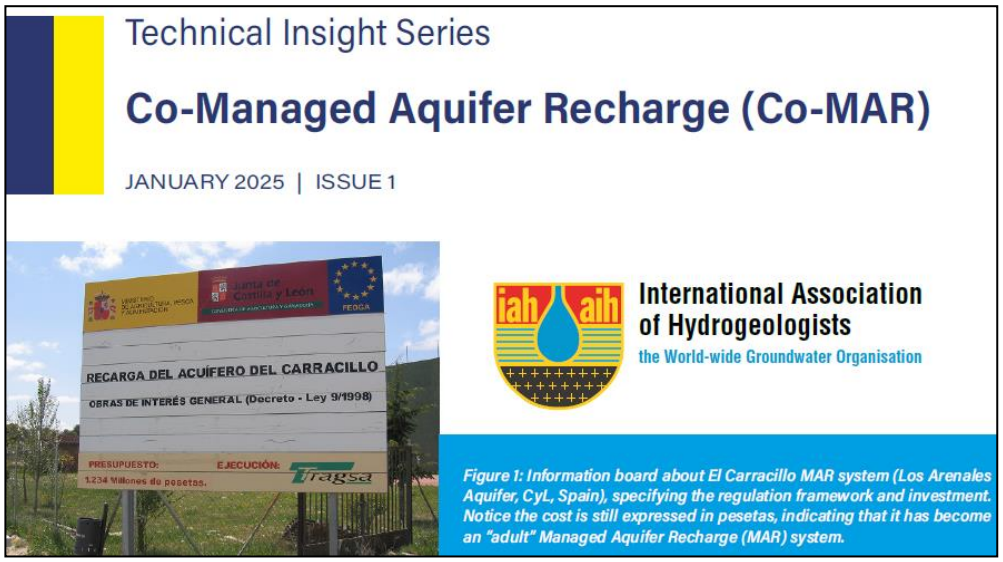
IAH Technical Insight Series

IAH has launched a new ***Technical Insight Series***, designed both to inform professionals in other sectors of key interactions with groundwater resources and hydrogeological science, and to guide IAH members in their outreach to related sectors. This is a technical overview with a different emphasis and intended audience to the highly appreciated *Strategic Overview Series*, which is aimed at a more general readership.

The latest Technical Insight Series paper '**Co-Managed Aquifer Recharge**' was produced by the Managing Aquifer Recharge (MAR) Commission. The paper discusses improving Integrated Water Resources Management (IWRM) with a new management approach: the co-managed aquifer recharge (Co-MAR) concept, in which stakeholders actively participate in the decision-making process, with the aim of improving governance, rural development and water security.

Hydrogeology Journal
IAH Book Series
IAH Technical Insight Series
Strategic Overview Series (IAH-SOS / AIH-SOS)
National Chapters
Commissions & Networks
Publications

https://iah.org/



IAH TIS access: https://iah.org/education/professionals/technical_insight_series