COLLEGE OF AGRICULTURE & LIFE SCIENCES
COOPERATIVE EXTENSION
WATER RESOURCES RESEARCH CENTER

Recent Research on Policies for Managed Aquifer Recharge in Mexico

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Tucson, AZ,

February 2nd, 2022


UNITED STATES OF AMERICA
MEXICO
N
0
305
610
1,220 Kilometers
Coordinate System: GCS WGS 1984
Datum: WGS 1984
Cartographer: Mary-Belle Cruz A.

Theme for World Water Day 2022:

Groundwater:
Making the invisible visible

igrac

Read more: www.un-igrac.org/WWD2022

UN WATER
22 MARCH
WORLD
WATER
DAY

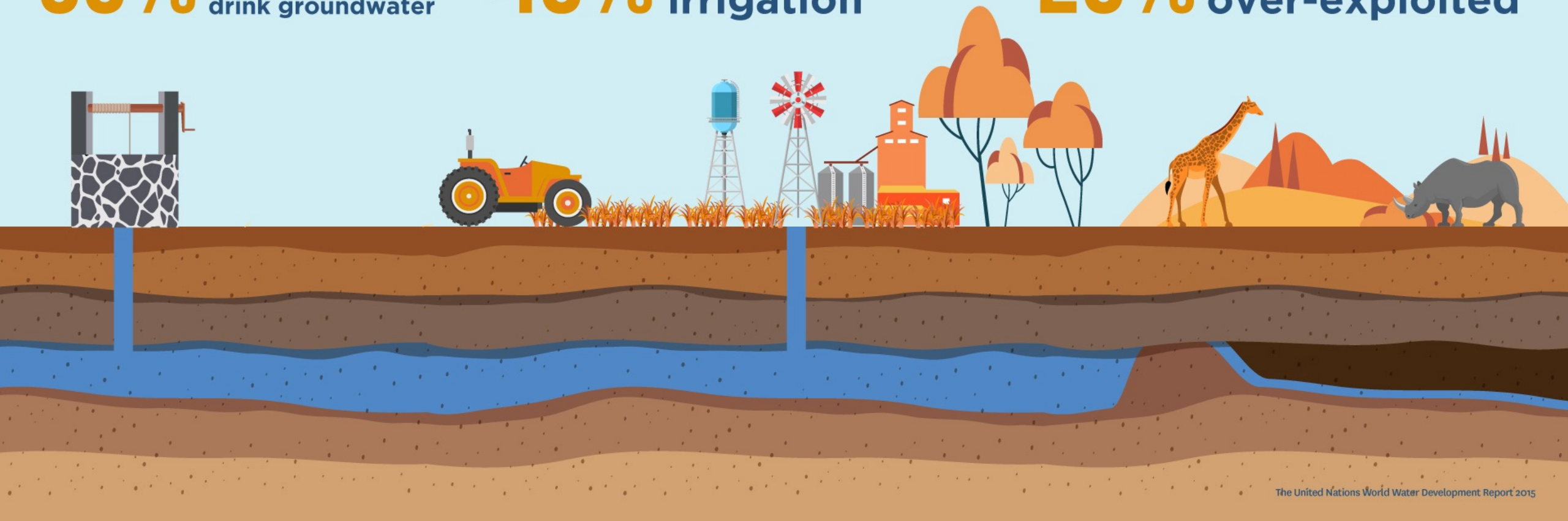
IWMI
International Water Management Institute

Groundwater depletion causes water scarcity

50% of the worlds **population** drink groundwater

40% of the groundwater abstracted is used for **irrigation**

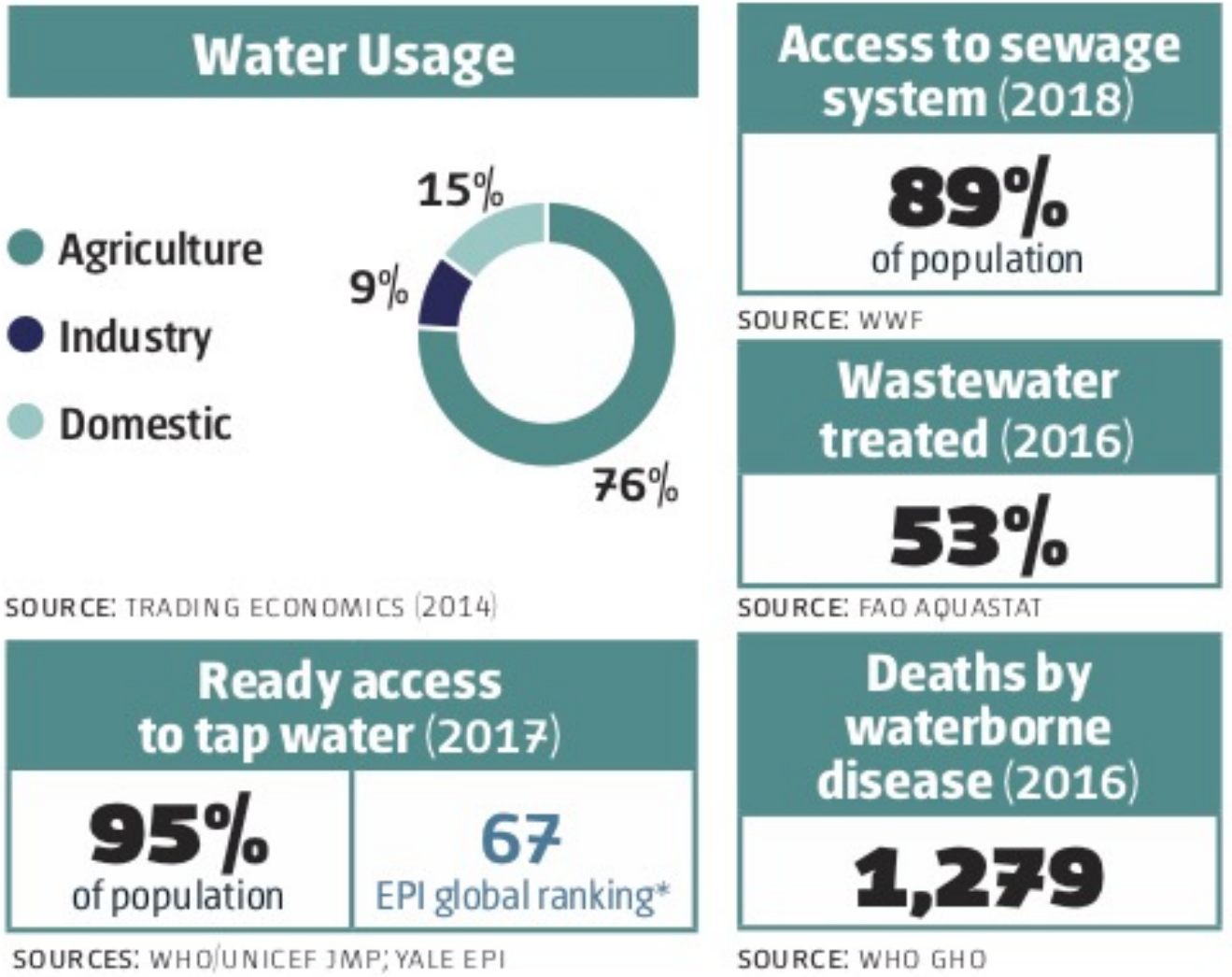
20% of the world's groundwater reserves are **over-exploited**



The United Nations World Water Development Report 2015

Water in Mexico

Water use, wastewater treated, access to sewage system in Mexico



https://www.americasquarterly.org/wp-content/uploads/2019/10/mexico_dash.png

However

- In Mexico, on average, **33 %** of the population **has no access to potable water** daily; **rural communities** are especially vulnerable because only **36%** receive water every day.

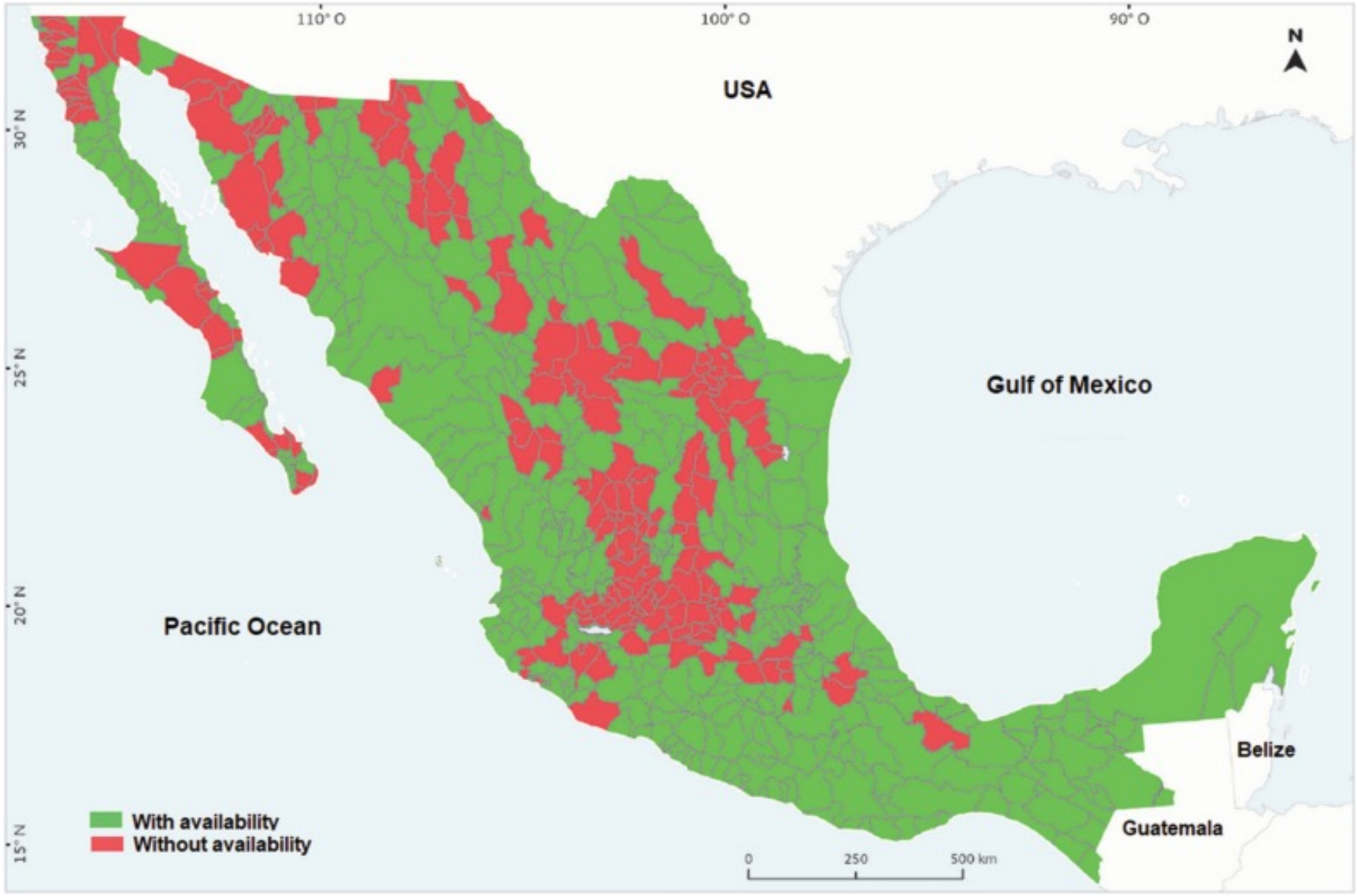
INEGI, 2016; Revollo-Fernández & Rodríguez-Tapia, 2021

Groundwater: the invisible water

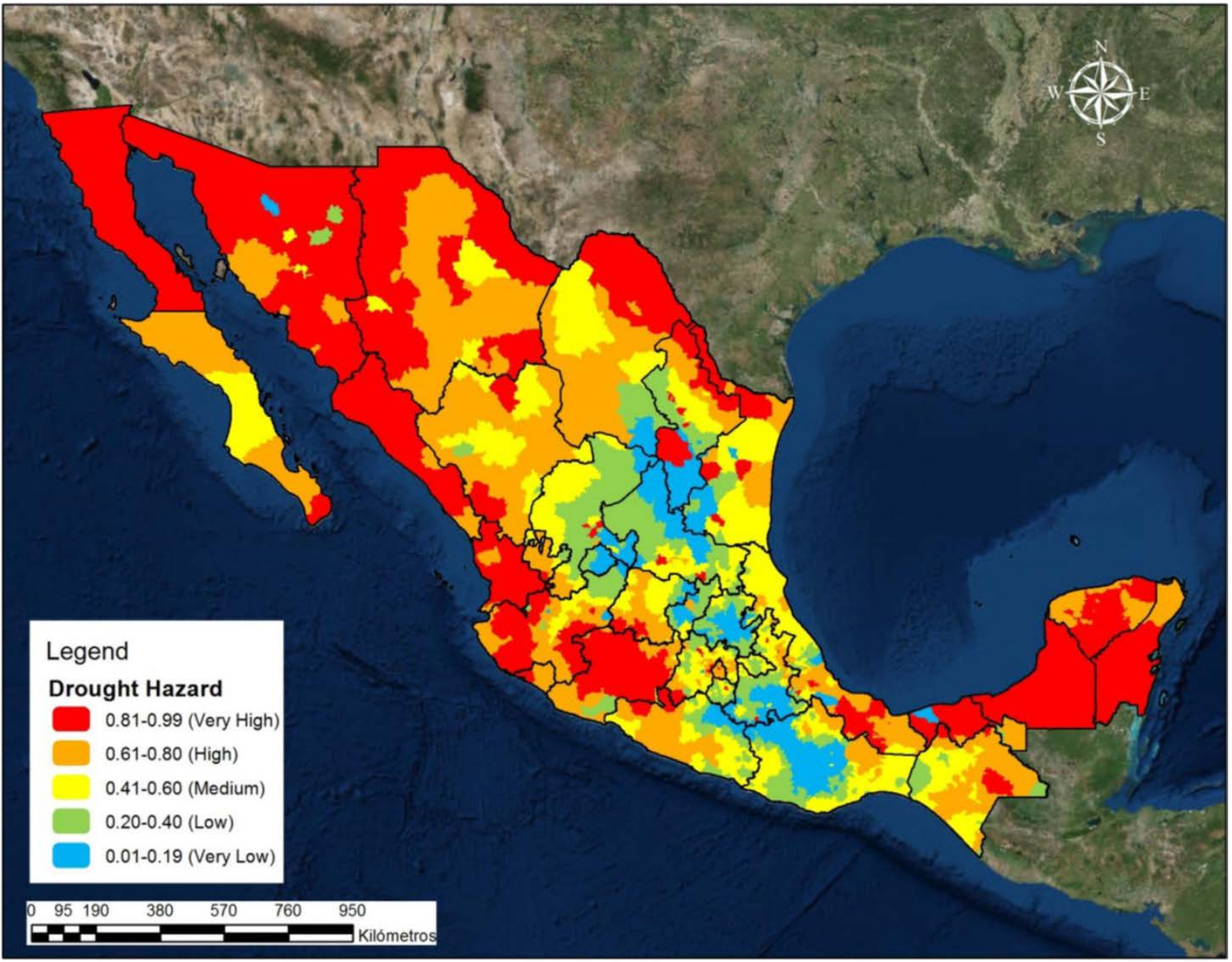
In Mexico:

- **54%** of water used for agricultural, urban, and industrial consumption is currently drawn from overexploited underground aquifers.
- **70%** groundwater is dedicated to the agricultural industry.

Groundwater Availability in Mexico



Gutiérrez-Ojeda & Escolero-Fuentes. 2020. Groundwater Resources of Mexico

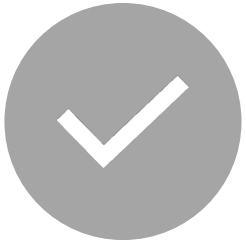


Drought hazard index in Mexico

Arreguín-Cortés et al., 2020

Portfolio with options to restore aquifers

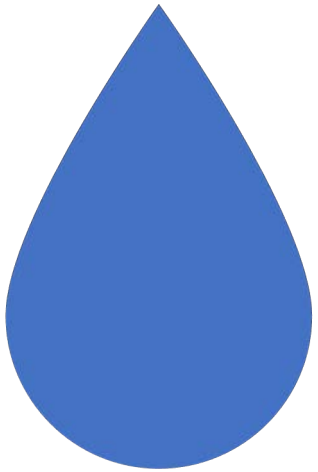
Desalination



Managed Aquifer Recharge

More efficient water use in irrigated agriculture

Water recycling



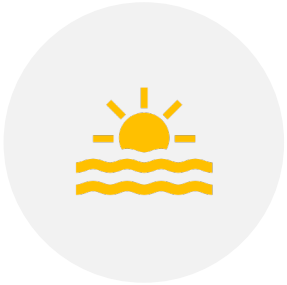
Managed Aquifer Recharge (MAR)

It is defined as intentionally banking and treating water for future use (Dillon, 2005)

Managed Aquifer Recharge (MAR)

to maximize **natural storage**

improve water quality



prevent seawater intrusion

ecosystem services provision.

MAR projects & facilities

Methods

Systematic literature review of publications in English and Spanish languages, using key words.

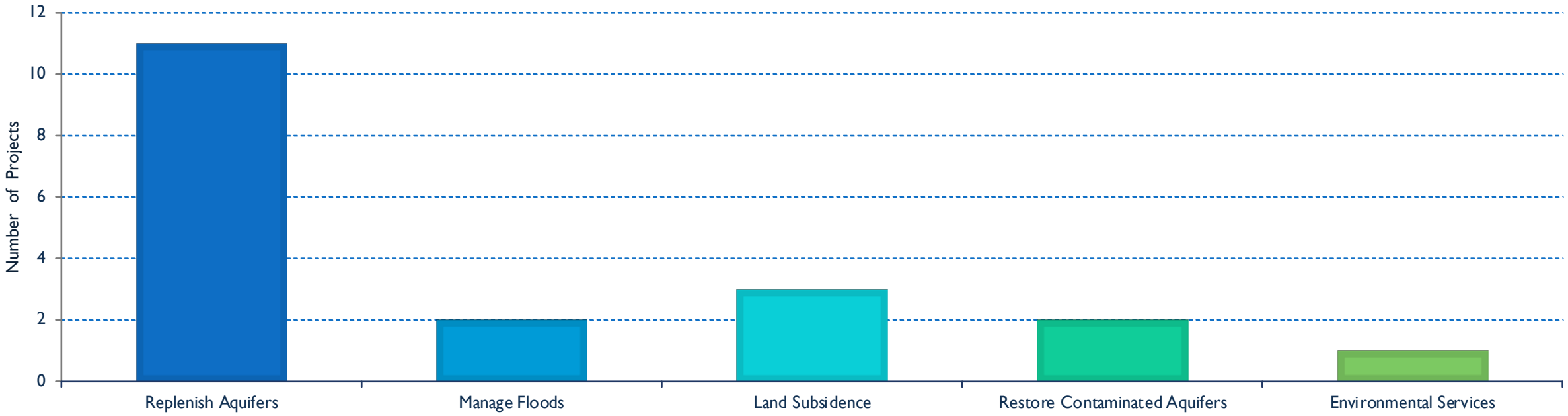
Analysis of Mexican legal framework regulating Managed Aquifer Recharge to identify gaps or aspects that could be addressed.

Decision makers, water managers, and researchers experienced in MAR, as well as representatives from NGOs were interviewed

Interviewees' organizations

	Sonora	Chihuahua	Mexico City
National Water Commission (CONAGUA)	CONAGUA	CONAGUA	CONAGUA
State agencies	Comisión Estatal del Agua	Junta Estatal del Agua	N/A
Municipal agencies	Municipal water agencies in San Luis Río Colorado and Hermosillo	Municipal water agency	Urban services office
Academic institutions	University of Sonora, Autonomous University of Baja California	Autonomous University of Chihuahua	Mexican Institute of Water Technology, Metropolitan Autonomous University, National Autonomous University of Mexico
NGOs and consultants	ProNatura Consultants	World Wildlife Fund	None Consultant

Objectives of MAR projects



Groundwater Governance

Table 2. Regulations for Groundwater and MAR in Mexico, and proposals.

	Native Groundwater	Artificial Recharge	Proposals
Definition of water rights and institutional arrangements for allocations	Concessions Assignations The Law of the Nation's Water (LAN) establishes procedures for allocations.	There is no procedure to allocate water recharged or a priority list to issue new permits.	LAN must define the procedures that must be followed to allocate water from MAR.
Identification of in situ requirements of available water	The National Water Commission (CONAGUA) publishes periodically water availability studies.	There is no a comprehensive study about potential water recharge projects.	CONAGUA and researchers can integrate a portfolio of viable MAR projects.
Abstraction limit	Entitlements are linked to a volumetric measure of water that can be extracted	The Official Mexican Standard, NOM-014-CONAGUA-2003 establishes that water recharged can be extracted after six months (surficial recharge) and 12 months of residency (direct recharge). However, there is not reference regarding the volume that can be extracted.	Based on the water rights in the basin, it could define a volume that MAR managers might extract.
Definition of priority uses	LAN includes a list of priority uses: 1. Domestic 2. Urban 3. Livestock 4. Agriculture 5. Aquaculture 6. Environment 7. Energy production for public service 8. Industry 9. Energy production for private service	None	The priority list set in the LAN might be used to define water rights to recover water recharged when using a MAR method.
Mechanisms for monitoring and enforcement	LAN and other federal regulations define what are the conditions under concessions can be cancelled.	LAN doesn't define penalties or mechanisms for enforcement for MAR facilities.	LAN must include mechanisms for monitoring MAR facilities.

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IMTA

Proposals

Fiscal incentives

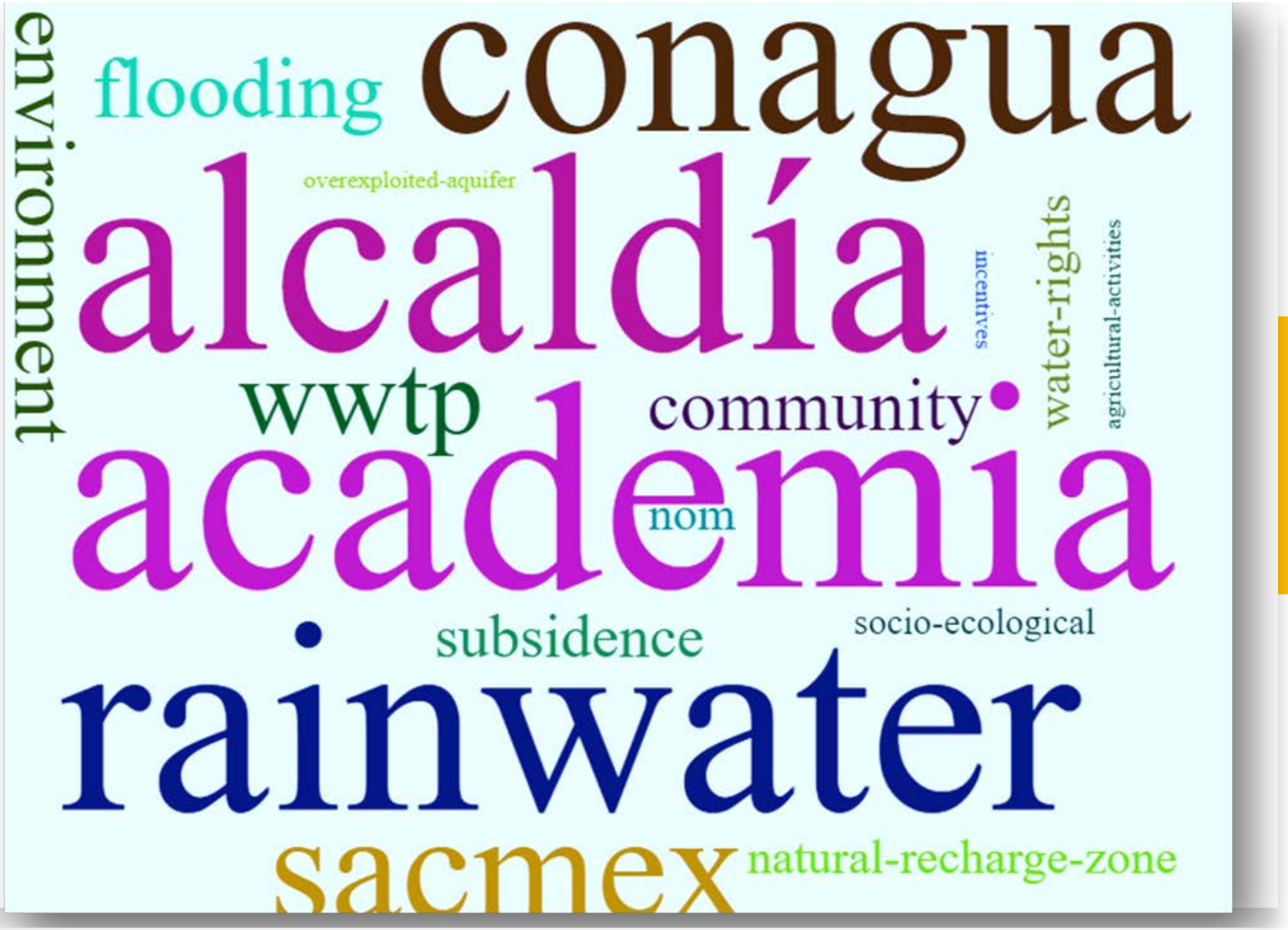
Water fees reduction or exemption for extraction of groundwater

Groundwater banking to guarantee water entitlements

Users and enterprises that have invested in MAR projects should be entitled to the recharged water

Create a federal program to transfer water rights

Increase public investment for MAR projects



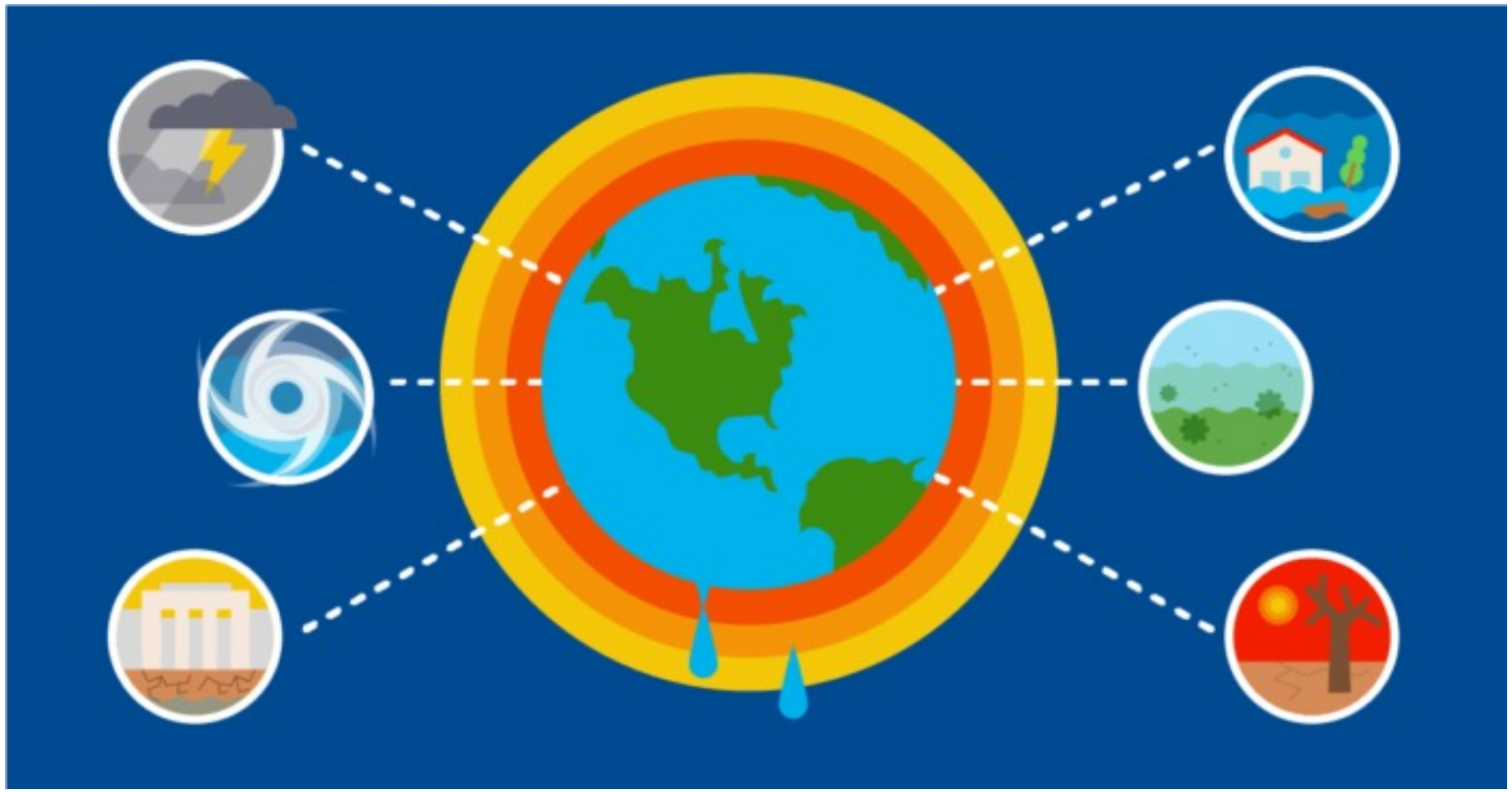
MAR ecosystem

MAR efforts in Baja California Sur and Sonora: opportunities for scientific collaboration with US researchers

Cruz-Ayala, M.B.; Gámez, Tapia-Villaseñor and Wurl, (2021). Visiones contemporáneas de la cooperación y la gestion del agua en la frontera México-Estados Unidos

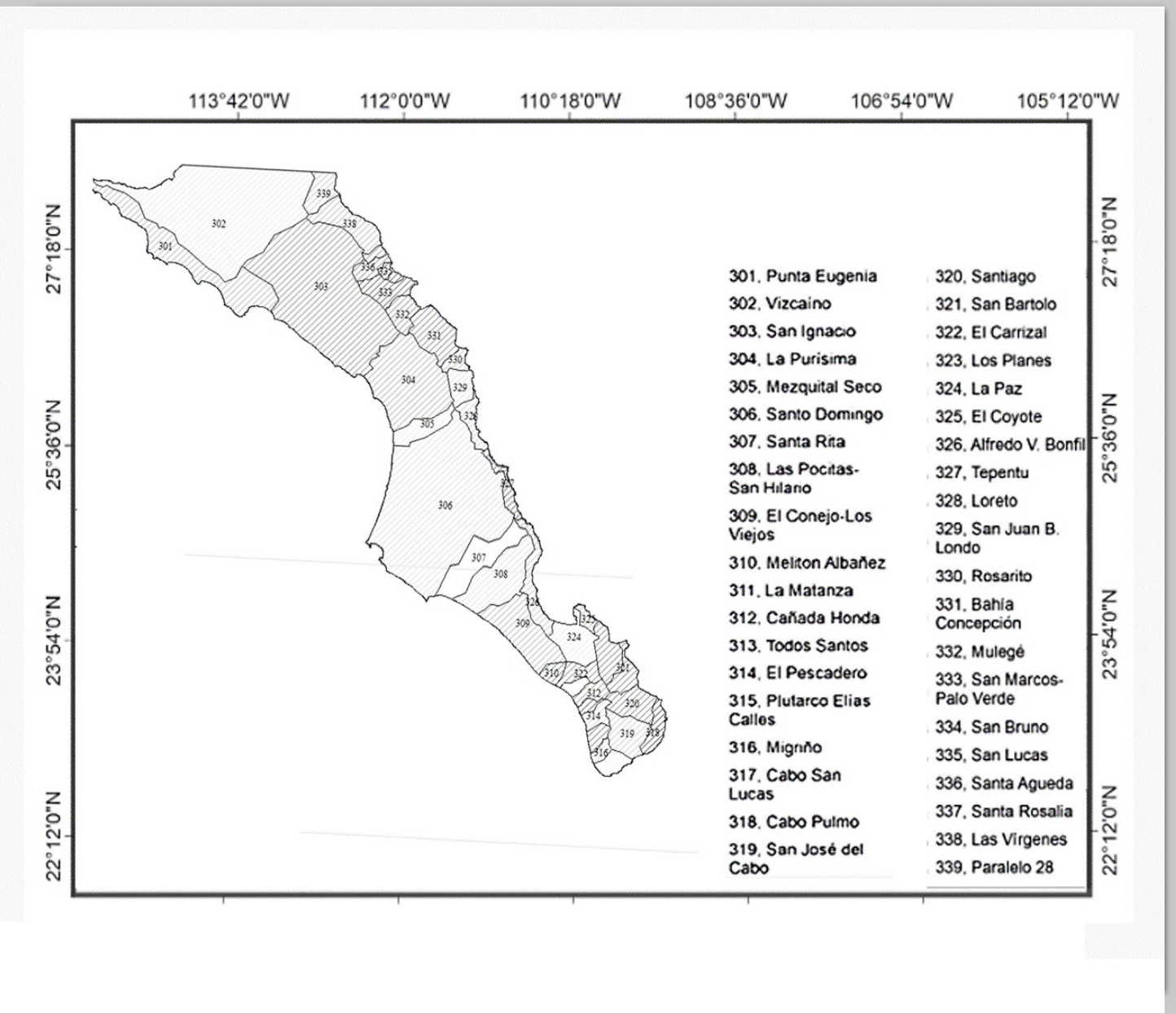
Growing water demand

- Population growth
- Climate change
- Urbanization
- Rising economy
- Agricultural activities



Mekonnen & Hoekstra. 2016. DOI: 10.1126/sciadv.1500323

https://www.acclimatise.uk.com/2019/10/02/the-impact-of-global-warming-on-water/



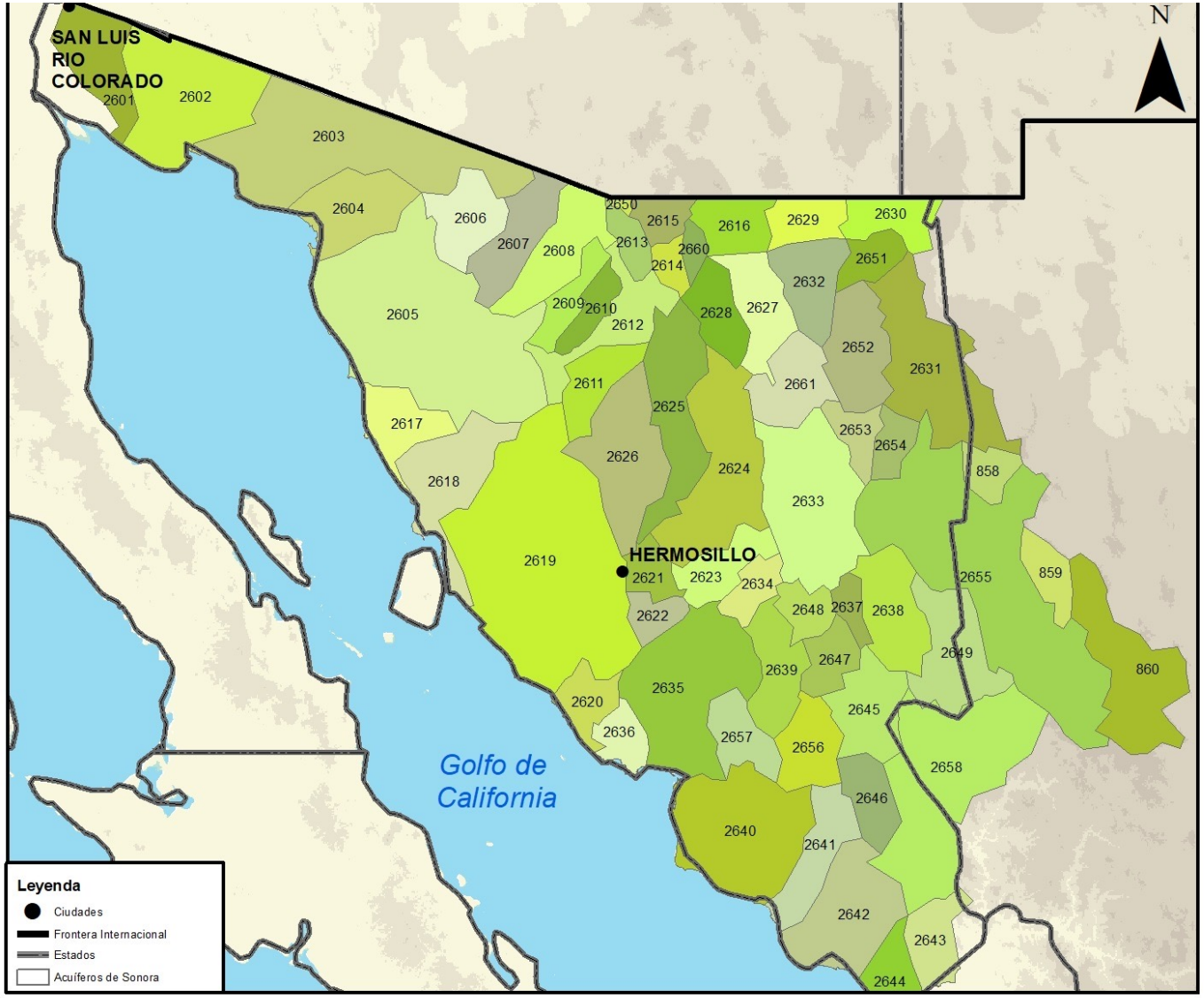
Baja California Sur

- Five aquifers with the highest water deficit: 306-Santo Domingo (30 MCM), 317-Cabo San Lucas (19.03 Mm^3), 324-La Paz (7.47 Mm3), 325-El Coyote (7.25 Mm^3), 319-San José del Cabo (5.91 Mm^3).

- Research studies have identified potential sites for MAR in Santo Domingo and La Paz.

Sonora

- Nineteen aquifers register a deficit with 2605-Caborca (90.87 Mm^3) and 2619-Costa de Hermosillo (97.007 Mm^3).
- Seawater intrusion and social conflicts between indigenous communities and urban citizens.



In summary

- There are some successful examples of scientific cooperation and communication between researchers from the US and Mexico focused on water conservation.
- Baja California Sur and Arizona
- TAAP: Arizona and Sonora.

CONCLUSIONS

It is important for water-stressed countries like Mexico to contemplate Managed Aquifer Recharge (MAR) as an option **to increase water availability**.

Beyond the technical issues that water recharge projects normally address, **the regulatory framework is a barrier** to increasing MAR facilities.

Adequate policies and guidelines must be in place to ensure the **benefits** that MAR can provide.

CONCLUSIONS

The recovery of over drafted aquifers, MAR project development and management should be a **shared initiative** between federal, state, and municipal governments.

Municipal agencies have developed water recharge projects and are operating them with limited financial support from the federal government, **they need financial** and technical assistance from this agency.

The Law of the Nation's Waters should be amended to incorporate specific ordinances for MAR.

CONCLUSIONS

Farmers are key actors in aquifer recovery; they could reduce their groundwater extraction if more treated wastewater were available to them.

Treated wastewater can be used for agricultural activities and MAR projects. However, the lack of a regulatory framework is hampering the opportunities for reusing this water.

Nonprofit organizations play a significant role in MAR facilities. They have functioned as a **bridge** between researchers and water officials to communicate scholarly findings.

Thanks!

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