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MEXICAN EXPERIENCES TO CONTROL GROUNDWATER USE IN AGRICULTURE

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Presentation outline

i. 1. Context of groundwater and surface water resources in Mexican agriculture
ii. 2. Case study: Altar-Pitiquito-Caborca, Sonora, Mexico
iii. 3. How to control groundwater use in agriculture?
iv. 4. Conclusions and remarks

Case study: Altar pitiquito, Sonora Mexico Irrigation district 037

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Distribution of irrigated agriculture:
86 irrigation districts and 40,000 irrigation units

- Mexican institutional arrangement has divided irrigated schemes in two broad types: irrigation units (IUs) and irrigation districts (IDs).
- IUs, with area of 2.9 million ha and about 40,000 small irrigation areas, have always been managed by water users.
- 86 irrigation districts (ID) with 3.5 million ha, formerly managed by the federal government and turned over to 474 water user associations.

Cropped area in Ha by agricultural season (2009-10 water year)

Season	Rainfed		Irrigated		Total	
	Cropped (Ha)	%	Cropped (ha)	%	Cropped (ha)	%
AF	1,498,042	9.2%	2,259,299	39.8%	3,757,341	17.1%
SS	10,259,285	63.0%	1,836,430	32.4%	12,095,715	55.1%
Perennial	4,518,832	27.8%	1,580,857	27.8%	6,099,690	27.8%
Total	16,276,159	100.0	5,676,586	100	21,952,745	100

75% of cropped area is rainfed. But half of total production value is generated by irrigated agriculture.

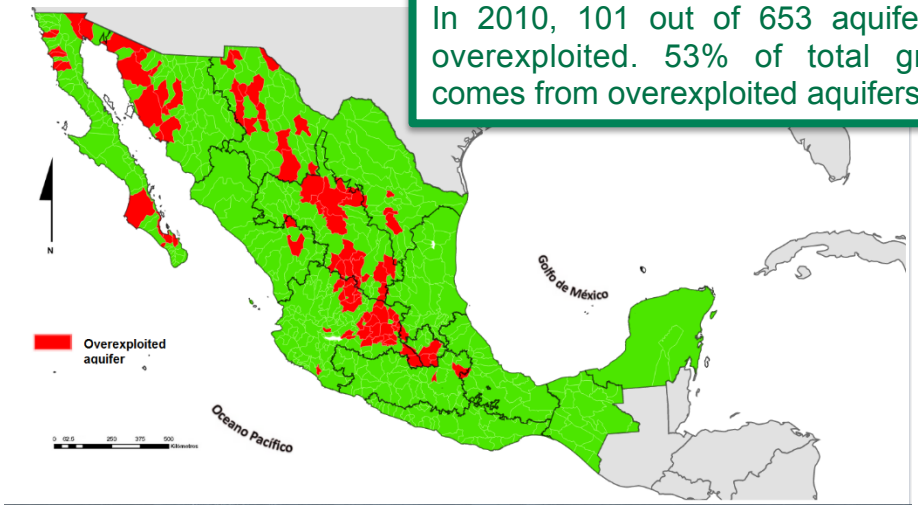
Context of groundwater and surface water resources in Mexico

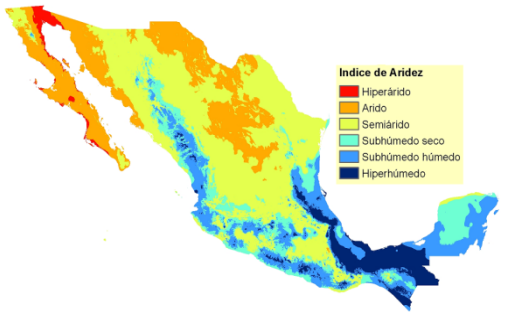
Water use by extraction source origin in km^3 (year 2008)

Uso	Origen		Volumen total	Porcentaje de extracción
	Superficial	Subterráneo		
Agrícola [a]	40.7	20.5	61.2	76.8
Abastecimiento público [b]	4.2	7.0	11.2	14.0
Industria autoabastecida [c]	1.6	1.6	3.3	4.1
Termoeléctricas	3.6	0.4	4.1	5.1
TOTAL	50.2	29.5	79.8	100.0

37% of annual used water volume 79 800 hm^3 comes from groundwater. 1/3 of concessioned volume (61 200 hm^3) for agricultural uses, main water user, comes from groundwater sources. 2/3 of concessioned volume (11 200 hm^3) for urban uses comes from groundwater.

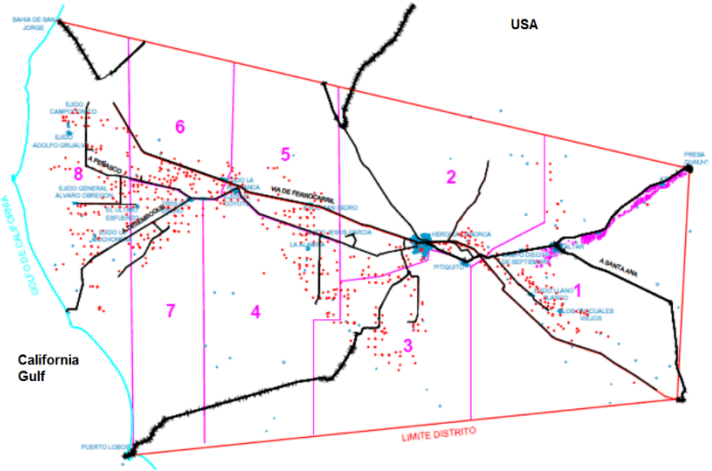
In 2010, 101 out of 653 aquifers were declared overexploited. 53% of total groundwater used comes from overexploited aquifers.





Two thirds of the country is classified as arid or semiarid with a rainy season concentrated from June to September.

Case study: Altar-Pitiquito, Sonora, Mexico Irrigation district ID037



- The ID 037 is located in the Sonoran desert with an average annual rainfall of 140 mm and a reference evapotranspiration of 1888 mm.
  Its irrigation development began in 1949 and in 1964 it was created as an irrigation district.
  Peak irrigated land was about 60,000 Ha with 844 pumping wells.
  Pumping levels vary from 150 m to 120 m, increasing at a rate of one meter per year at the beginning of this century.
  Aquifer recharge (natural and induced) was estimated of about 212.9 hm^3 but peak aquifer extraction was 760 Hm^3
- In 2003, 30 pumping wells were cancelled when the program Water Rights Use Adequacy was applied in this irrigation district.
- Control groundwater use in ID 037 has a long history since in 1962 when new pumping wells were prohibited but control did not work.

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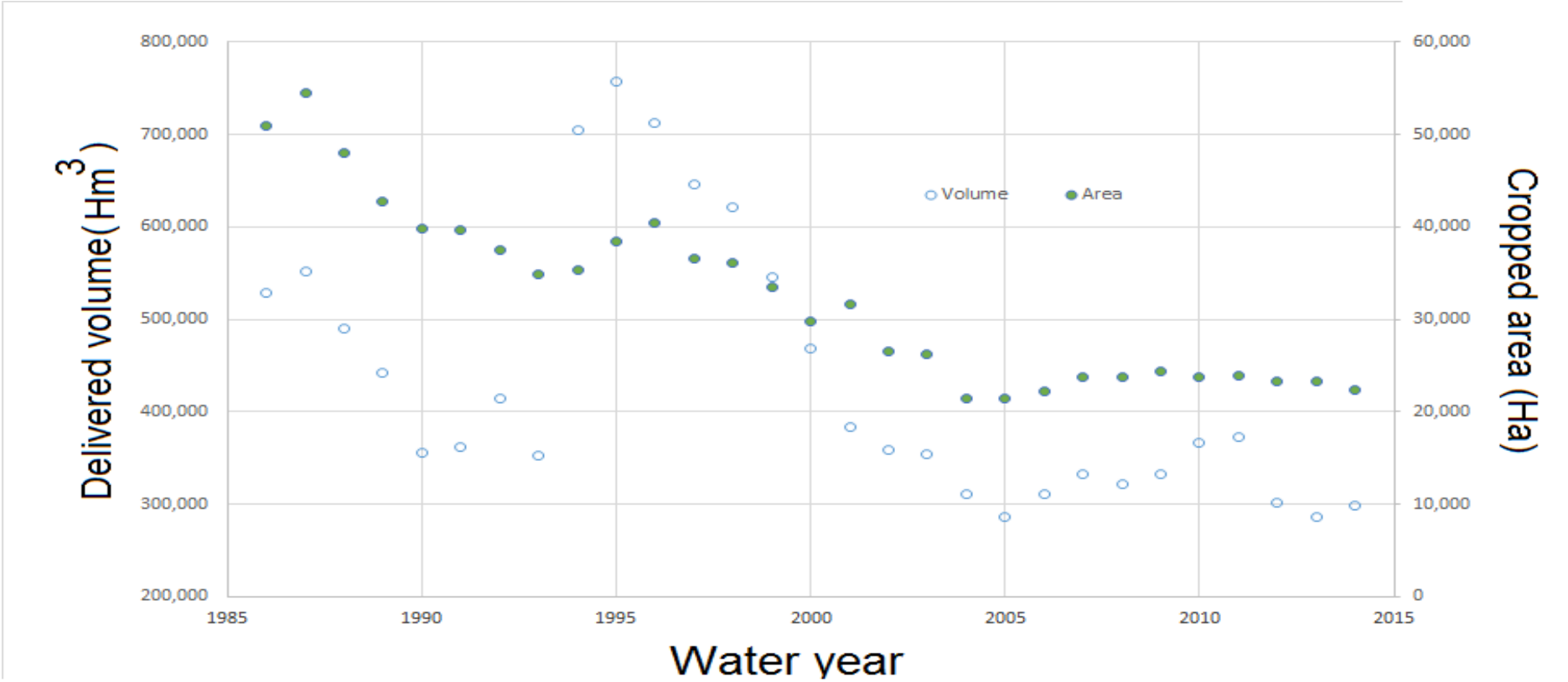
Case study: Altar pitiquito, Sonora Mexico



Annual variation of cropped area in ha and delivered volume in hm^3 at Irrigation District 037, Altar-Pitiquito, Sonora, Mexico

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Case study: Altar pitiquito, Sonora Mexico

Actions proposed to stabilize the ID037 aquifer:

① Cropping area reduction to 12,000 ha.
② Cropping pattern conversion to increase water productivity.
③ Modernization of irrigation districts with conversion of surface irrigation to pressurized irrigation systems.
④ Reduction groundwater extraction to 150 hm^3.
⑤ Adequate water rights to actual conditions, leaving operating 501 pumping wells and canceling 329 pumping wells.
⑥ Rehabilitate operating pumping wells and install water measuring devices in each well.

How to improve water governance in irrigation districts?

Program Water Rights Use Adequacy and Resizing of Irrigation Districts (PADUA)

Due to groundwater overexploitation in several irrigation districts supplied by subterranean sources, the federal government through the Ministry of Agriculture in Mexico implemented the program Water Rights Use Adequacy and Resizing of Irrigation Districts (PADUA). Its objective was to buy back permanent water rights to maintain and improving the water productivity and competitiveness in critical irrigation districts. This program was operated from 2004 to 2006. It had a unitary cost of 243 USD per thousand cubic meters of groundwater. The ID 037 was the first district where the PADUA program operated.

Problem: Due to higher return in irrigated agriculture supplied by groundwater sources than in those supplied by surface source, the buyback price of water rights set by the federal government was no an incentive to sell water rights by well owners.

Actions to control groundwater extractions in Mexico

1. Supervision of cropped area and volume withdrawn for each pumping well.
2. Strict supervision and penalization of pumping wells with over-extraction above concessioned volume.
3. Annual estimation of static water levels during a non-pumping period.
4. Analysis of critical zones where pumping water levels are beyond expected.
5. Frequent update of aquifer water balance to improve understanding of the magnitude of the recharge and discharge components using new data from pumping wells. Enforcement of water law and regulations.
6. Apply governmental programs to improve operation and efficiency of wells, irrigation modernization, groundwater monitoring and control, and permanent buyback of water rights.

Conclusions

- The analysis of the permanent buy back of water rights in Mexico showed that this policy had a positive effect on water resource conservation in most irrigation districts where was applied but the buyback price of water rights needs to be updated depending of irrigation district.
- The establishment of a legal framework and the modernization of irrigation districts reduced the deficit of the recharge-extraction of some important aquifers that supply important Northern Mexico irrigation districts.
- Coordinated efforts, among federal, states, and local governments, with strong participation of irrigation users are required to improve the groundwater management and control aquifer over-extraction in the medium term