Addressing US and Mexico Water Management in the Binational Drylands Region

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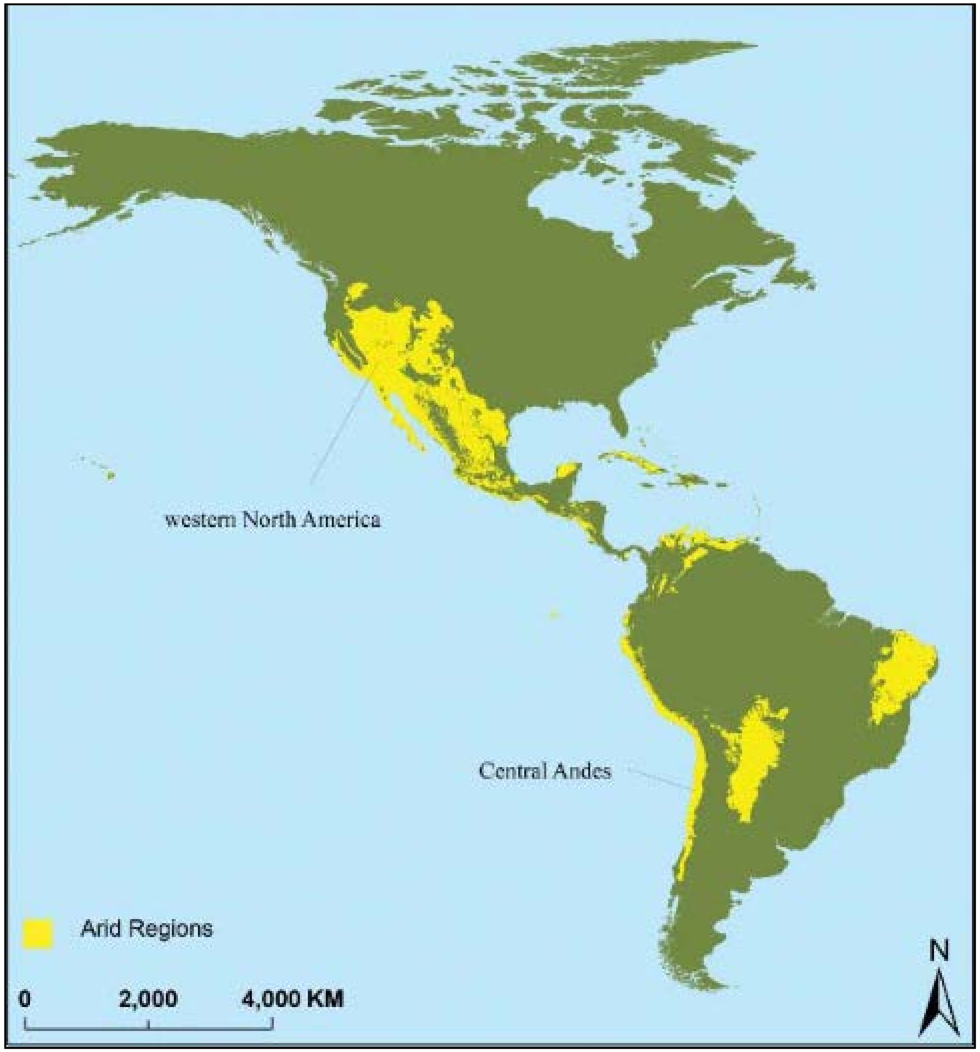
Arid regions: U.S., Mexico, and the Americas

Southwest U.S. and Northwest Mexico in the climate bulls-eye

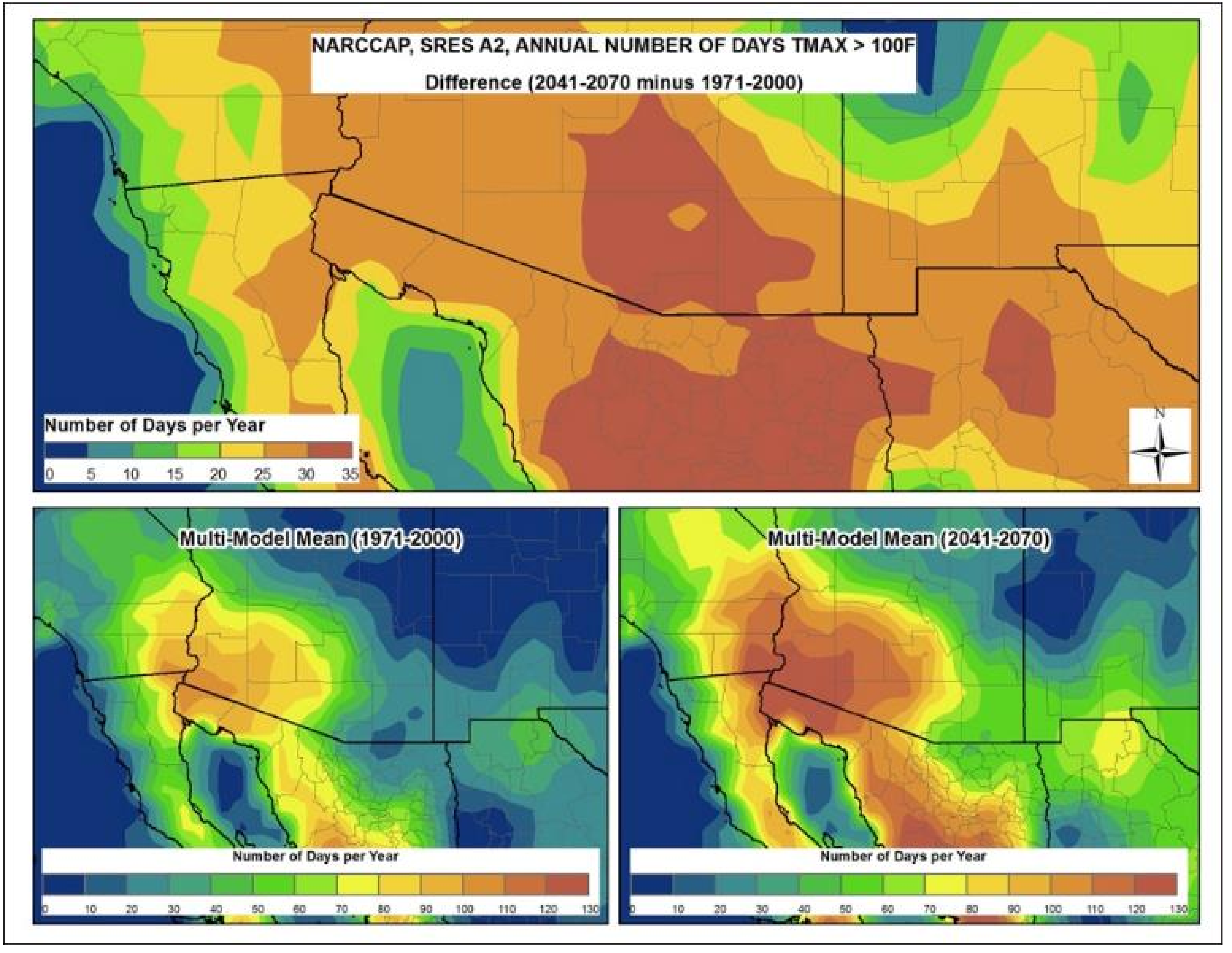
Environmental, social, economic challenges

Vulnerability - including Indigenous populations

Implications for climate challenges globally



Climate change, prolonged drought: more days above 100 °F



Source: NCA, 2013

Increasing climate change impacts

- – Snow pack below average (60%)
- – Changes in amount and temporality of natural runoff
- – Reservoir storage below average (40%)
- – Increasing natural and anthropogenic salinity of water flows

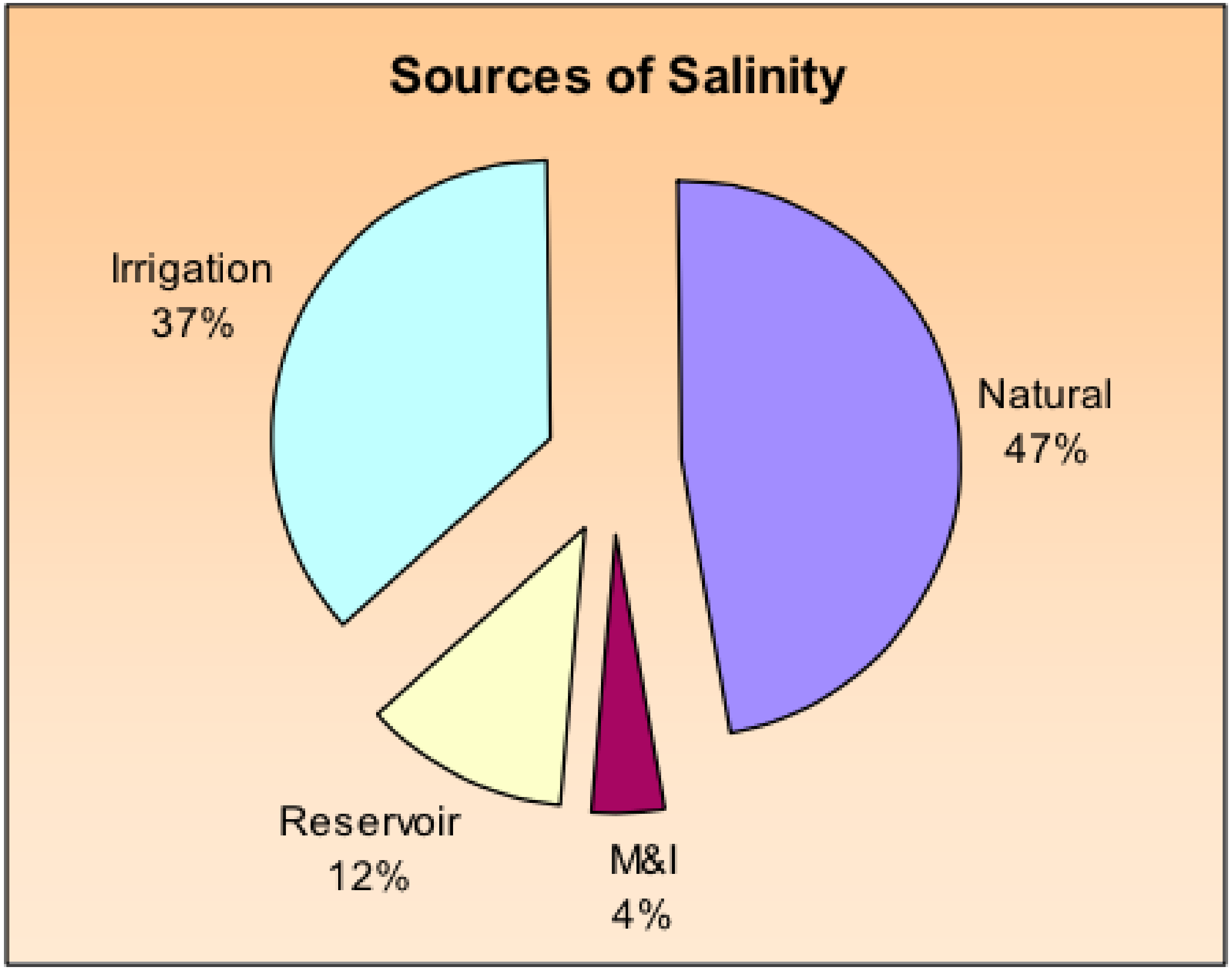
Presa Hoover-Lago Mead
(1983/ 100%)

Source: US Bureau of Reclamation 1983.

Presa Hoover-Lago Mead (2018/40%)

Source: Cortez Lara, 2018

Salinity challenges

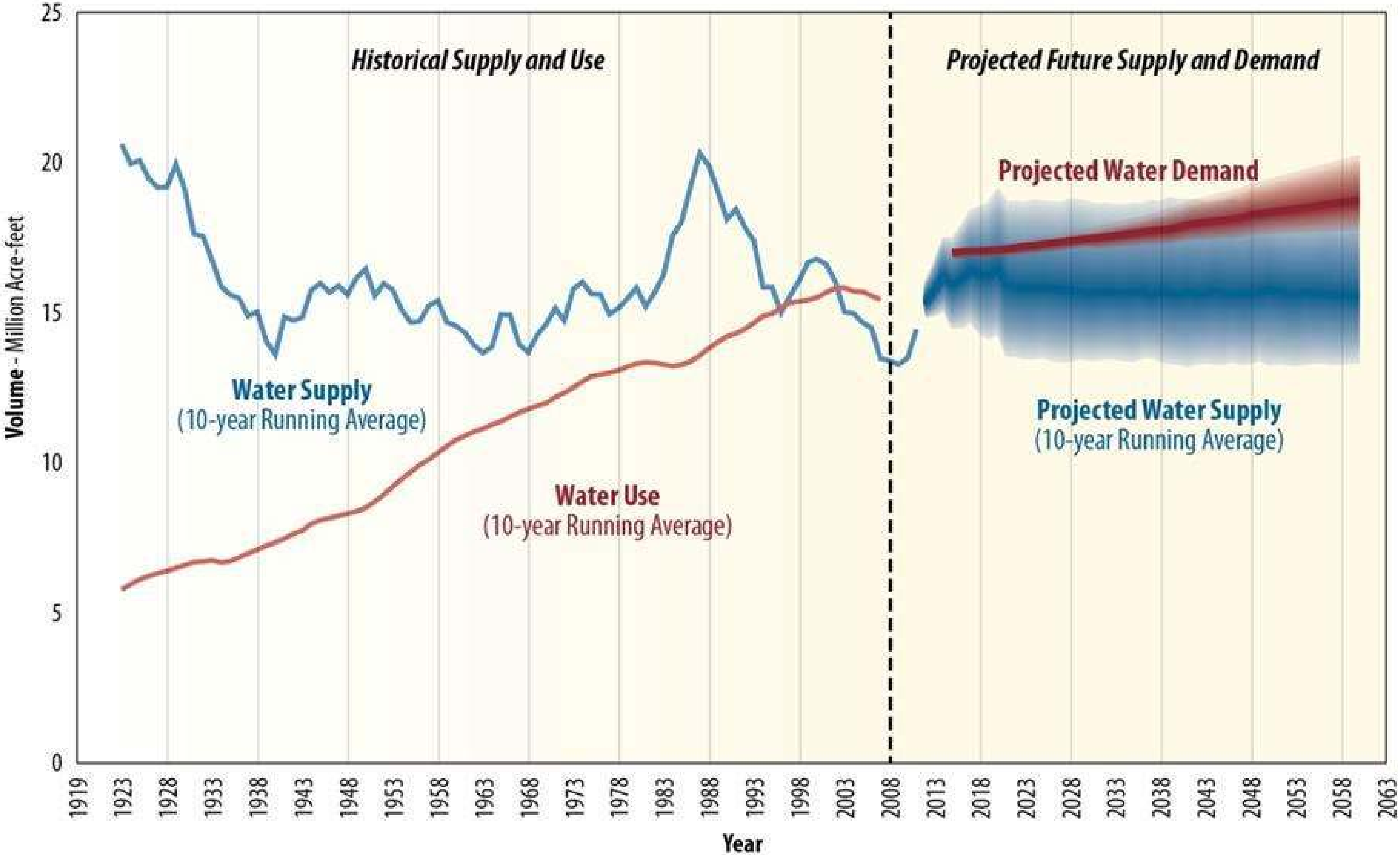


Source: Waterhouse, 2015.; UABC, 2015.

Colorado River Basin
Salts carried = 9 M tons/y
Removed = 1.33 M tons/y
Damages = 615 MD/y

Mexicali Valley
Salts carried= 3.5 M tons/y
Removed = 1.8 M tons/y
Damages = 60,000 hectares

Water supply and demand in the Colorado River



Source: US Bureau of Reclamation, 2016

Human security, water security

- Growing recognition and acceptance of ‘human security’ principles
  - Quality of life
  - Equitable access to and control over resources, services, and outcomes
  - Human health, environmental quality
  - Water as a human right

Crossing the Border

What's Similar? What's Different?

Similarities

- Climate, landscape, environment, resource base
- Traditional economic mainstays, urbanization

Differences

- Culture, language; legal, political, educational and research systems
- Economy, demographic trends, infrastructure
- Degree of autonomy, types of agencies
- Relative vigor of civil society
- Vulnerability to & coping with environmental stress

Source: R. Varady

What does adaptation capacity improvement mean?

– Better binational and local institutional **coordination**

– Better binational and local water **governance**
  – More horizontal telations
  - Citizens forums
  - Public monitoring
  - Transparency in water management processes
- Must pay attention to water resource impacts of energy and food systems (water-energy-food nexus)

Transboundary water governance

- From conflict to cooperation to collaboration
- Natural scarcity + climate change +

Exacerbated by growing demand
(population & industrial growth)

It is paradoxical that a period of maximum water stress (last 5 years) gave rise to a new collaborative capacity

(Minutes 319 & 323)

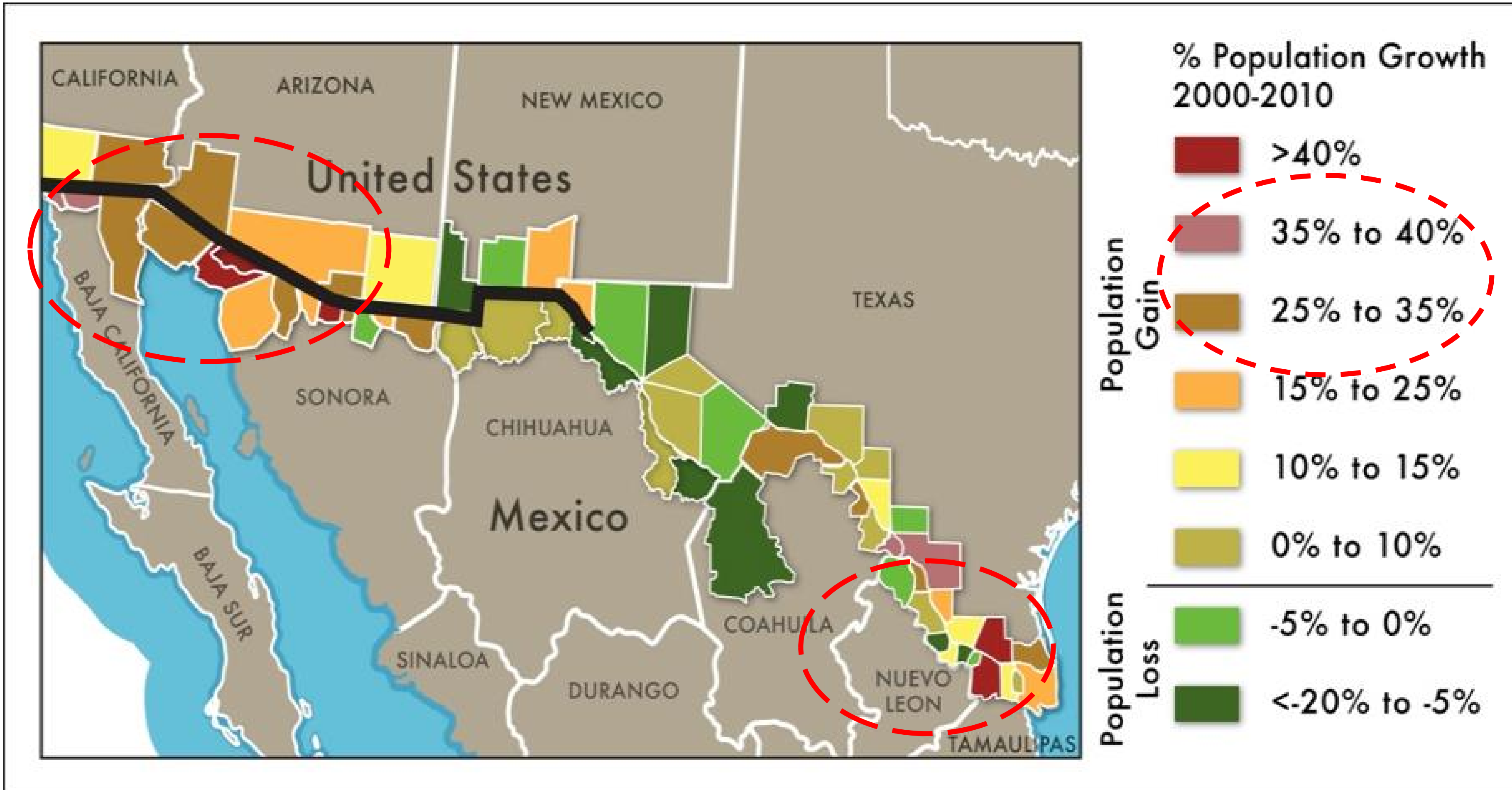
Future water governance challenges

- Demand management
- Conservation
- Re-use
- Cooperation around water storage (reservoirs)
- Manage shortages collaboratively
- Seek sources for ecological flows
- Cooperate/collaborate on desalination?

Shared environment and water resources

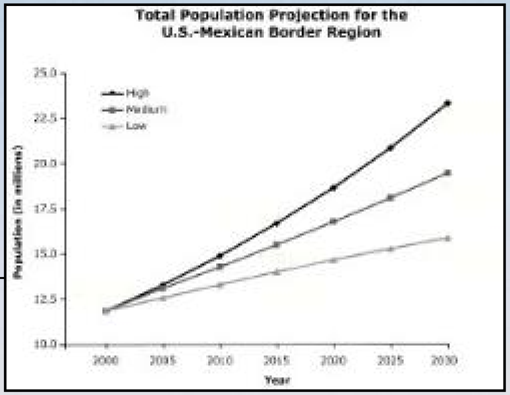
- Resources and adaptation to stressors invariably bring transboundary neighbors together
  - “Water conflicts” over-hyped
  - Requires institutional commitment
- Multiple initiatives that address these challenges collaboratively, sometimes initiated unilaterally

Population dynamics in the borderlands

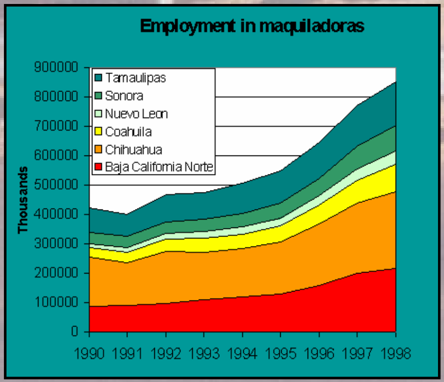


Source: US Bureau of Census and INEGI, 2012

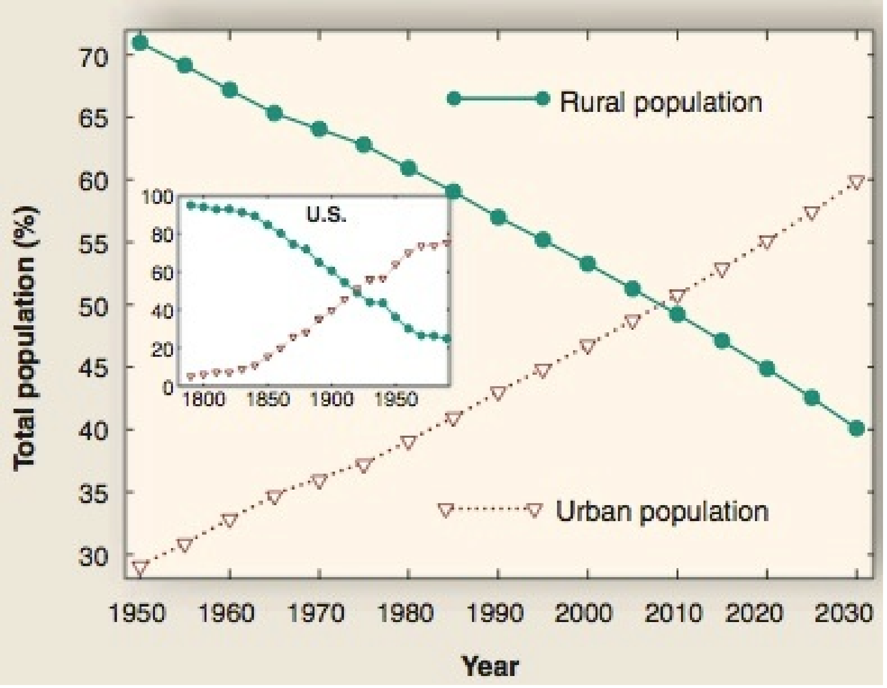
Demographic, economic growth



- Population increases on both sides, but for different reasons
- Urban growth, maquiladoras, mining, food trade
- Increased vulnerability to climate extremes
  - – Strains on water resources and challenges to allocation institutions & infrastructure



Urban growth in arid lands



Change in world rural and urban population (%) from 1950 to 2030[2]

- Cities are rapidly expanding[1]
- Even more so in drylands.
- The drier the land, the larger the fraction of population will be living in urban areas[3]

Urban resilience

- In 2050, 70% of the population will be living in cities.
- Climate change is making weather and natural resource distribution more volatile (e.g., more storms and droughts).
- Cities are more vulnerable due to rapid urbanization and the expansion of infrastructure.
- Building resilience into our increasingly densely populated urban environments is crucial.

Houston, TX after Hurricane Harvey

The US and Mexico are both energy-rich with water stress challenges, highlighting energy-water nexus tensions

Energy for Water

- Energy for water treatment, pumping, distribution, and reclamation
- Energy for end-use appliances
- Energy for water reuse at hydraulic fracturing sites

Water for Energy

- Water for power generation
- Water for hydraulic Fracturing
- Water for biofuels production

In Mexico and the US, water supply and demand are often mismatched

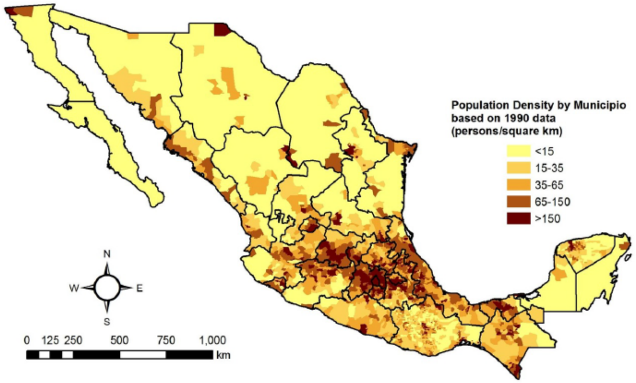
In Mexico:

- North and central regions only receive 28% of annual rain but represent 92% of Mexico's irrigated land
- Irrigated land produces 55% of agricultural activity
- In 2005, 100 of 202 monitored aquifers were overexploited

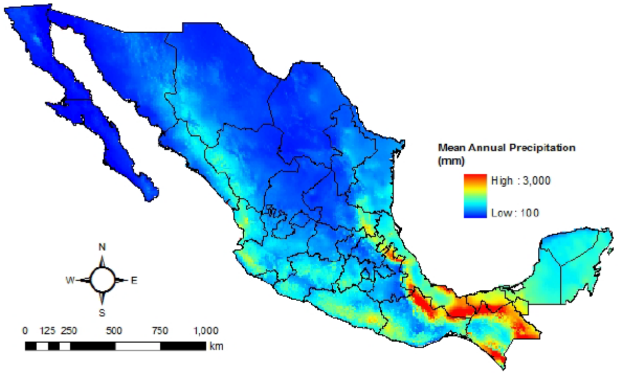
In the US:

- Population growth is occurring in regions that are already water-stressed

Alternative sources of water are often expensive and energy-intensive (desalination, interbasin transfers, etc.)

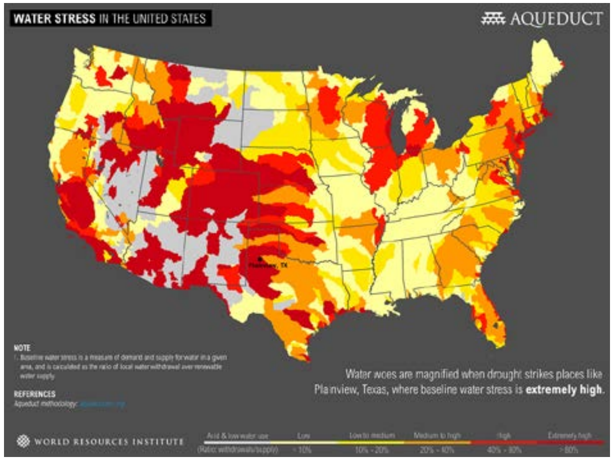


Population Density

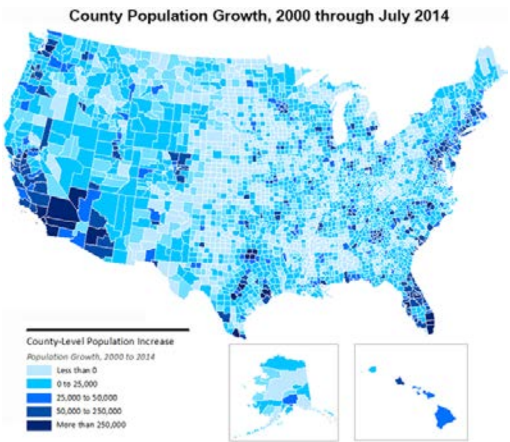


Current mean annual precipitation in (mm)

Source : King et al, 2011



(Source: WRI, 2013)



(Source: Brookings Institution)

Mexico - large energy producer, with large water resource management challenges

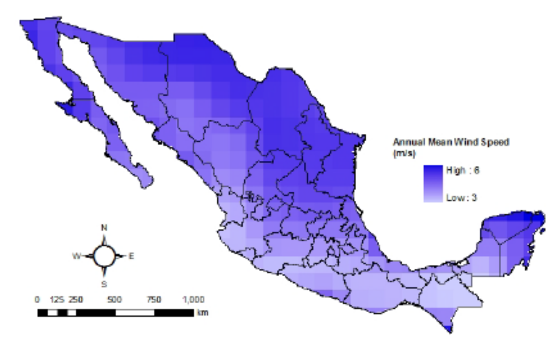
- Energy-rich nation
  - 12th largest producer of oil
  - 13th largest consumer of electricity
  - Among the highest renewable resources in the world
  - 1% of population lacks access to electricity
- Water-scarce nation
  - 3.9% of population lacks access to improved drinking water sources (8% in rural areas)
  - 15% of population lacks access to adequate sanitation (25% in rural areas)
  - Reservoirs are becoming increasingly depleted and contaminated
  - Predicted to become increasingly arid
- Measures to reduce water waste would also save energy
  - Pumping water is highly energy intensive
  - Conservation is cheaper than implementing alternate modes of electricity production
  - Policy reform to reduce water waste might include a “polluter pays” or “user pays” system, which is difficult to implement
    - Requires new modes of measurement
    - Enforcement of property rights
    - Development of water user associations
    - Widespread deployment of meters

Data: CIA Factbook, 2018

US and Mexico share similar energy-water nexus challenges

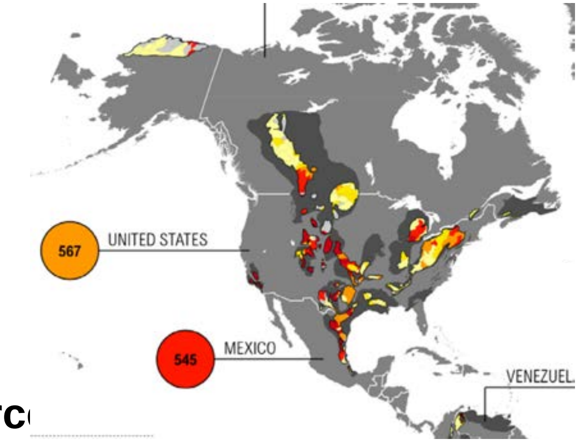
- Both countries are energy-rich (conventional & unconventional oil and gas resources, renewable energy resources)
- Many energy rich areas are located in areas of high water stress
- Both countries are vulnerable to drought and flooding, which are expected to be intensified by climate change
- Energy development could exacerbate existing water tensions
  - Shale oil and gas development is expected to rise significantly in both countries in the future and requires more water for development than conventional resources.
  - Wind and solar photovoltaic panels offer water-lean alternatives for electricity production

North American Solar Resource Potential (Source: solargis.info)



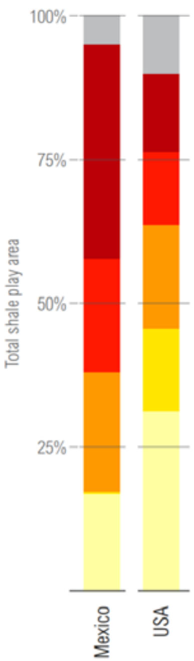
Annual mean wind speed (source: King et al, 2011)

Baseline water stress in shale play regions of the US and Mexico (Source: WRI, 2014)



High baseline water stress coincides with many shale oil and gas plays across the US and Mexico

Countries with the largest recoverable shale resourc

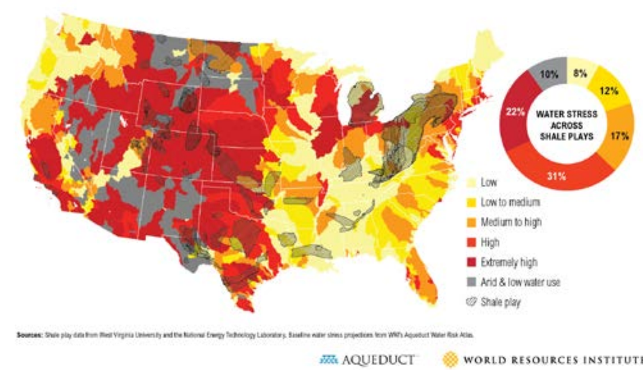


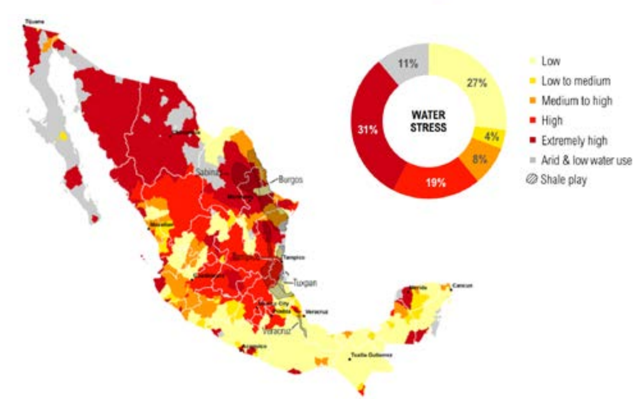
(Shale Gas)

(Shale Oil)

RANK[a]	COUNTRY	AVERAGE EXPOSURE TO WATER STRESS OVER SHALE PLAY AREA
1	Russian Federation	Low
2	United States	Medium to High
3	China	High
4	Argentina	Low to Medium
5	Libya	Arid & Low Water Use
6	Australia	Low
7	Venezuela, RB	Low
8	Mexico	High
9	Pakistan	Extremely High
10	Canada	Low to Medium

PROJECTED BASELINE WATER STRESS ACROSS U.S. SHALE PLAYS IN 2030



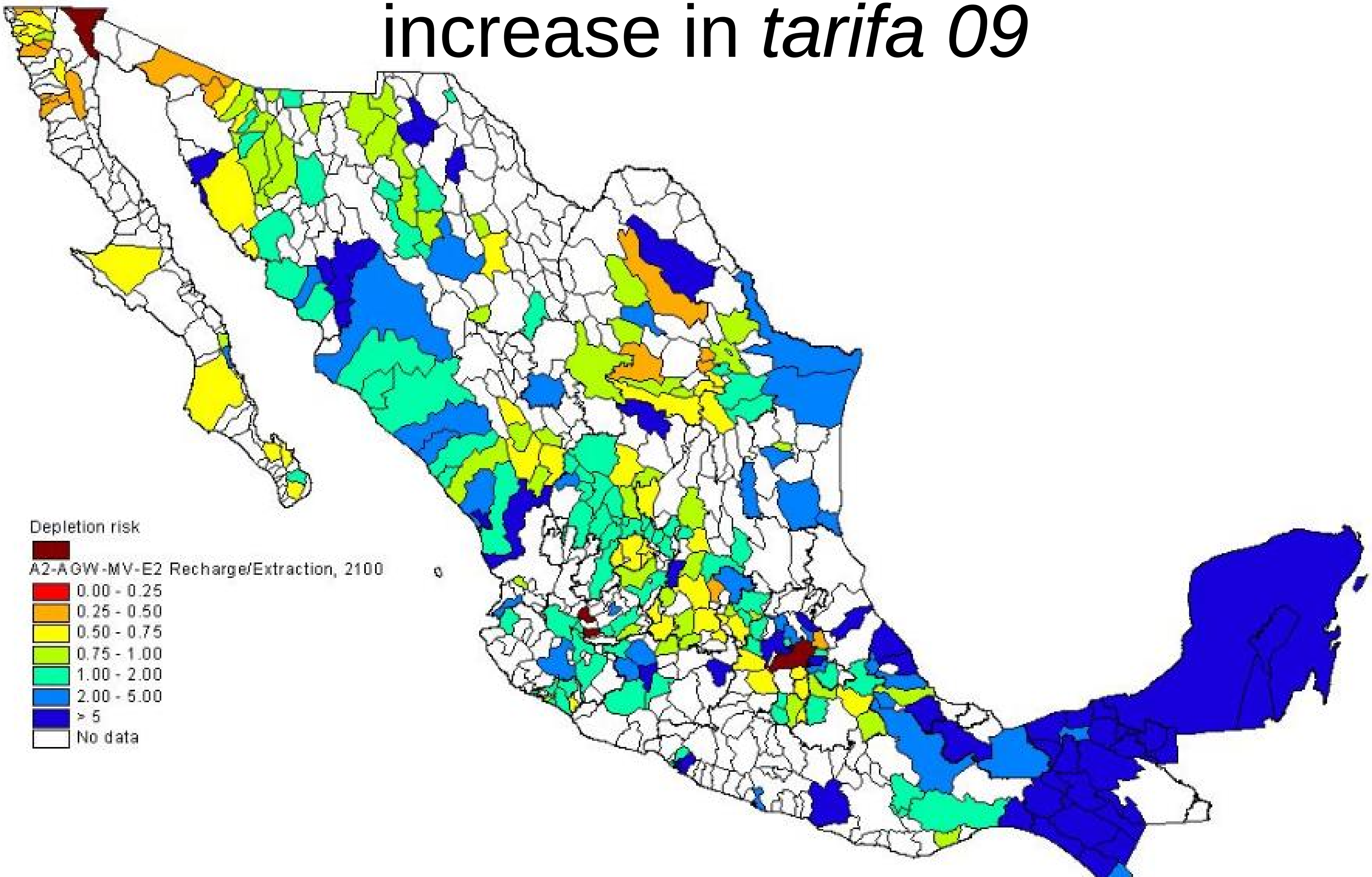


Sources: Location of shale plays from West Virginia University and The National Energy Technology Laboratory. Estimates of baseline water stress from WRI's Aqueduct Water Risk Atlas.

Agua y energía renovable

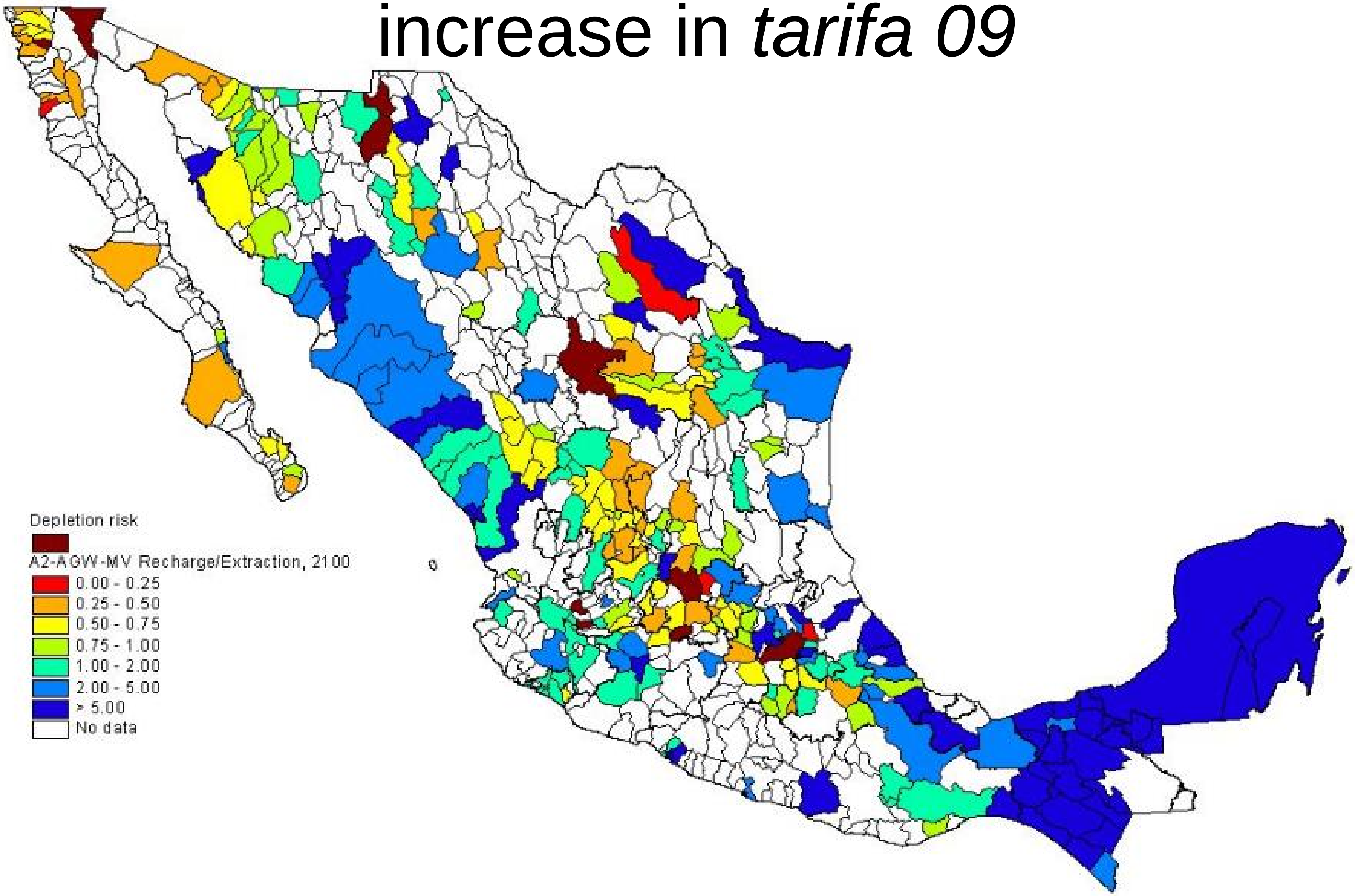
- Energia solar
  - Boileres solares
  - Bombas solares (para el riego)
  - Paneles solares para las casas
  - Alumbramiento público
  - Cercos eléctricos

Groundwater depletion <u>with</u> 2% annual increase in *tarifa 09*



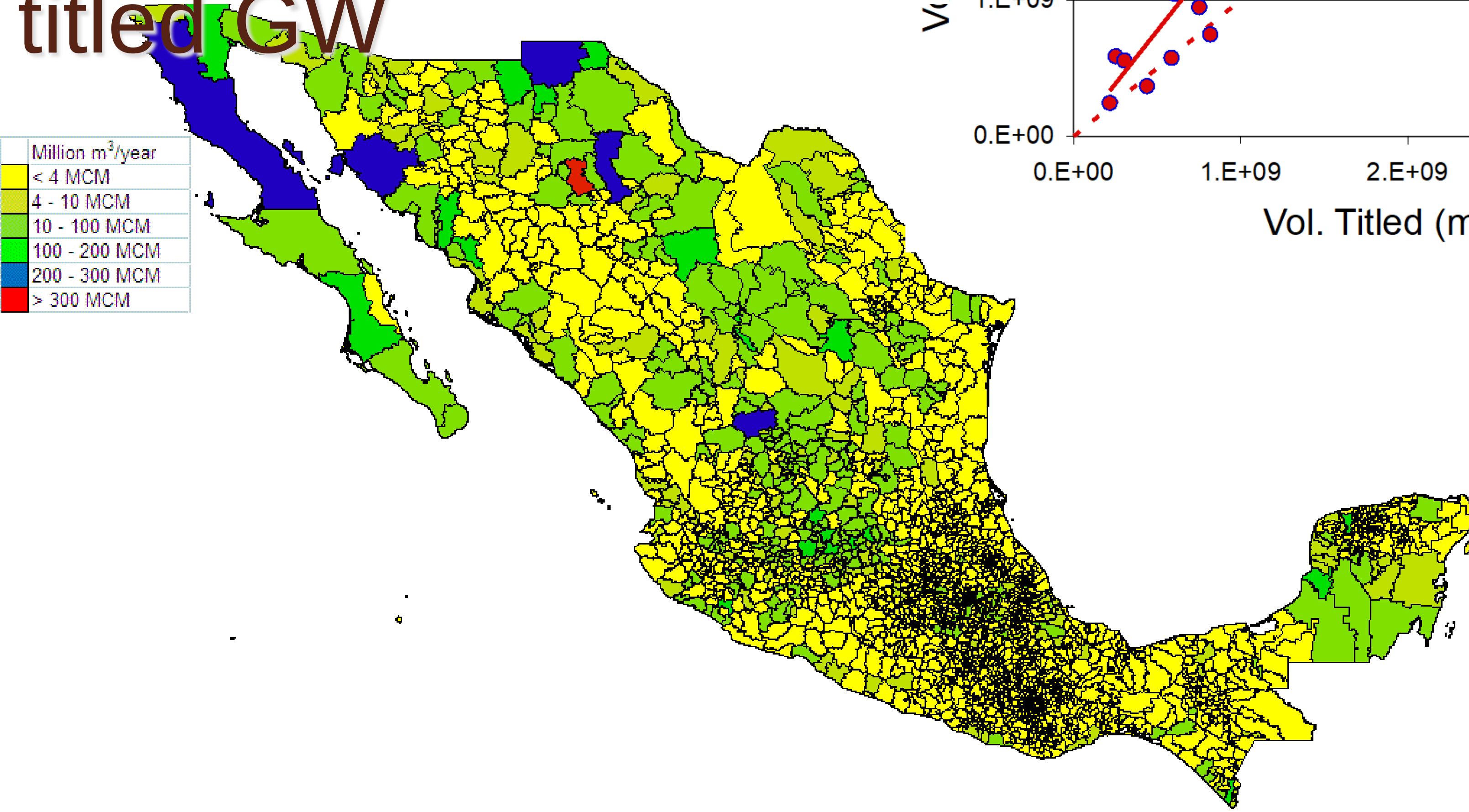
2% annual ***increase*** over 21st Century means *tarifa 09* in 2100 would reach current 2010 tariffs for domestic high-consumption or public service users (in constant 2010 pesos). Instead, from 1999-2009, tariffs ***fell*** at a compound rate of 0.94% annually.

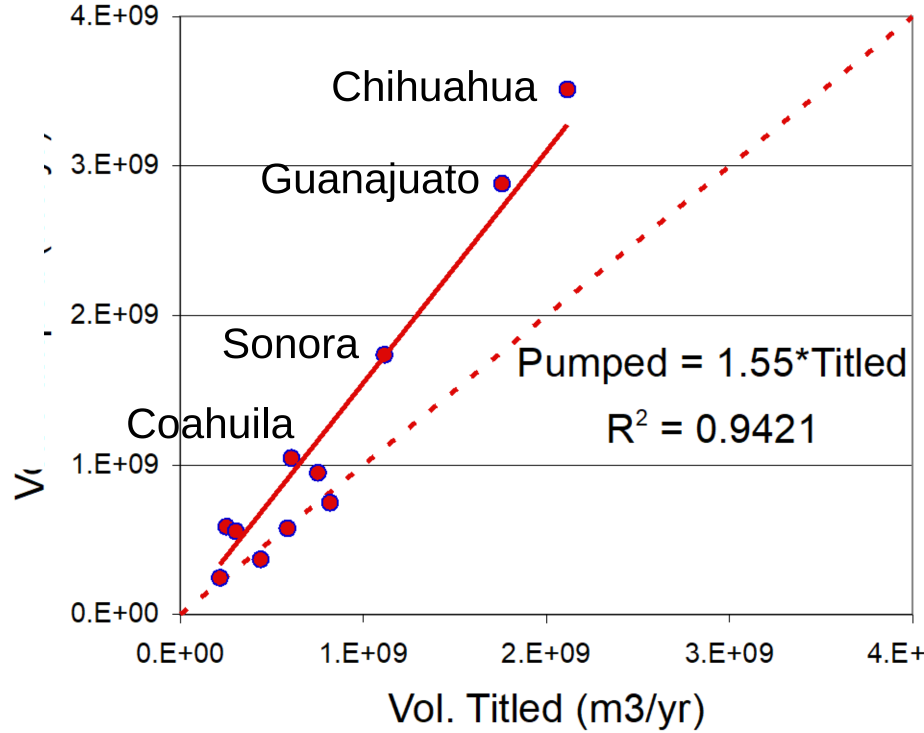
Groundwater depletion without 2% annual increase in *tarifa 09*



unsuccessful

Drilling bans (*vedas*) and concession titles alone are inadequate; pumped GW exceeds titled GW





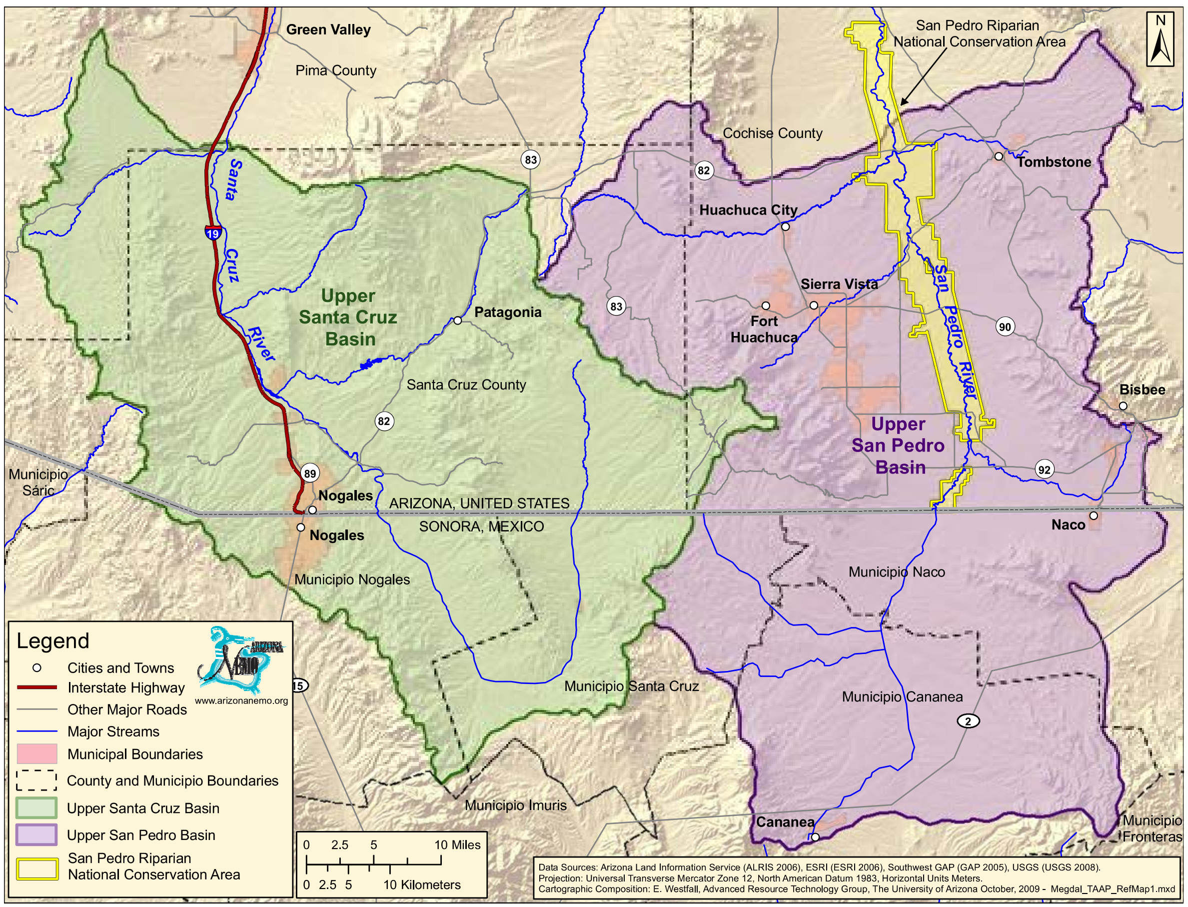
Binational, regional initiatives – some examples

- AQUASEC Center of Excellence for Water Security
  - Inter-American Institute for Global Change Research (IAI)
  - International Water Security Network (Lloyd's Register Foundation, Univ. West of England)

Shared groundwater

Transboundary Aquifer Assessment Program (TAAP)

- US Geological Survey, Univ. Arizona
- CONAGUA, CEA, Univ. Sonora …



Colorado River: US-Mexico collaboration

The Nature Conservancy

OUR WORK GET INVOLVED ABOUT US MEMBERSHIP & GIVING

Areas

- Colorado River
- Where We Work
- How We Work
- Explore
- Restoring the Delta
- Newsroom
- Contact Us
- Ways of Giving

Colorado River

Six Months After the Pulse Flow

Other effective initiatives (may be initiated unilaterally)

- CLIMAS
- Assessment of Climate Change in the Southwest U.S.
- Good Neighbor Environmental Board
- NAFTA institutions (now merged)
  - Border Environmental Cooperation Commission
  - North American Development Bank

Consortium for Arizona-Mexico Arid Environments (CAZMEX)

- Generate basic scientific knowledge; monitor biophysical, social dynamics in Sonoran Desert region, other arid environments
- Create strategies to improve quality of life and sustainably adapt to changes (climate, environmental, social, political)
- Strengthen, forge new binational partnerships to study the binational socio-ecological region

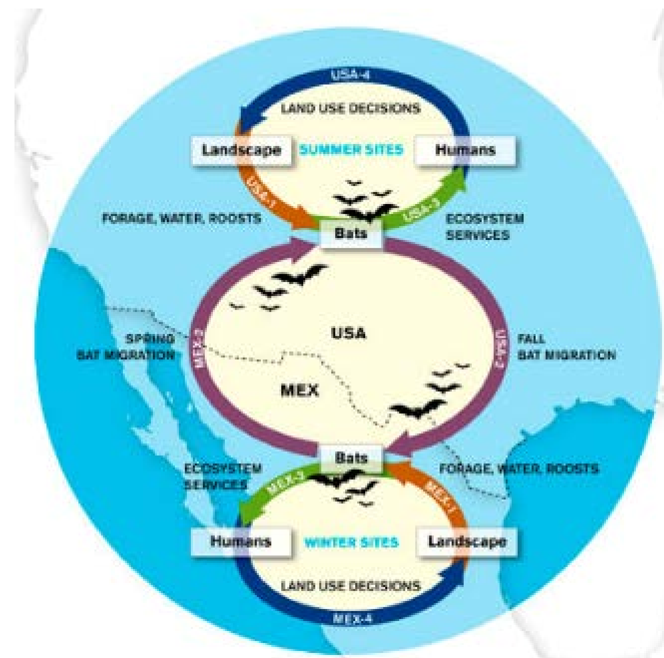
CONACYT

THE UNIVERSITY OF ARIZONA

Agnese Nelms Haury Program
in Environment and Social Justice

Collaboration principles

- Develop shared vision
- Human and ecological security
- Comparative, applied research
- Inter- and transdisciplinary approach
- Science-policy dialogues
- Involve students, youth



Lessons for arid-region resilience

- Water scarcity results from demand-supply imbalance
  - Need for adaptive management incorporating social, hydromet, ecological dimensions
  - Soft-path measures precede hard-path infrastructure
  - Water, energy, food interlinked: resources, institutions, security
- Collaborative, transboundary identification of challenges
  - Co-production of science and policy
  - Outreach beyond academy walls
  - “Inreach” to build policy objectives into research

Udall Center for Studies in Public Policy

Human security: water, biodiversity, renewable energy

- US-Mexico borderlands and water-insecure regions in the Americas, South Asia

Native Nations Institute

- Governance and economic development in
  - North America
  - Australia, New Zealand

Photo by Robert Merideth

Udall Center programs with Mexico:
30 years of cooperation on environmental policy

Binational, cross-border cooperation on research since 1989

- Ford Foundation support for transboundary water management policy (1989-2001)
- Long-term studies on environmental institutions resulting from North American Free Trade Agreement (1994-2001)
- 12 years' funding from NOAA for human dimensions studies of water-climate-society in U.S.-Mexico border region (2003-2015)
- 11 years' support from Inter-American Institute for Global Change Research for research on water-climate information flows and convening of science-policy dialogues (2007-2018)
- 5 years' support from Lloyd's Register Foundation for northern Mexico component of International Water security Network
- Joint research program on environment with CONACYT, CAZMEX (2013-present)

www.watersecuritynetwork.org
www.twitter.com/water_network

Acknowledgement

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For more information, see: www.lrfoundation.org.uk

International Water Security Network

Thank you

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