

Moving Forward from Vulnerability to Adaptation:

Climate Change, Drought, and Water Demand in the Urbanizing Southwestern
United States and Northern Mexico

Avanzando desde la Vulnerabilidad hacia la Adaptación:

El Cambio Climático, la Sequía, y la Demanda del Agua en Áreas Urbanas del Suroeste de
los EEUU y el Norte de México

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CHAPTER 1
INTRODUCTION

Moving Forward from Vulnerability to Adaptation: Theory, Methodology, and Context

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The Arizona-Sonora region along the U.S.-Mexico border has been called “the front line of ongoing climate change” (Harrison 2009). Due to its rapid growth, industrialization, and climate characteristics, it is recognized as a highly vulnerable region in terms of socioeconomic and climate characteristics (Liverman and Merideth 2002; Ray et al. 2007; Wilder et al. 2010). Ensuring future water supply is the region’s highest priority challenge. Climate change projections for reduced precipitation and severe drought in this “already water-scarce region” are expected to cause “troublesome consequences for the southwest United States and Mexico” (Seager and Vecchi 2010:21277).

From 2008 to 2011, a binational team of researchers led by the University of Arizona and El Colegio de Sonora worked closely with decision-makers, water managers, and disaster relief planners (i.e., stakeholders) to conduct linked urban water vulnerability assessments of four urban climate change “hotspots” in the Arizona-Sonora region, as part of the NOAA/SARP project, *Moving Forward from Vulnerability to Adaptation: Climate Change, Drought, and Water Demand in the Urbanizing Southwestern United States and Northern Mexico*. The case studies were conducted by the research team using linked questions and methodologies to assess near- and long-term (5 to 20+ year) climate-related vulnerability and adaptive capacity of the water sectors in four urban areas in the region: Tucson, Ariz.; Nogales, Ariz./Nogales, Son.; Hermosillo, Son.; and Puerto Peñasco, Son. Research support was provided by the National Oceanic and Atmospheric Administration’s Sectoral Applications Research Program (SARP), NOAA’s Climate Assessment for the Southwest (CLIMAS) Program; and the Inter-American Institute’s Global Change Research Human Dimensions program (IAI).¹

The rapidity of growth in Arizona and Sonora increases the vulnerability of urban water users to climatic changes due to such factors as aging or inadequate water-delivery infrastructure, over-allocation of water resources within the region, and location of poor neighborhoods in flood-prone areas or other areas at risk. Since 1980, the urban populations within our study region have exploded: Tucson has grown by 53 percent; Hermosillo by 116 percent; and Nogales, Son., by 189 percent. With Arizona remaining one of the United States’s fastest growing states, and Sonoran cities growing at twice the national Mexican average over the last decade, water demand over the next 20 years is projected to double. Another sector vulnerable to climate – agriculture – continues to be an important

1 National Oceanic and Atmospheric Administration Sectoral Applications Research Program (NOAA-SARP) grant NA080AR4310704; NOAA’s Climate Assessment for the Southwest (CLIMAS) Program grant NAG16GP2578; and Inter-American Institute’s Global Change Research Human Dimensions program (IAI) grant SG-HD-#005, supported by the National Science Foundation grant GEO-0642841.

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part of the regional economy and consumes approximately 70 to 80 percent of available water in the Arizona-Sonora region (Arizona Town Hall 2004; CNA 2008).

Research Questions

The *Moving Forward* project responds to four central research questions:

- How is urban water sector vulnerability defined in the four urban sites in the study region?
- What is the institutional capacity of this transboundary region to develop adaptive strategies for future water management, at a 5 to 20+ year horizon?
- How can the capacity of water managers and preparedness planners to use climate science and information to improve long-range and “adaptive” decision-making best be institutionalized?
- How can climate science best be integrated into planning processes to enhance the resilience of urban border communities to climatic and water-resources uncertainties?

To respond to these questions, we planned **three major outputs** from the study:

1. **Case studies of climate-related water sector vulnerability** in the four urban areas (Tucson, Ambos Nogales, Hermosillo, and Puerto Peñasco) based on analysis of identified vulnerability indicators, including biophysical, demographic, socioeconomic, and institutional characteristics;
2. Production of a quarterly **binational climate summary** (in Spanish and English) focused on dissemination of value-added, timely, and regionally focused climate information based on a principle of co-production of regional climate knowledge by policymakers and the scientific community;
3. A series of **stakeholder workshops** focused on identifying priority vulnerability areas and improving the fit between climate information needs of stakeholders and the climate information produced by the scientific community in the binational region.

Overview of Study Area: Four Urban Climate Change Hotspots

For these studies, we identified four major growth “hotspots”: Tucson; Ambos Nogales (referring to Nogales, Ariz., and its ‘twin’ city, Nogales, Son.); Hermosillo, Sonora’s state capital; and Puerto Peñasco, on the Gulf of California coast (see Figure 1-1). Climate is the key unifying factor in our selection of these sites—we have intentionally selected urban areas within monsoon-driven climate regimes.

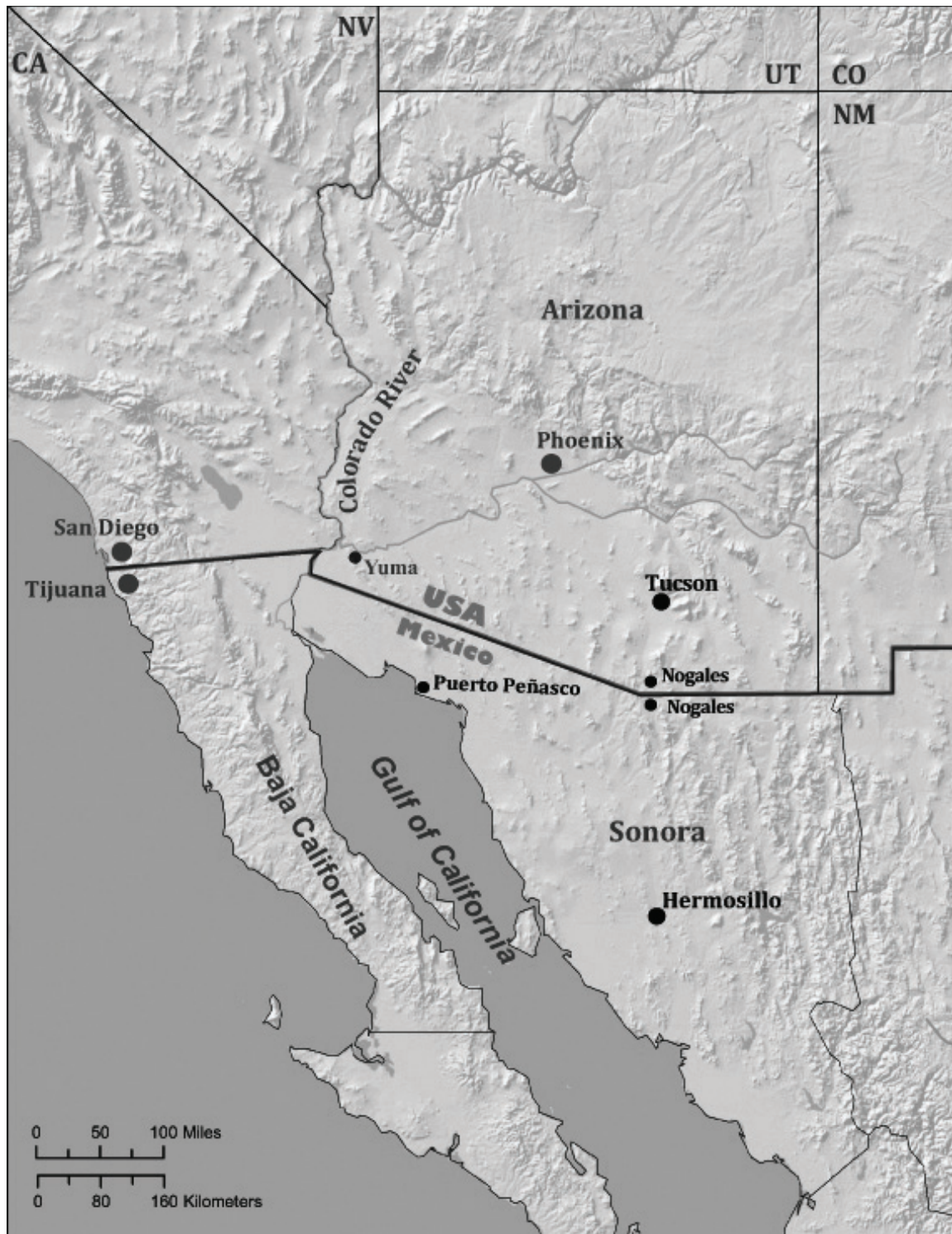


Figure 1-1. U.S.-Mexico border area and study sites (in black): Tucson, Ariz.; Nogales, Ariz./Nogales, Son.; Hermosillo, Son.; and Puerto Peñasco, Son. Source: Zack Guido, CLIMAS Project, University of Arizona.

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These sites also encapsulate the most critical issues facing this region: changing urban water supply and demand in high-growth border-region cities; urban-rural interface and urban/agricultural water use tradeoffs; and the expanding phenomenon of resident-tourism driven growth that has transboundary economic drivers. (“Resident tourism” refers to the North American vacation house industry resulting in new subdivisions and commercial tourism development on the Sonoran coast.) Our study area includes the Colorado River system to the west of our main study area to the extent that its water is integral to current and future water-supply planning for the Tucson area; however, we did not include an extensive study of that basin within the scope of this project, given its distinct climate, water-resources profile, and demographic challenges. (The CLIMAS program does have ongoing climate and sustainability projects within the Lower Colorado River and Delta region.)

Theoretical Framework: Vulnerability and Adaptation

Vulnerability is produced by “on-the-ground” inequalities and political-economic conditions, rather than “falling from the sky” (Ribot 2010:49), and is conditioned by socioeconomic, institutional, and political, as well as environmental factors, including climate (Adger 2006). Uneven development is also a hallmark of relatively high vulnerability (Romero-Lankao and Borbor-Cordova forthcoming). Figure 1-2 identifies how biophysical and social processes interact with one another to create vulnerability to climate change.

In keeping with Kelly and Adger (2000), we define “vulnerability” as “the ability or inability of individuals and social groups to respond to, in the sense of cope with, recover from or adapt to, any external stress placed on their livelihoods and well-being.” “Adaptive capacity” refers to the ability of a given region to anticipate, respond dynamically to, and/or plan for projected changes associated with climate change. “Resilience” refers to a human-environment system’s ability to “bounce back” by developing social networks and institutions capable of adaptation and learning to respond more sustainably to climate change (Tompkins and Adger 2004).

The uneven development evident in the border region poses challenges for developing adaptations in the Arizona-Sonora region. Climate impacts are not uniformly distributed across populations and space, but instead are closely-related with specific vulnerable populations and places (Romero-Lankao and Borbor-Cordova forthcoming). In the United States, studies have documented higher vulnerability among Latino and African-American populations, for example, due to factors such as low average incomes and lack of affordability of energy for cooling and heating in periods of extreme temperatures; outdoor employment; and lack of green spaces (Morello-Frosch 2009; Verchick 2008; Harlan 2006).

At the same time, effective cross-border collaboration can enhance the border region’s adaptive capacity through developing shared understandings of regional vulnerabilities and working cooperatively to address them (Wilder et al. 2010). Shared information and data are particularly important. Integration of climate information into decision-making processes can help reduce social and climate vulnerability within the identified region and build community resiliency (IPCC 2007; Kelly and Adger 2000). Thus, the assessment of an area’s social vulnerability and institutional capacity to respond to crises are points of beginning for research that may lead to increased community resilience (Ray et al. 2007).

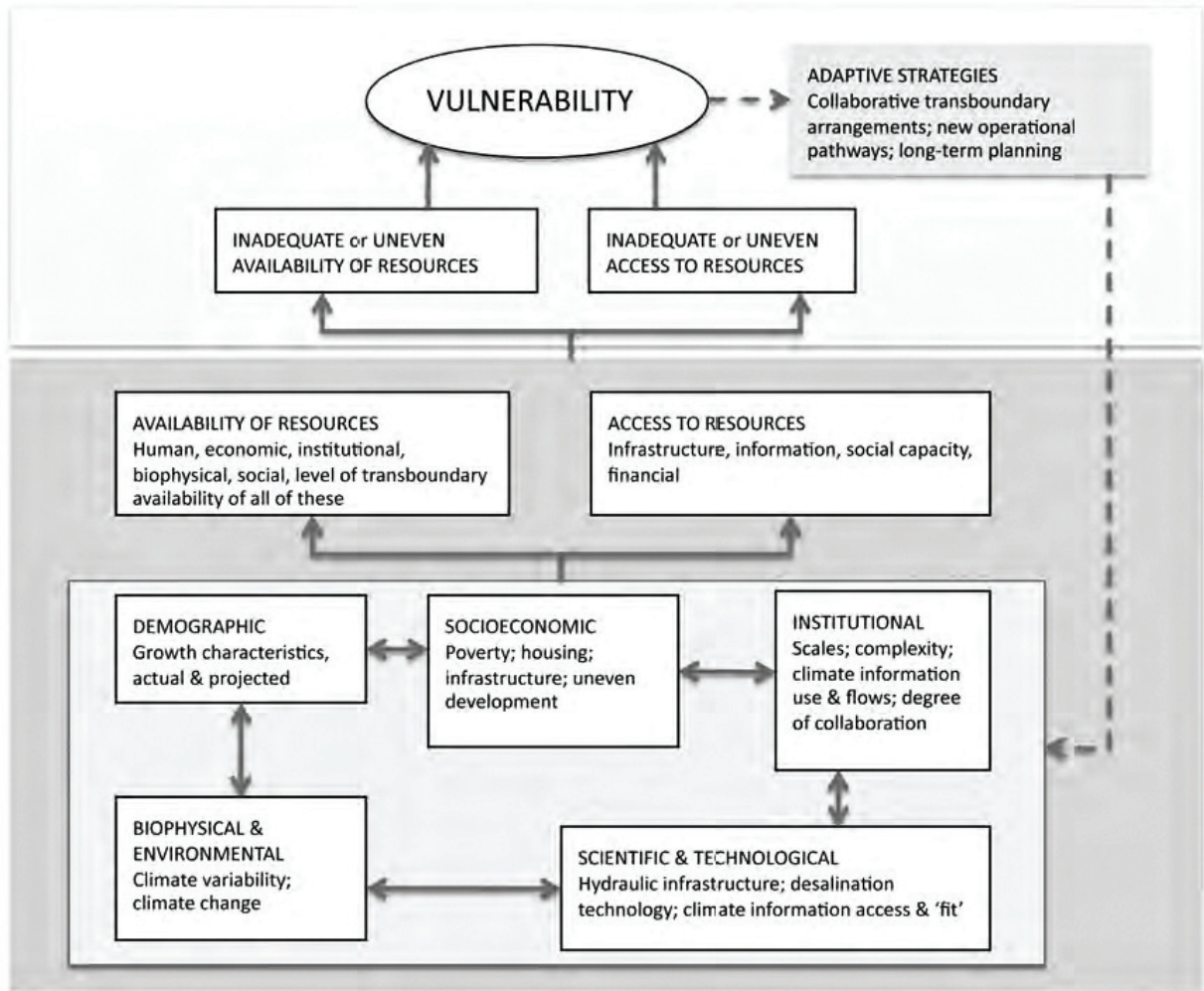


Figure 1-2. Theoretical Framework of the Processes Driving Vulnerability. Scaled analysis including global, binational, regional, and local drivers acting over the short term (shock) or long term (chronic). Adapted from Misselhorn 2005.

These key concepts need to be operationalized for assessment purposes. Thus, these case studies are integrated through their reliance on a common framework for assessing regional vulnerability. Our research framework (see Figure 1-2, adapted from Misselhorn 2005) is based on assessment of five indicators of regional vulnerability: demographic, socioeconomic, biophysical/environmental, scientific and technological, and institutional vulnerability. Each case study utilizes these five indicators to assess urban water vulnerability. At the same time, we use urban plans, transboundary collaboration, information-sharing and alternative conservation strategies as evidence of adaptive capacity. In Table 1-1, the major vulnerabilities and adaptation activities of each study site are summarized.

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Table 1-1. Summary of Preliminary Findings.

| RESEARCH SITES | PRIORITY VULNERABILITY THEMES IDENTIFIED | ADAPTATION ACTIVITIES (initiated, ongoing, or in planning stage) |
|---------------------------|---|---|
| Ambos Nogales, Ariz./Son. | <p>Fragmented, complex transboundary water management across Ambos Nogales</p> <p>Inadequate access to drinking water and sanitation in poor Nogales, Sonora neighborhoods; and staggered water service (tandeo) across municipality</p> <p>Inadequate infrastructure for flood management in Nogales, Sonora</p> | <p>Collaboration on wastewater treatment and groundwater assessment via IBWC/CILA and state/local water management organizations</p> <p>Systematic research on water vulnerability at neighborhood level; community mobilization on key vulnerabilities in water access; alternative strategies being tested (e.g., compost toilets)</p> <p>Developing flood management and warning systems (municipal water authority, OOMAPAS, USGS & IMIP)</p> |
| Puerto Peñasco, Son. | <p>Aquifers exhausted and cannot support projected future growth of tourism/hotel industry</p> <p>Fragile estuaries in Upper Gulf with endangered species need protection from both over-fishing and tourism expansion</p> | <p>Municipal desalination plant in feasibility study to serve Puerto Peñasco and tourism industry</p> <p>Active NGO (Center for Protection of Deserts and Oceans, CEDO) working with local fishermen and businesses to put protections in place</p> |
| Tucson, Ariz. | <p>Reliance on sole-source supply from over-allocated and water-stressed Colorado River</p> <p>Drought-prone and high-growth area</p> | <p>Long-term water supply/climate scenario planning by Tucson Water</p> <p>Conservation promotion at household scale and recharge/re-use at municipal scale</p> |
| Hermosillo, Son. | <p>Water rationing (tandeo) across Hermosillo due to low water supply, use patterns, & infrastructure losses</p> <p>Regional and urban-rural competition for water</p> | <p>Arizona-Sonora have joint binational desalination planning underway for new desalination plant in Puerto Peñasco</p> <p>Sonora Integrated System (Sonora SI) plans major water transfers from commercial irrigation districts in the south of Sonora to Hermosillo and other cities</p> |

Overview of Climate Variability and Climate Change Forecasts and Impacts in Region

The U.S.–Mexico border region is a textbook case of “double exposure” (Leichenko and O’Brien 2008) to climatic and globalization processes (Liverman and Merideth 2002; Ray et al. 2007) as a vulnerable area undergoing urbanization, industrialization, and agricultural intensification. As mentioned above, the region has been called “the front line of ongoing climate change” (Harrison 2009). Global climate models for the region project severe precipitation decreases and temperature increases. Regional climate change is expected to lead to a 2 to 3° C increase in annual temperature and a 5 to 15 percent decrease in annual precipitation by 2080-99, in comparison with a 1980-99 base period, based on 21 global climate models (GCMs), using an A1B greenhouse gas emissions scenario (IPCC 2007). All models agree on the increase in annual temperature and more than 75 percent of models agree on the decrease in annual precipitation.

Moreover, Diffenbaugh et al. (2008) identify northern Mexico, and the Mexico-Arizona border region as persistent climate change hotspots; they note that these regions are sensitive to changes in winter and summer season precipitation variability, during the 21st century.

Anticipated probable impacts include longer, more extreme droughts, higher water and energy demand, decreased inflows to rivers and streams, and increased urban–agricultural conflict over water (IPCC 2007; Seager et al. 2007). Drought impacts on water supply are expected to become more severe (Cayan et al. 2010; Seager and Vecchi, 2010; Seager et al. 2007). If anticipated reductions in precipitation come to pass, aggravated by increased evapotranspiration due to increased temperatures, as projected, “they will lead to reduced surface moisture and river flows and stress water resources in an already water-scarce region with troublesome consequences for the southwest United States and Mexico” (Seager and Vecchi 2010:21277).

Summers during the observed early 21st century drought were remarkably warm, a feature also evident in many simulated droughts of the 21st century. These severe future droughts are aggravated by enhanced, globally warmed temperatures that reduce spring snowpack and late spring and summer soil moisture. As the climate continues to warm and soil moisture deficits accumulate beyond historical levels, the model simulations suggest that sustaining water supplies in parts of the Southwest will be a challenge (Cayan et al. 2010).

Institutional Framework and Stakeholder Engagement

The Arizona-Sonora region has a complex and fragmented set of water management institutions that can pose challenges for the development of adaptive strategies for urban areas in the study region. At the same time, the Arizona-Sonora region is the site of dynamic multi-stakeholder collaborations involving government agencies, non-governmental organizations, and civil society groups. Effective collaboration is key to adaptive water governance and may help coordinate responses by the diversity of water managers while helping develop common understandings of climate-related vulnerability in the water sector. These factors, we argue, potentially add to regional resilience (Wilder et al. 2010).

Recent research has increasingly shed light on the importance of understanding how society interacts with climate and how social stakeholders utilize (or fail to utilize) climate information (Jacobs et al. 2005). Adaptive capacity is a dynamic process based on social learning between and within institutions, rather than a static condition or set of attributes and outcomes (Wilder et al. 2010; Pahl-Wostl 2007; Pelling et al. 2008). Shared social learning in a transboundary setting refers to the development of common conceptual understandings of climate challenges and regional vulnerability integrated over multiple institutional scales, from individuals and local agencies to state, federal, and binational actors and authorities. The mere existence of climate information is not enough—stakeholders require tailored climate information that suits institutional needs and specific contexts for making decisions, as well as information available at multiple spatio-temporal scales (Wilder et al. 2010; Ray et al. 2007; Browning et al. 2007; Bales et al. 2004; Rayner et al. 2005; Jacobs et al. 2005; Feldman et al. 2008). In fact Feldman et al. (2008), quoting a 2008 National Research Council report, note “greater weight was given [by decision-makers] to ‘creating conditions that foster the appropriate use of information’ rather than to the information itself.” Lowrey et al. (2009) also found that interactions between scientists, information providers and water managers helped improve managers’ perceptions of risk, as well as scientists’ understanding of parameters critical to management operations; the combination of such exchanges and the combined expertise of scientists and decision-makers, generated a co-production of knowledge in ways that fostered use of climate information, outlooks, and projections to adapt to changing climate conditions and increase water supply reliability.²

A more sophisticated and integrated use of climate information clearly resides in the adeptness of the science-stakeholder interaction. Thus, this project has responded to the needs identified in the studies discussed here by developing vulnerability assessments and site-specific studies for four urban areas unified by their location within the monsoon climate region. Through sustained collaboration and communication with regional stakeholders—including urban water managers and preparedness planners—this research was intended to move the science-stakeholder interaction forward toward a new plateau focused on assessing social and climate-related vulnerability in the context of future water supply planning at a long-term perspective. Central to this research was the development and delivery of a binational climate outlook product and the facilitation of institutional innovations to enhance access and use of climate information appropriate to specific contexts.

² The Feldman et al. 2008 citation (CCSP 5.3, chapter 4) and CCSP 5.3 chapter 3 have abundant lessons, examples, and information germane to the co-production of knowledge between scientists and decision-makers.

Study Methodology

The binational research team on this project consisted of over twenty individuals in 8 institutions with consistent involvement from key policy making agencies involved in water management in the region.³ The research team utilized a variety of research methods to assess urban vulnerability and adaptive capacity, including 60 fieldwork site visits, 84 stakeholder interviews, four online and on-site surveys of stakeholders, three focus groups, and participant observation at ten meetings from 2008 to 2010 (Table 1-2).

Table 1-2. Study Methodology.

| RESEARCH METHOD | FREQUENCY |
|---|-----------|
| Fieldwork visits | 60 |
| Stakeholder interviews | 84 |
| Online and on-site (at workshops) stakeholder surveys | 4 |
| Focus groups | 3 |
| Participant observation at meetings | 10 |
| Stakeholder workshops (350 attendees) | 5 |

In addition, the research team sponsored five major stakeholder workshops with the objective of identifying priority vulnerabilities and assessing the institutional capacity for meeting the climate challenges relating to the urban water sector at a 5 to 20+ year horizon (Table 1-3).

Finally, a major project output includes the quarterly bilingual Border Climate Summary/Resumen del Clima de la Frontera, now in its 10th edition.

Table 1-3. Stakeholder Workshops.

| WORKSHOP | LOCATION | DATE | ATTENDANCE |
|---|------------------------|-------------------|------------|
| NOAA-SARP/CLIMAS/IAI “Moving Forward” Project Launch | Tucson, Arizona | Sept. 26, 2008 | 50 |
| Water and Climate Workshop | Hermosillo, Sonora | Nov. 8, 2008 | 60 |
| Information Flows and Climate Diagnostics for the U.S.-Mexico Border Region | Jiutepec, Morelos | July 9, 2009 | 50 |
| Water and Climate Workshop and Research Team meeting | Puerto Peñasco, Sonora | October 2-3, 2009 | 75 |
| Water and Climate Workshop | Hermosillo, Sonora | May 10, 2010 | 60 |

³ University of Arizona (Tucson) and El Colegio de Sonora (Hermosillo) were the lead academic institutions in this collaborative study. In addition, researchers from the National Center for Atmospheric Research (NCAR) (Boulder CO), National Oceanic and Atmospheric Administration (NOAA), and the IRI (Columbia University, New York) also participated in the U.S. In Mexico, other key research institutions were the Instituto Mexicano de Tecnología del Agua (IMTA, the research arm of Mexico’s National Water Commission), the Universidad de Sonora (Hermosillo), CIBNOR (Guaymas, Sonora), CICESE (Ensenada and La Paz, Baja CA). Key government agencies that participated consistently in the workshops and assisted with research included Servicio Meteorológico Nacional (National Weather Service), National Water Commission, CEA, OOMAPAS, Tucson Water, Arizona Dept of Water Resources, among others.

Introducción en español

Este documento es un documento de trabajo y es uno de una serie de cuatro estudios vinculados que abordan la cuestión de la vulnerabilidad del agua en los lugares urbanos de la frontera de los EEUU y México. Como parte del proyecto NOAA/SARP, Avanzando desde la Vulnerabilidad hacia la Adaptación: El Cambio Climático, la Sequía, y la Demanda del Agua en Áreas Urbanas del Suroeste de los EEUU y el Norte de México. Los estudios de los casos se llevaron a cabo por un equipo de investigación con unas cuestiones y metodologías vinculadas para evaluar la vulnerabilidad relacionada con el clima a corto y largo plazo y la capacidad de adaptación de los sectores del agua en cuatro zonas urbanas de la región de Sonora y Arizona, incluyendo: Nogales, Arizona; Nogales, Sonora; Hermosillo, Sonora; y Puerto Peñasco, Sonora (Figura 1-1, página5).

La región de Sonora-Arizona en la frontera de México y Estados Unidos ha sido llamada “la primera línea de la batalla contra el cambio climático” (Harrison 2009). Debido a su rápido crecimiento, la industrialización y las características del clima, es reconocido como una región de alta vulnerabilidad en cuanto de sus características socioeconómicas y del clima (Wilder et al. 2010; Ray et al, 2007; Liverman y Merideth 2002). La garantía del suministro de agua en el futuro es la prioridad más difícil de la región. Proyecciones del cambio climático se espera la disminución de las precipitaciones y la sequía severa en esta región que ya tiene un problema con la “escasez de agua” van a causar “consecuencias molestas para el suroeste de los Estados Unidos y México” (Seager y Vecchi 2010:21277).

De 2008 a 2011, un equipo binacional de investigadores de la Universidad de Arizona y El Colegio de Sonora trabajó estrechamente con los encargados de tomar decisiones, los gestores del agua, y los planificadores de socorro (por ejemplo, las partes interesadas) para llevar a cabo evaluaciones de la vulnerabilidad de agua en cuatro lugares urbanos que son “puntos calientes” con respecto al cambio climático en la región Sonora-Arizona. El estudio se centra en el nexo entre el clima y el agua en los próximos cinco o veinte años. En nuestra investigación, el término *la vulnerabilidad* se refiere a la producción “en el terreno” de las desigualdades y las condiciones políticas económicas (Ribot 2010:49) y está condicionada por factores socioeconómicos, institucionales y políticos, así como el medio ambiente y las condiciones climáticas (Adger 2000). La capacidad de adaptación se refiere a la capacidad de una región a anticipar, responder dinámicamente a, y / o planear para los cambios esperados y asociados al cambio climático. Por último, *la resistencia* se refiere a la capacidad de un sistema humano y medio ambiental a “recuperarse,” y desarrollar redes sociales e instituciones capaces de adaptarse y responder de manera más sostenible al cambio climático (Tompkins y Adger 2004).

El desarrollo económico desigual y la asimetría entre los procesos de instituciones diferentes son los factores más influyentes con respeto a la vulnerabilidad en la región fronteriza. Al mismo tiempo, la colaboración transfronteriza efectiva puede mejorar la capacidad de adaptación de la región fronteriza a través de una comprensión compartida de las vulnerabilidades regionales y también una cooperación en hacerles frente (Wilder et al. 2010). La información compartida y los datos son particularmente importantes. La integración de la información climática en la toma de decisiones puede ayudar a reducir la vulnerabilidad social y climática en la región y construir la resistencia de la comunidad (IPCC 2007; Kelly y Adger 2000; Finan et al. 2002; Vásquez-León et al. 2003).

Sin embargo, estos conceptos deben ponerse en práctica para propósitos de evaluación. Por lo tanto, estos estudios de casos se comparten un marco común para la evaluación de la

vulnerabilidad regional. Nuestro marco de investigación (adaptado de Misselhorn 2005) (véase la Figura 1-2 en página 7) está basada en la evaluación de los cinco indicadores de vulnerabilidad en la región: demográficos, socioeconómicos, biofísicos, científicos y tecnológicos, e institucionales. Cada estudio de caso en esta serie de borradores utiliza estos cinco indicadores para evaluar la vulnerabilidad del agua urbana. Al mismo tiempo, usamos los planes urbanísticos, la colaboración transfronteriza, el intercambio de información y estrategias alternativas de conservación como prueba de la capacidad de adaptación. En el cuadro de resumen a continuación (Cuadro 1-4), las vulnerabilidades principales y las actividades de adaptación más usadas de cada área del estudio se están detalladas.

Preguntas de investigación

Cuatro cuestiones principales guían estos estudios:

- ¿Cómo se define la vulnerabilidad urbana del sector del agua en los cuatro sitios urbanos en la región del estudio?
- ¿Cómo es la capacidad institucional de esta región transfronteriza al desarrollar estrategias de adaptación para la gestión de agua en el futuro, en un horizonte de 5 a 20+ años?
- ¿Cómo puede ser institucionalizado en una manera mejor la capacidad de los administradores del agua y los planificadores de la preparación a utilizar la ciencia del clima y la información? ¿Y como pueden hacerlo en una manera que se va a mejorar la capacidad de tomar de decisiones para adaptar?
- ¿Cómo puede ser mejorada la resistencia de las comunidades urbanas de la frontera a las condiciones climáticas y a las incertidumbres de los recursos hídricos a través de la integración de la ciencia del clima en los procesos de planificación?

Metodología del estudio

Un equipo de investigación binacional de más de veinte personas de ocho instituciones trabajó en este estudio y constantemente colaboraron con agencias políticas claves en la gestión del agua en la región. El equipo de investigación utilizó una variedad de métodos de investigación para evaluar la vulnerabilidad urbana y la capacidad de adaptación, incluyendo 60 visitas al campo, 84 entrevistas con las partes interesadas, cuatro encuestas en el internet y en el campo con las partes interesadas, tres grupos de discusión y observación de participantes en diez reuniones. Además, el equipo de investigación patrocinó 5 talleres con las partes interesadas (en Tucson, Hermosillo (2), Puerto Peñasco, y Jiutepec, Morelos con una asistencia de 350 en total. Por último, una salida importante del proyecto incluye la publicación bilingüe de la trimestral Binacional Climate Summary / Resumen del Clima de la Frontera, ahora en su 10ª edición. Las conclusiones preliminares sobre la vulnerabilidad del agua relacionada con el clima urbano se resumen en la tabla de abajo.

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Cuadro 1-4, español. Resumen de las conclusiones preliminares.

| SITIO DE INVESTIGACIÓN | TEMAS DE VULNERABILIDAD IDENTIFICADAS | ACTIVIDADES DE ADAPTACIÓN (iniciado, en curso o en fase de planificación) |
|---------------------------|--|--|
| Ambos Nogales, Ariz./Son. | <p>Una gestión de aguas transfronterizas fragmentada y compleja</p> <p>El acceso inadecuado al agua potable y saneamiento en los barrios pobres de Nogales ,Sonora</p> <p>Una infraestructura inadecuada para la gestión de alimentación</p> | <p>Colaboración en el tratamiento de las aguas residuales y la evaluación de las aguas subterráneas a través de CILA y organismos estatales y locales de gestión del agua.</p> <p>Investigación sistemática sobre la vulnerabilidad del agua a escala de barrio; la movilización de la comunidad sobre las vulnerabilidades clave en el acceso al agua; las estrategias alternativas que se están probando (por ejemplo, letrinas de composta)</p> <p>El desarrollo de la gestión de inundaciones y sistemas de alerta (la autoridad municipal del agua, OOMAPAS, USGS y IMIP)</p> |
| Puerto Peñasco, Son. | <p>Acuíferos agotados y no puede soportar el crecimiento proyectado del futuro de la industria hotelera/ turismo</p> <p>Estuarios frágiles en el alto Golfo que tiene especies en peligro de extinción que se tiene que proteger tanto de la pesca excesiva y la expansión del turismo</p> | <p>Desalinización municipal en el estudio de viabilidad para servir PEN y la industria del turismo</p> <p>Unas ONGs que son activas (Centro para la Protección de los Desiertos y Océanos, CEDO) y trabajan con los pescadores locales y las empresas para proteger en lugar</p> |
| Tucson, Ariz. | <p>Una dependencia en una sola fuente de suministro—el Rio Colorado— que es uno de los ríos mas más asignados y escasez de agua</p> <p>Una región propensa a la sequía y el alto crecimiento (todos los sitios)</p> | <p>La planificación de escenarios del suministro del agua/clima a largo plazo hecho por Tucson Water</p> <p>La promoción de la conservación de la promoción a la escala familiar y de recarga / re-uso a la escala municipal</p> |
| Hermosillo, Son. | <p>Un tandeo en HMO debido a un suministro de agua baja, los patrones de uso, y las pérdidas de infraestructura</p> <p>La competición regional y urbano-rural para el agua</p> | <p>AZ-SON han planeado conjuntamente la construcción próxima de la planta de desalación binacional en Puerto Peñasco</p> <p>Sistema Integrado de Sonora (SONORA SI) se planea transferencias de agua de los distritos de riego comerciales en el sur de Sonora a Hermosillo y otras ciudades</p> |

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