ISSC 'Transformations to Sustainability' Programme Concept Note

Water Governance Challenges, Mexico City and Phoenix

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Introduction and sustainability challenge

Mexico City, Phoenix, and other populous cities around the world are caught in a complex of problems concerning the quality and quantity of water, and its distribution in space, over time, and between the rich and the poor. The problems manifest themselves in three distinct but related dimensions of water supply: obtaining clean water for drinking and household use, disposing of wastewater and sewage, and managing precipitation (including both the adequacy of aquifer recharge and the management of episodic overflows of storm water). The problems are exacerbated by extremes of weather and climate, and by the uncertainties of population growth, settlement patterns, interacting and inconsistent governance, and secondary effects of water problems. (Among these are the increased use of bottled water, contamination of water supplies (caused by upstream development), land subsidence (caused by depleting aquifers in the urban area), and distribution inequities in the piped water system.) Science, engineering, and governance lag behind the rate of change in water stressors and appear to be overmatched by the complexity of interactions among problems (and the emergence of unexpected problems) and by the need for foresight and anticipatory technologies and policies.

The North American Hub of the Constructing Pathways to Sustainability Network focuses on the sustainable governance challenges associated with water provisioning and waste water management in large metropolitan areas, and the tools, strategies and social interactions that can create new pathways for change. The collaborators in this network are located in the metropolitan areas of Phoenix and Mexico City. A major city in the desert south western United States, Phoenix has always faced challenges of supplying water to its growing urban population, and has resorted to a sophisticated and complex assortment of institutional mechanisms, interstate legal agreements and associated hydrological infrastructure to meet demands of current and future residents. Mexico City, located in what was once a series of shallow lakes, faces similar challenges of meeting water demand, while also afflicted during its rainy season by chronic flooding of combined sewage and storm water (which is an emerging problem in Phoenix). At macro-scales, these cities also face similar challenges related to finding the appropriate balance between groundwater exploitation – associated with severe subsidence in

both cities – and surface water development. Both cities import water uphill over long distances, at significant costs in terms of fossil fuel expenditure and infrastructure maintenance. Furthermore, the reliance on exogenous sources of water necessarily requires political negotiation and arbitration among neighbouring states, where water issues are also acute and highly politicized. At a micro-scale, communities and local governments in both cities face issues of inter-sectoral water competition (e.g., peri-urban agriculture and urban use) and tensions over water rights and perceived injustices in water allocation.

Despite persistent and growing concerns about water supply, quality and equitable access, both cities are recognized for water innovation, primarily in relation to water institutions (Phoenix) and water resource infrastructure (Mexico). Among the institutional innovations in Phoenix are water banking arrangements and "credits" associated with deferred water rights; in Mexico City massive infrastructure projects have, over time, enabled the city to avoid extensive flood events and maintain a basic level of water provisioning. Nevertheless, these achievements mask persistent inequities in water distribution, quality and access in the case of Mexico City, and persistent tensions in water distribution and allocation among different user groups in Phoenix. Collaborative, grassroots social innovation in relation to water resource management, while in existence, has not yet emerged as a force shaping the direction of water development more broadly. In the face of growing concerns over changing water regimes and climatic uncertainty, local governments, citizens and water authorities potentially will confront the limits of the policy strategies and institutional arrangements that served them in the 20th century.

Background and the range of water-related problems

The water-related problems in both cities have several dimensions. First, there are issues of the water-energy nexus, and the implications of energy prices for water supply and distribution. Both cities pump water uphill across long distances to supply the urban population, and Mexico City must also pump wastewater out of the city at considerable energy expense. In both cities the depletion of groundwater brings land subsidence, which manifests itself as almost imperceptible changes punctuated by occasional catastrophe. Volatile fossil fuel prices affect the affordability of water in both cities. In Mexico City the cost of pumping is largely absorbed by the public sector, and water is heavily subsidized. Nevertheless, inter-governmental (local/ municipal vs. city or state) disputes about paying energy costs can result in temporary failures in infrastructure followed by localized flooding as pumps are shut off. In Arizona much of the energy used to move surface water is provided by the coal-fired Navajo power plant in the north of the state, which is a heavy polluter. Providing cheap water by using cheap (but dirty) coal benefits agriculture, home construction, municipalities (that grow while keeping taxes low), and creates jobs and revenue for the Navajo, but it also harms the environment, recreation, and Navajo health. Water-related interests and uses are in conflict: growth, development, jobs, and low taxes are at odds with conservation, environmental protection, downstream users, and future generations.

Second, anticipating and managing extreme events also challenges existing infrastructure and institutional arrangements. In Phoenix, water management agencies try to buffer the population from experiencing flooding or drought conditions by ensuring a reliable and stable water supply. Nevertheless, increasing reliance on external (Colorado River) water supplies (representing 40% of total supply for the Phoenix area) has made the Phoenix system more sensitive to longer-term drought conditions in the Colorado River basin, and adjustments in inter-sector water allocation will be required in the coming years. Agricultural interests in and around the city will be most affected, potentially causing land use change and farm abandonment. In Mexico, localized flooding is a chronic problem during the rainy

season. The existing infrastructure cannot handle intense rainfall events; flooding of combined storm water and sewage water occurs annually in densely populated neighbourhoods to the east and north of the city. These areas are some of the poorest in the city, highlighting inequities in exposure to flood risk. In Phoenix localized flooding is a newly emerging problem as occasional torrential rains overwhelm "hundred-year" flooding provisions.

Third, reliable water access is one of the more pressing concerns in much of the peripheral areas of Mexico City. In so-called "informal" settlements, residents are typically not connected to the city's water supply and sewage system, or receive water irregularly (a few hours a day, or a few days a week). Commercial and public sector actors work to fill the unmet demand with water delivered and purchased from trucks. Some communities tap directly into local springs, but their access is unregulated and tenuous. Sewage water often is deposited directly into surface water canals that transect the city and mixes with storm water runoff before being pumped out of the city. Water access, quality, and affordability are critical concerns in these areas.

Fourth, bringing fresh water into each city and transporting waste water away require significant infrastructure that is missing or incomplete in some places, aged and in need of updating and repair in others. In each city roughly 40% of a year's water usage is lost through leaky pipes. For Mexico City water must travel twice over mountains, for Phoenix much water is transported by canal hundreds of miles uphill.

Finally, all of the above problem strain existing water governance arrangements. In the Phoenix area, the state (Arizona Department of Water Resources) works with municipal governments, local water agencies, irrigation districts and communities to mediate water related challenges at the local level, as well as to negotiate inter-state agreements on water supply and distribution. Water institutional development and governance in Arizona has a long and contested history, yet there are many examples of cross-scalar and inter-sectoral water resource collaboration and policy. Significant tensions continue over perceptions of fairness in urban-agricultural water distribution and Indian – non-Indian water rights, and the relative priority that will be given to urban expansion and growth vs. conservation, and a recognition of constraints on urban water resource availability. Water allocation to maintain ecosystem function is also highly contested and disputed. In Mexico City, water is similarly contentious. There is little trust among residents of the city and federal water authorities, and many residents perceive injustices in water allocation across economic classes and between residential areas. Many of the struggles in the city stem from fragmented and uncoordinated policy agendas related to privatization of urban resources and the need for increased housing for the city's poorest sectors, and the persistent problems associated with inequities in water distribution, access and use. This tension results in mistrust that periodically erupts in protests and civil actions, some of which turn violent. Local government and civil society actors have few avenues to participate in water management decisions, policy and planning. Water resource management is heavily centralized and largely in the hands of authorities who rely on conventional engineering and infrastructural solutions rather than social interventions.

Dynamic changes and complex interactions among the problems listed above exacerbate the challenges confronting the cities, and their ability to meet such challenges is further crippled by structural deficiencies in their patterns of water governance. Some components of change are gradual (such as population), some are episodic (major leaks, flooding, subsidence-induced damage) and some have elements of both (climate change). This is an expected consequence of coupled natural and human systems, but its character is emergent and cannot be predicted. In both cities water sufficiency estimates and land use planning are short-term and narrowly focused on present economic interests, distorted by economic necessity and urgent needs, leading to overgrowth of both formal and informal housing. It is difficult to make good decisions with inadequate information and strong political cross-

currents. To meet such challenges each city must rely upon an imperfectly organized governance structure. In Mexico decisions about water are made at the federal level and at the local level, with no authority in between; in Phoenix much water (about 40%) comes from the Colorado River and its access is governed by complex allocation laws that involve longstanding agreements among several states. The Colorado continues into Mexico, and so upstream decisions to allocate water to US states affect the quality and supply of water available to downstream residents of Mexico. Such decisions also have environmental effects along the river's course and in its delta. One major shared governance challenge is determining which sorts of problems are best handled at which scale (and providing the necessary information, authority, and resources for action). With the middle scale of governance weak or absent, one of the key levels for effective action is missing.

What current (ineffective solutions) are being tried?

In both cities, the primary pathways of water management are at two levels: the macro-scale (i.e., inter-state/water basin), where large scale infrastructure investments and policies are developed, and at the local scale, where individual users are encouraged to take steps to ensure water supply through conservation (Phoenix and Mexico City) and to care for water quality via water boiling, filtering or water purchase (Mexico City). These pathways operate in parallel, and focus primarily on techno-managerial innovations and the promotion of incremental changes in behaviour. In Mexico City, the property and health risks of localized flooding are largely borne by individual households, who must take steps to recover damage property and to prevent contaminated water from entering their homes. Failures in water quality or provisioning are addressed individually rather than by the public sector, or, in the cases of more wealthy residential developments, by the private sector administrators of housing infrastructure. The city government takes preventative actions (dredging clogged sewage canals and storm drains) and mitigates flood events by repairing infrastructure. Many residents in underserved areas feel their knowledge and experience are undervalued, and their concerns about water access are secondary to more economically advantaged neighbourhoods and water uses, and thus instinctively distrust any interventions of the city government in the water system. Problems in supplying water to homes through the formal network are addressed individually at the household level by buying water from private providers (water tanks), some of which are contracted by local government. At the macro-scale, Mexico City is investing huge resources in the development of massive infrastructure to enhance the capacity of the city's sewage system to move water out of the city into the neighbouring valleys, where the water is used for irrigation. Plans to treat this water as it leaves the city have been controversial: farmers believe this will deprive them of valuable nutrient-rich water (sewage).

In Phoenix, the threat of reduced water supplies has motivated the city's water planners to begin discussions with other cities (Tucson) to enhance inter-city water storage and transfer, and irrigation districts and water resource planners are undertaking voluntary cutbacks to water supply to fill dams and postpone more dramatic institutional solutions to pending water scarcity. Efforts emphasize measures that enable business as usual to continue rather than transformative change in water allocation, water demand, or supply. While households are encouraged to conserve water, conservation is largely voluntary. Nevertheless, improved standards have reduced per capita consumption considerably, although generally the effort of water managers has been to assure the public and urban developers that adequate water is available and to enable current lifestyle practices to continue, albeit with greater water efficiency. The state water authority has, however, intervened in numerous local water management improvement efforts and has helped coordinate new governance arrangements involving different sector interests (agriculture, residential, municipal) in specific areas. These experimental and other ad hoc efforts have reportedly improved public participation, collaboration and water sustainability.

What would it require to open new pathways to innovation?

The central challenge in both cities is to improve water governance to enhance the possibility of finding pathways to more just and sustainable water use. In Mexico City, prevalent distrust, perceptions of injustice in water access and distribution, and poor communication across levels of authority and between the public sector and citizens continually threaten effective water management. While there are substantial infrastructural weaknesses and great need for engineering solutions to many of the city's problems, the social dimensions of water management are often neglected. Residents are often portrayed as the source of the problem rather than potential resources for its solution. A variety of technological interventions have been proposed (including rainwater capture, restoration of remaining surface water sources, improved separation of waste and storm water, reparation of leaks and new water treatment facilities), but less attention has been given to public perceptions and to collaborative and cooperative efforts to achieve equitable solutions to water challenges. Where communities have come together to participate in water management proposals and projects with the public sector (i.e., the Master Plan for Magdalena Contreras River or the Xochimilco wetlands, see proposed case studies, below), the eventual actions taken by authorities give the appearance that their knowledge and contributions were not taken seriously. While it is not difficult to get actors in the civil sector together for collaboration, public sector agencies need mechanisms through which they can more effectively engage with residents to find collaborative solutions, rather than the traditional consultative/ informative participatory processes that currently characterize interactions.

Phoenix needs positive cultural change to bend the system in the direction of better governance. In part this entails stronger commitment to future thinking by taking into account the composition and needs of future populations in current planning. (In the case of Mexico City, this entails taking into account the diverse social composition of the city and the diverse lives and "realities" of residents.) To do so planners must consider not only the necessities that require immediate solution but also the life patterns and styles that shape evolving needs. Scant knowledge of how a vast majority of the population lives by the people in government (who tend to come from only certain social and economic strata) creates a rift between planning strategies and durable, long-term solutions. To achieve such solutions in Phoenix will require making more visible and salient the diverse water needs and challenges confronting agriculture, industry, and households of varied socio-economic background, then creating a shared vision of a just and sustainable water future among such diverse (and sometimes competing) stakeholders (for example, the Navajo and city residents or environmentalists). Absent a collaborative process of mutual learning, it is possible that nothing short of a crisis (drought, shortages, unmanageable storm water) will alter the decision framework.

Exchanging knowledge and experience with international groups engaged in similar challenges about what constitutes enabling environments and processes for effective collaboration and governance could open up new pathways towards sustainability in these on-going governance processes.

Pathways toward Sustainable Alternatives (and the Actors Who Will Create Them)

The collaboration proposed in this project will focus on opportunities for improved and more sustainable governance strategies. It will make use of on-going processes of stakeholder collaboration in Mexico City in three Boroughs (or *Delegaciones*). The on-going processes are, to some extent, participatory, as well as conflictive, involving a range of public and civil society actors, including the National Autonomous University of Mexico (UNAM), the Autonomous Metropolitan University (UAM), local (borough) authorities, city agencies, NGOs, and neighbourhood or professional organizations (See table…). Each of

the cases focuses on different aspects of the city's water resource challenges, including water resource capture and watershed resilience (Magdalena Contreras), ecosystem service provisioning, livelihood viability and water quality issues (Xochimilco); water access, rights and socio-hydrological risks (Iztapalapa). Magdalena Contreras is located in the southeast of Mexico City, incorporating part of the "conservation zone" – the large forested area in the south of the city that has, for most of the last 100 years, been under a regimen of environmental protection as a means of protecting the watershed that feeds the aquifer under the city. Over half of Mexico City's water supply comes from groundwater; overexploitation of the resource combined with urbanization of the watershed, threatens the sustainability of the supply. Magdalena Contreras also contains the last free-flowing river entering Mexico City; while the river has been the focus of considerable ecological research and policy analysis, the latest effort to implement a Master Plan for the river resulted in widespread frustration among the diverse social groups that participated. Xochimilco is also in the south of the city, representing the last remnants of the extensive lake system in which Mexico City was built. The remaining wetland/lake is now artificially supported by minimally-treated wastewater from the neighbouring borough of Iztapalapa. While it is threatened by rapid urbanization, there are counter-forces that provide hope for its restoration: the growth of an urban agricultural movement involving the traditional *chinampas* farming system, the persistence of eco-tourism, and citizen groups interested in biodiversity conservation. The borough of Iztapalapa, as one of the poorest and most densely populated areas of the city, encapsulates the critical injustices that characterize the city's water distribution system. Here, residents suffer from inadequate water supply, poor water quality and chronic flooding. All three cases represent core concerns in water resource governance, in which different understandings of the sustainability challenges among actors have resulted in different interventions and often, social conflict.

Borough	**Key water challenge**	**Existing innovation(s)**
Magdalena Contreras Actors: Local and city government, agrarian community, ecotourism associations, academics	Urban encroachment on the watershed, loss of biodiversity, and contamination of the last remaining free-flowing river in the city	Institutional: the collaborative development of a Natural Protected Area and associated Master Plan; development of ecotourism capacities
Xochimilco Actors: Local and city government, federal government, local agriculturalists (*chinamperos*), tourism operators (*trajineros*), local NGOs, neighbourhood associations, acadmeics	Water contamination, urban infill, loss of livelihood and loss of cultural heritage of Mexico City's lacustrine origin	Institutional, economic: International recognition of wetland ecological value and function; restoration of agricultural (*chinampas)* areas to inhibit urbanization; biological interventions to enhance water quality
Iztapalapa Local and city government, federal government, neighbourhood associations, regional urban rights advocacy groups, academics	Water access and water quality for one of the more densely populated and poorest areas in the city; flooding of contaminated storm water	Social-organizational: Mobilization of neighbourhood associations to address water access injustices; rainwater capture

The approach entails two lines of activities: 1) empirical, transdisciplinary research within each geographic case and 2) reflexive engagement among local actors and across international collaborators in the sustainability network, supporting a process of social learning.

The empirical research will address the following questions:

1) How is the water problem in Mexico City conceptualized differently by different actor groups?
2) What actions, or interventions, are associated with different actor groups, and what are the local and systemic implications of these interventions?
3) How do different conceptualizations result (or not) directly or indirectly influence the social and ecological context in which innovations for water resource governance must emerge, for example, by impeding innovation or enabling structural change?

The more reflexive, interventionist component of the project will entail a series of activities involving subsets of participants involved in water resource governance at different scales within the city (sub-borough level, city-level), designed to facilitate reflection about expectations, experiences, and outcomes of collaborative processes, and to construct together a shared conceptualization of what "good governance" looks like for water and sanitation concerns, as well as concrete steps to improve governance in each site/process. The challenges across sites are similar: how to build trust, establish and maintain commitment, value distinct forms of knowledge, and overcome political obstacles to innovation. This part of the project will entail answering the following questions:

1) What has been the experience of the actors involved in relation to having their perspectives heard, respected and considered in water resource management engagements in the city?
2) To what extent can representing different forms of knowledge and understanding (*different mental models*) in a single decision support system catalyse increased trust and provide conditions for improved dialog?
3) To what extent can lessons about collaboration, conflict and governance be transferred from one specific context of water resource management to another?

Methods

Empirical Research on the Sustainability Challenge

Over a 12-month period, the project coordinators will work with project partners to conduct a series of interviews (with key informants from civil society and public officials) and workshops (with organized social groups, such as NGOs, neighbourhood or professional associations) to elicit mental models of the water and sanitation challenges in the city (1-3). Mental models capture how individuals and groups cognitively conceptualize external social-ecological relationships and outcomes. Mental models are considered important components of risk perception (3). Research on social-ecological systems and governance for sustainability has also indicated the relevance of understanding mental models as part of collaborative planning and conflict resolution (1, 2, 4). We will conduct structured interviews and participatory workshops to elicit the different mental models held by key actors within each case study, as well as the suite of actions taken by these actors to cope with and adapt to water resource challenges. Mental models can be represented visually as conceptual networks; we plan to represent these models as decision networks using the Analytical Network Process (ANP), a mode of Multi-criteria Decision Analysis (5). Together with a review of policy documents and academic literature, newspaper reports and interviews with experts, we will explore how specific mental models are reflected in the institutional context (formal and informal rules and norms) of decision-making, as well as materially and spatially in

the (dys)functioning of the city's water system. This effort will make visible to participating actors how mental models shape choices and, ultimately, opportunities for innovation and change in development pathways.

Reflexive Engagement and Social Learning

We envision the focus on reflexive engagement and social learning to be structured as a three-tiered process of learning ("triple-loop learning") and interaction (Fig. 1), involving:

1) Learning about collaboration, within specific problem settings (e.g., Phoenix and Mexico City) – *instrumental learning and collaboration*
2) Learning from and across collaborative contexts (e.g., between Phoenix participants and Mexico City participants) –*substantive learning and collaboration*
3) Learning about learning, which entails finding ways to accelerate the ways people with diverse skills, backgrounds, values and interests work together to solve complex sustainability challenges--*reflexive learning and collaboration*

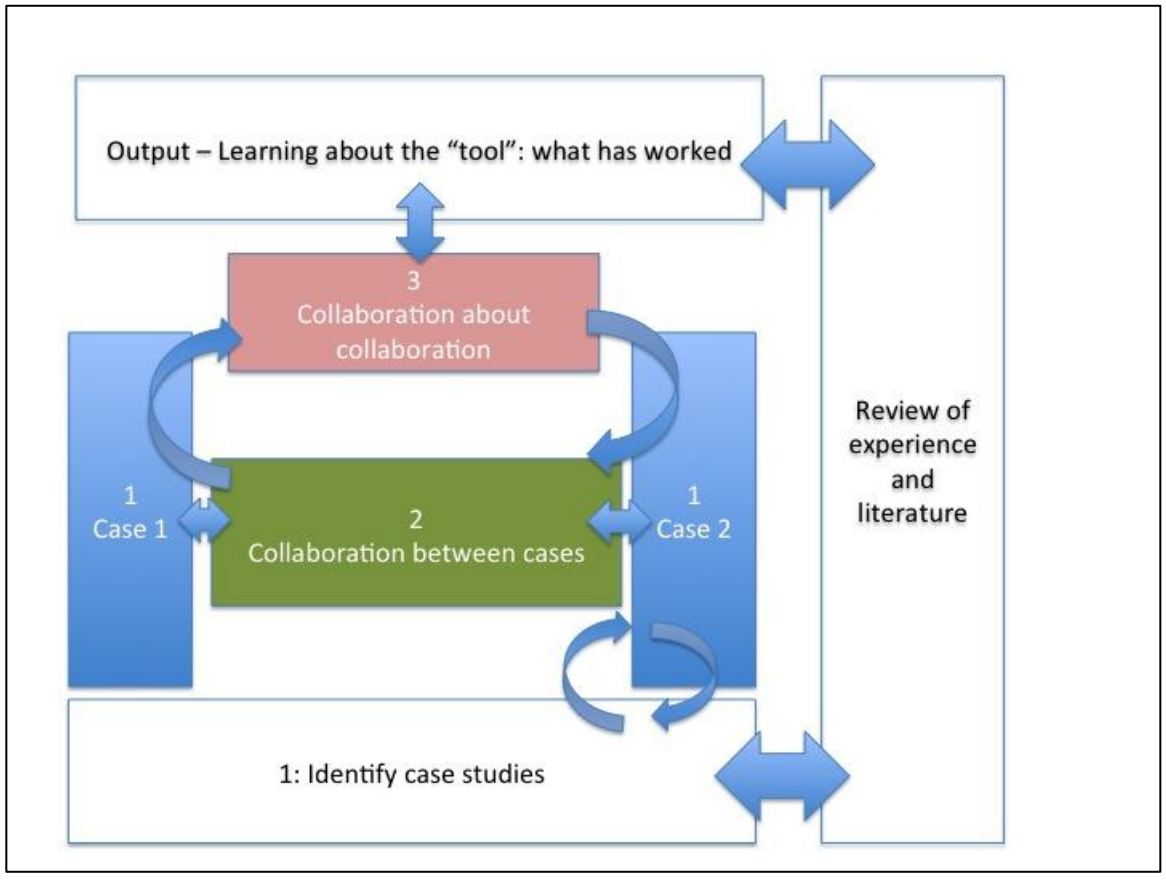

Figure 1: Schematic Representation of the collaboration process

To learn about collaboration within a specific problem setting, the project will use a standardized survey and in-depth interviews with participants in each site to establish a baseline of expectations and prior experiences with collaborative and transdisciplinary efforts around water and sanitation concerns. The results of this baseline measurement will be then circulated among participants within each problem

setting to stimulate a facilitated discussion about the challenges of sustainable governance, and the ways in which prior experiences may be related to the integration and reinforcement of specific mental models of the sustainability challenges in water institutions and governance. The same survey and interviews will be repeated in the final stages of this intervention as a metric of change and social learning(6).

To facilitate cross-site learning and collaboration we will also organize a cross-site discussion of the results of the initial exercise, hosted at the National Laboratory for Sustainable Sciences at UNAM, in which representatives from all the three governance processes will participate.

Following this initial intervention, we will organize a series of site visits. We will use these visits to bring diverse stakeholders from one city to meet with a similarly diverse group in the other, and to reciprocate and repeat the visits. The meetings will be focused on comparative problem solving—that is, using the comparison between cities to catalyse problem solving within each city. The participants, building on their initial discussions concerning expectations and prior experiences in governance, will determine the specific purposes, agendas and activities to be realized in these site visits. Given the contentious and often hostile interactions between civil society and government water agencies, one issue that will likely be the initial focus will be exchanging experiences on how government representatives of the water and sanitation sector engage with different publics, how different mental models of specific problem contexts are incorporated (or not) into decision-making, how conceptualizations of problems may "close down" options and alternatives. Participants will identify where innovations have occurred, and explore how these innovations are associated with alternative conceptualizations of water challenges and solutions. Other opportunities will arise in discussions of policy innovations and institutional arrangements that enhance system flexibility (resilience) in face of water stress, particularly as related to development interests and urbanization. Phoenix has developed institutions that make water needs and supply explicit in development planning, through water resource credits and storage arrangements. Mexico City's water issues often come to the fore as new housing developments are formally approved without adequate water provisioning, or as irregular settlements petition government agencies for more reliable supplies. The linkages among development agencies and water resource managers are not often coordinated, and the lack of coordination produces conflict and breeds distrust at the level of the local community. The opportunity in Phoenix for Mexican participants to explore the utility of the WaterSim model, developed by Arizona State University to facilitate scenario planning and policy analysis in relation to water resource management in Phoenix, will also be constructive. We expect the participants to focus explicitly on how knowledge is produced, valued, presented and evaluated within dominant mental models and in formal and informal contexts of decision-making, and how the management of knowledge can enhance governance across the different sites.

The site visits will result in a new set of experiences and learning opportunities. To build upon these experiences into a structured process of facilitating change in governance, we will organize professionally facilitated follow-up meetings in which participants will identify the knowledge availability and gaps, the institutional obstacles, and policy opportunities for implementing specific strategies of change. We intend that this collaborative exchange will not result simply in a document outlining a wish-list of policy strategies or opportunities; rather, we will challenge the participants to make specific changes in practice, behavior, instruments of knowledge production and analysis, and in relation to the visions of the resource base that they are collectively managing. These outcomes will be defined and evaluated by the stakeholders themselves through the collaborative exercises. It will be the responsibility of the host institutions (UNAM and ASU) to enable the observation of these outcomes through different instruments of evaluation and monitoring.

Measurement and Analysis

It is premature to develop the survey instrument and interview questions for the study, but we will indicate the topics and the qualities of social interactions that are most salient for our study.

Knowledge of various sorts (formal, local, tacit) will be made accessible and useful to others, and in the course of this ideas will be combined in original and useful ways (integration, synthesis). Something tangible will be accomplished, and innovations and tools for action will be created. These will be observed in the course of interactions, embodied in boundary objects that will be created (improvised) for the purpose of communication, and will be reported by participants in their survey and interview responses.

Values and social justice dimensions of water problems and pathways will be surfaced and their conflicts and potential reconciliation will be explored. It probably will not be possible to separate values from knowledge: what is known or taken to be known will be integrated with personal and professional values.

Power pervades water-related issues and will enter any meeting about such issues. In Mexico City risk and danger are also involved. This, in combination with the vital human concerns that surround water and participants' potentially incommensurably knowledge and values, will probably elevate the emotional tone of the meetings. If the meetings are as involving as we anticipate, some participants will change their minds about important matters and some will become angry…and some may do both. The collaboration itself is legitimating and empowering, with implications (good and bad) for those who participate (or are not invited).

Despite the emotional tone and power implications, the substance of the meetings will focus, as much as possible, on constructive creation of original pathways to improved water management, grounded in data and evidence, including cross-site comparisons (and visits to field sites and communities).

Criticism is an essential part of such meetings: not all ideas are equally good, some will be represented in outcomes and others will be set aside. Participants will receive competent response from other group members —feedback that they recognize as well informed and that therefore they value. Some of this feedback will be critical, yet we expect that it will be accepted. The group must be solidary enough to hold together through the emotional heat of mutual criticism. This includes commitment to the group and to successive meetings, because commitment into the future increases the likelihood of compromise in the present.

The process will be comparable, at some reasonable level of abstraction, to efforts underway in the paired site in Delhi, and will yield design principles that will inform similar efforts elsewhere. This is the promise and purpose of triple-loop learning.

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- Arizona Department of Water Resources, State of Arizona
- Laboratorio Nacional de las Ciencias de Sostentabilidad
- Instituto de Ecologia, Universidad Nacional Autónoma de México
- Delegación Magdalena Contreras
- Comunidad Agraria La Magdalena Atitlic
- Comisión de Recursos Naturales, Gobierno del Distrito Federal (CORENA)
- Comisión Nacional de Areas Naturales Protejidos (CONANP)

- Isla Urbana, A.C.
- Autoridad de la Zona Patrimonio Munidial Natural y Cultural de la Humanidad en Xochimilco, Tláhuac y Milpa Alta
- Asociación Chinamperos, San Gregorio Atlapulco