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WETLANDS UNDER PRESSURE

The experience of the Xochimilco
T-Lab, Mexico

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Introduction

The question of transformation is complex. It involves uncertain, often unpredictable, outcomes in contested spaces fraught with historical meaning, long-standing and often polarizing perspectives on what is “good” and what is necessary for such spaces, and who will benefit or lose out from any intervention. Such is the case with the Xochimilco wetland in the southern part of Mexico City, in the borough of Xochimilco. This urban wetland is the last remnant of the complex lacustrine system that was the basis for agriculture and livelihoods in pre-Columbian times (Morehart 2018). Xochimilco’s fate is intertwined in the history of water exploitation, access and use in Mexico City. Prior to the arrival of the Spanish, natural springs fed the wetland, providing a freshwater system supporting significant biodiversity and enabling a unique agricultural innovation, the *chinampa* system. *Chinampas* are artificial islands of rich organic matter, intentionally built up through the excavation of lakebed soils, which are carefully contained by a border formed by the roots of *ahuehuete* trees, planted in rectangular formation directly into the wetland. This highly productive farming system supplied the pre-Hispanic population with food and transformed the wetland into a significant agroecosystem with deep cultural and economic significance (Morehart 2018).

The *chinampa* system continues to be a source of diverse ecosystem services as well as the basis for micro agro-enterprises that supply vegetables to high-end consumers and city and local markets. However, the wetland agroecosystem is much smaller than in the past. Irregular, urban settlements have encroached on the wetland conservation area and contribute to significant contamination of the wetland’s water through illicit sewage discharge, together with waste from tourism, agriculture and other activities (Zambrano et al. 2009). Water quality

concerns have undermined fishing and agricultural livelihoods, and threaten the eco-tourism activities of the area (Mazari-Hiriart et al. 2008; Zambrano et al. 2009). The wetland ecosystem nevertheless is recognized and valued locally and internationally as a cultural and historical site, green water infrastructure, and symbol of Mexico's indigenous past and ecological aspirations for the future (Manuel-Navarrete et al. 2019).

This was the ecological and social domain in which the North America Hub working in Mexico focussed its transformation lab (T-Lab) experiment. The numerous interventions that had been made over the prior three decades had largely been unsuccessful in reversing ecological degradation and creating viable livelihood opportunities for those who depend on the wetland's sustainability. Despite the clear value of the area to local residents, its cultural and historical symbolism, and its stated ecological significance for the city as a whole, efforts to conserve the wetland were failing. Our premise was the possibility that *problem reframing* and *new sources of collective agency* might be necessary to find alternative pathways towards sustainability (Charli-Joseph et al. 2018). We proposed a T-Lab as a novel form of intervention that might serve this function.

The problem space

Sustainability challenges in Xochimilco have been long in the making, and are intimately related to the broader challenges the megalopolis of Mexico City, population 21.6 million (United Nations 2018), faces concerning water, poverty, urbanization and governance. Water is highly political and contested in Mexico City, and characterized by significant inequities (Castro 2004; Jiménez Cisneros 2011). The solutions that have been implemented to address scarcity and flooding in the city have often exacerbated social inequities. Natural springs, perceived as the dominion of *pueblos originarios* (villages of indigenous origin on Mexico City's watershed), have been tapped and piped to supply the economic activities and population of Mexico City's urban centre – an action that has left deep resentment in communities that once controlled the use of such springs, and has exacerbated water scarcity (Aguilar and López 2009, Tellman et al. 2018). In Xochimilco, the water that sustains the wetland is no longer from local natural springs, but rather from treated wastewater from the neighbouring urban borough of Iztapalapa.

As Mexico City's population burgeoned in the 20th century, groundwater extraction from the aquifer below the city accelerated, eventually supplying 60% of the city's demand. This exploitation is not sustainable: extraction vastly exceeds recharge and has triggered massive subsidence of as much as 300 mm/y (Osmanoğlu et al. 2011). Subsidence, in turn, exacerbates flood risk – leaving some *chinampas* in Xochimilco chronically inundated. Subsidence and flooding together add to the precariousness of housing, particularly informal housing, which is unlikely to meet urban construction standards, in what is also an active seismic zone.

The challenges of Xochimilco are also embedded within a larger problem of urbanization and access to adequate housing in Mexico City. A lack of affordable public housing in the urban core has pushed lower-income residents to the urban fringe where cheaper land is more available. Low-income families have used informal networks and strategies to build homes where they can: most often on agricultural parcels, or land reserved for ecological services and watershed conservation (Wigle 2010). The border of the Xochimilco wetland, despite its unstable soils and risk of flooding, as well as the *chinampas* themselves, have become sites of such informal expansion (Connolly and Wigle 2017).

As one can imagine, the chronic pressures of housing, water scarcity and flood risk have become significant burdens for urban governance (Lerner et al. 2018). 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 (Eakin et al. 2016). This tension results in mistrust that periodically erupts in protests and civil actions, some of which turn violent (Castro 2004; Eakin et al. 2020). 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 (Lerner et al. 2018).

Informal residents in the wetland area not only struggle with exposure to flooding and subsidence, but are also villainized in public discourse for not complying with urban regulations and for discharging their sewage directly into the wetland waters. Government-funded infrastructure solutions are also prohibited by law in those settlements considered “informal” or “irregular”. Yet corruption is also in play: public officials are not inclined to enforce regulations during electoral seasons and permit housing construction or even incentivize construction by promising that formal public services will follow, if the candidate is elected (Connolly and Wigle 2017). The fishers and farmers who rely on the wetland’s ecosystem services, and struggle to maintain their livelihoods, are also often implicated in its degradation through association with agrochemical contamination, mechanization, illicit land sales and construction. In this context, the younger generation – the children of *chinamperos* – are less and less inclined to pursue farming, leaving less incentive for wetland conservation.

While there is broad recognition that the Xochimilco wetland is faced with persistent, often interdependent issues, different groups have conflicting perceptions of the causes and solutions to these issues. Many residents in Mexico City perceive the area to be polluted and degraded, but simultaneously recognize it as part of the cultural heritage of the city and as a site for recreation. For civil society groups, there is a problem of siloed activism, with uncoordinated groups working on different, specific challenges. While urbanization of the wetland is widely recognized as a problem, the dominant narrative and effort has been focussed on ecological conservation and restoration, rather than on the drivers of urbanization itself. Informal and illegal settlements are typically blamed for environmental “bads”, yet it is also recognized that informal urban growth is often incentivized through electoral politics.

In light of the multiple agents involved in Xochimilco, the North America Hub hypothesized that a new foundation for collective action in this complex problem space might be needed for systemic change towards a more sustainable future. This foundation would need to be based on reframing the problem from one that is out of anyone's control and driven by exogenous stressors degrading the system, to one in which all agents could see their role in, and capacity for, enacting change. We hoped that the T-Lab process would help create problem ownership, system understanding and the identification of alternative pathways.

Theory, research and action

Our primary objective was to create a space and process through which a small group of diverse actors from Xochimilco could work towards discovering new collective possibilities for transformative action. Our approach thus foregrounded participatory methodologies that were designed to foster alliances among the participants in the process. The T-Lab was designed as a two-year process in which there would be at least two intensive collective interactions among a group of actors (named T-Lab workshops 1 and 2), along with a series of other activities – individual interactions between single participants and the research team or other small group events. No specific project outcome or innovation was envisioned by the research team; rather, our aim was to provide space and facilitate the activities to let collective agency emerge without our control or direction.

Theory of transformation

Our design of the T-Lab was based on the idea that transformation entails internal, cognitive shifts as well as changes in behaviour and institutions (O'Brien and Sygna 2013). We also initiated the activities with the premise that agency – individual and, critically, *collective agency* – is fundamental to any social-ecological transformation. Collective agency is built from explicit recognition and reflection on individual agency and empowerment in relation to the role of individuals as part of shaping and being shaped by a complex social-ecological system (Bandura 2000; Pelenc et al. 2013; 2015). Transformation thus entails eliciting the values, meanings, skills, expectations and understandings experienced by the actors within a social-ecological system (SES); mobilizing existing agency and connecting actors to novel ideas, new actors, new sources of knowledge and understanding; problem reframing; and finally a collective process of opening-up and defining courses of action and experimentation. This process creates an opportunity to make new connections and alliances, and potentially enables actors to feel empowered to engage with existing power structures and processes with new energy and constructive strategies.

Reframing (for details on our project's efforts in problem reframing, see Chapter 11) is about reflecting on meanings and it includes a set of steps: (a) to

recognize what is meaningful, (b) to detach meanings from their material support, (c) to question narratives that support a given set of meanings, (d) to create new narratives and connections between meanings and (e) to find new material support for those meanings. This does not necessarily follow a linear process. However, these steps were iterated multiple times during our T-Lab process. Reframing can contribute to breaking cognitive pathways and mental models that limit one's ability to imagine solution possibilities. But we further intended that reframing would result in social learning and the emergence of new solutions. We think that if reframing is achieved through discussion and accompanied by the formation of new relationships, there is a greater possibility that the internal changes that happen within agents manifest in projects and collective actions that impact material, system dynamics.

Fostering collective agency involves engaging with methods that help actors identify their own agency, reflect on what they value in the SES as well as how their own activities and actions relate to those values, find common values with others and realize complementarity in skills and capacities. In reframing the problem, we emphasize the need to focus less on the current material state of the social-ecological system, and more on shared values and emotions associated with the system. In recognition of the September 2017 earthquake and its effects in catalysing action among participants in the T-Lab, we note that external circumstances and windows of opportunity are also critical in enabling actors to reflect and mobilize relationships and engage in new activities towards social and environmental change.

Research methods: observing change and transformation

By focussing on process, rather than a specific outcome, our entire approach entailed considerable attention to and innovation in participatory methodology and group facilitation. These approaches and methods are described in the sections that follow. T-Labs workshops were structured and organized by the research team, but the content was constantly co-produced; we held preparation meetings with participants prior to the workshops in order to get input into the structure, objectives and desired outputs. Consistent co-production along the process, and of the very process, was key to sustain the participants' commitment. This co-production required continuous one-on-one interactions of members of the research team with individual actors in between group meetings, activities, and T-Lab workshops 1 and 2. Concurrent to both these forms of interaction was intensive work by the research team in analysing the data collected in the individual meetings in order to have material to return to participants prior to group activities.

In parallel, we also implemented and designed metrics to evaluate change in agency and problem perception through interviews with participants and periodically repeated exercises employing a method we called "Agency Network Analysis" or ANA, which articulates cognitive mapping and action networks

and that is accompanied by Q-Method analysis (Charli-Joseph et al. 2018). These combined metrics allowed us to measure changes in, e.g. how long-established inhabitants perceive new, often irregular, settlers; instead of viewing them as “others” and a “threat”, they might now be viewed as potential collaborators. In addition, we have evidence from pre- and post-Q-methodology evaluations, social network evaluations, and qualitative evidence of empathy. The Q-Method (baseline and change) captured learning as changes in individuals’ perceptions, and the divergence or convergence of these perceptions within the group. In terms of empathy, we recorded comments indicating how participants learnt to see the system from the perspective of another. An additional indicator of learning and collective agency was simply the continued participation of the actors, and their growing confidence in their relationships with each other (Shelton et al. 2018).

Measuring “transformation” is far more difficult. We do not know whether or when (potentially years) or in what context transformative change will materialize, nor in what form or the extent to which it might be attributed to the T-Lab. Our goal was to create the collective agency necessary as one important ingredient towards system transformation, and our methods of evaluation focussed largely on that intermediate goal. We did, however, conduct follow-up interviews after the second T-Lab and we continue to think about ways in which to understand the system-level impacts of T-Labs.

T-Lab implementation sequence

The project evolved in an organic and dynamic fashion over the course of the two years. While the first activities were intentionally and carefully designed by the National Autonomous University of Mexico (UNAM) – Arizona State University (ASU) research team, we left open the design of subsequent activities to reflect the nature of the group and the direction it would want to take. During this second period, the research team played the role of sustaining, documenting and feeding an emergent process (Figure 9.1).

FIGURE 9.1 Individual and collective interactions throughout the process, indicating the first (T-Lab 1) and second (T-Lab 2) T-Lab workshops.

Phase 1: activities leading up to the first T-Lab workshop

Preparations leading to T-Labs are as important as the T-Lab workshop itself and therefore they require the allocation of significant effort and resources. The steps taken and decisions made during this initial phase will determine the entire process and from the outset we conceived of the actual T-Lab workshop as only a culminating moment in a larger process.

To identify and invite individuals to join us in this experiment, we drew from existing literature on sustainability change agents (e.g. Westley et al. 2013) as well as our own intuition. We sought individuals who all together possessed: (a) diverse types of knowledge about the area; (b) influence over other social actors (e.g. through capacity building projects, organized collective work, institutional attribution); (c) capacity and willingness to experiment with different approaches; (d) determination and will to support conservation of socio-ecological attributes of the system; (e) sense of attachment to the place (identity); (f) experience in alternative activities (e.g. organic farming, ecotourism, eco-technologies); (g) solidarity and empathy with respect to other group members and (h) experience working on problems of community development and grassroots innovation. We expected that individuals with these characteristics would be most likely to embrace the open-ended, experimental nature of what we were proposing to do in the T-Lab and would add constructive diversity and/or strategic social connections to the process (Charli-Joseph et al. 2018). We conducted in-depth interviews with 17 individuals identified by these criteria (11 of which resulted in continuing core participants).

A key innovation in this phase consisted of designing and implementing specific methods to elicit the profiles of each agent, articulated in a novel approach

FIGURE 9.2 Profile of actor = ANA + Q-Method.

called Agency Network Analysis (ANA), which enables the visualization of an individual's activities, social interactions and relationship to the social-ecological system (Figure 9.2). The information and baseline data collected through these innovative methods allowed us to strategically design the actual T-Lab interaction.

Phase 2: T-Lab workshop 1

Design

The first T-Lab entitled “A transformative space for the Xochimilco wetland” was conducted over two days in February 2017, in Mexico City, with 11 participants (3 *chinamperos*, 3 residents and activists with informal settlements, 4 members of civil society groups working in sustainable agriculture, rainwater harvesting or ecological restoration and 1 person associated with the federal government). All activities in the first T-Lab were designed to help build trust among participants, and reveal explicit, implicit and underlying meanings, values, and emotions associated with the social-ecological system that constitutes “Xochimilco”. It was clear from the interviews that the personal process of accepting loss of geographic or physical attributes of the wetland (e.g. the agricultural land, the *chinampas*, or the problem of water contamination) are a key step in embracing social-ecological transformations (Eakin et al. 2019). We wanted to direct the conversation away from the standard dynamics of non-academic partners requesting more data and information from the universities, and the universities dumping such knowledge on non-academic partners without a real plan for action. We worked to avoid a “blame game” in which the discussion focussed on external actors and how they had created the problems as such discourse may undermine the agency present in the local population. Participants were invited to stay overnight in the retreat where the interaction was facilitated. We hoped that this retreat-style design would encourage casual social interaction over food and drinks.

Facilitation methods

The first day was spent in a series of participatory and tactile activities. For example, each participant created an “avatar” to represent him or herself, with associated “powers” that reflected their particular personal capacities or skills that we had *a priori* selected as potentially associated with collective action and agency (Westley et al. 2013). In small groups, the participants created dioramas of aspects of the social-ecological system that were particularly meaningful to them, discussed what those meanings were and what values they represented, and shared those with the broader group. Collectively, we decided to focus on examining the more abstract underlying values that the participants had articulated. These, then, became the focus of discussion: were they threatened? How

could they be preserved? What were barriers to change? What was threatened? As participants became more familiar with each other they shared more intimate narratives of change and stagnation, identified underlying senses of loss associated with the psychological impacts of ecological degradation and livelihood viability (Charli-Joseph et al. 2018; Eakin et al. 2019). The second half-day, inspired by the 3-Horizons approach, was dedicated towards brainstorming strategies for overcoming barriers to change: what would these look like? What would they entail? How might these strategies draw upon the knowledge and capacity existent among the group? What should be the next steps?

Reflections

The first T-Lab accomplished many things but perhaps most important for our purpose of catalysing collective agency was the facilitation of trust and a spirit of collaboration among the participants, very few of whom knew each other prior to the meeting and acknowledged having shared concerns. However, we found that reflecting as a group about system transformations can be daunting. One challenge was to separate material objects and realities (e.g. the land on which they traditionally farmed) from the participants' values and feelings towards them (e.g. the autonomy that farming provided the household). Centring the conversation on the potential persistence of intangible attributes allowed a discussion of the possibility of inevitable material losses intrinsic to transformations. While some objects must go, we can still preserve or recreate their benefits and associated values. The goal was to reconceptualize the wetland system in terms of a suite of intangible values that seemed to resonate with the group as a whole to then think about possible intervention pathways.

Another challenge was the tendency of the collective conversation to focus on what had already been tried and practised in the past. People had difficulty imagining that any effort to, e.g. sustain "self-sufficiency" would be aimed at a different material manifestation in the system than "maintaining the *chinampas*". Thus, the pathways turned out to be less transformative than we had hoped: a pathway to support the value of "self-sufficiency" was not "imagine an alternative livelihood in case the *chinampas* was no longer viable" but rather "use rain barrel technology to capture clean water for the *chinampa*". This was somewhat different than the more traditional response of "improve the water quality in the wetland", but we did not feel like we were moving the group into a new mode of thought. When we probed participants to explain how these solutions (e.g. "organize workshops to help people use rain barrel technologies") might lead to outcomes that were different than what had been tried in the past, the conversation turned to recognizing existing structural barriers that hinder more transformative change. We ended Day 2 with a recognition that if the internal barriers – those emerging within the community – were not addressed directly, the proposed pathways would likely not have results different than those of the past.

We had initially wanted to avoid conversation about barriers to change, fearing that this would be a disempowering conversation. We realized, however, that if the barriers are not tackled explicitly, the types of interventions proposed by the group would unlikely be different from those in the past. The conversation around barriers seemed to open up new ways of thinking about an issue and revealed some of the deeper cognitive and social factors perceived as impeding change within the community. These barriers then became the focus of action (for instance, how to address lack of self-esteem in the community), rather than the concrete strategies for addressing the manifestation of the problem in the landscape (i.e. how to address water quality). The first T-Lab laid the foundation of a new social network and a shift in framing reflected in a shared language among participants and interest in continuing to engage and meet in the months that followed. We noted the emergence of a greater sense of problem ownership and individual empowerment, and crucially, that solutions must be formed and implemented from the ground up.

Phase 3: continuous engagement

As a way of building momentum towards T-Lab workshop 2 and eliciting what the participants hoped to achieve from the process, we conducted three exploratory exercises, and organized two excursions: to a *chinampa* cultivated by one of the participants, and a walk on a volcanic mountain that overlooked the wetland, on which irregular settlements were developing. These exercises and activities, discussed in greater detail in the “Innovation and alternative pathways” section of this chapter, were designed to help participants assume alternative perspectives on the challenges they perceived, explore possibilities of collaboration, and envision alternative realities.

Prior to T-Lab workshop 2, we convened a small group of core participants to play a role in planning the next steps. It was the first time they expressed their restlessness towards the project’s open design and focus on interactions, which contrasts with more traditional, goal-oriented workshops and projects. They also questioned how far we were willing to take our involvement as researcher-activists and wanted to know if they could count on us to participate in the initiatives they proposed. During the meeting, participants decided that any intervention had to address not only the urban-*chinampa* divide, but also recognize and connect with the other groups found in Xochimilco in a more concrete initiative with both short- and long-term goals.

Notably, a major earthquake occurred in Mexico City during this phase of our work (September 2017); this devastating event provided an opportunity to focus the group on concerns of solidarity and collective agency in the midst of “rebuilding” in a fragile and hazardous ecosystem. The earthquake itself appeared to reinforce the nascent idea that the urban residents do not have many alternatives to residing (illegally) within the wetland and thus are not entirely to blame for the encroachment. Building on our prior effort to help all participants identify their “powers”, we organized a meeting in which we exchanged ideas about the services

and capacities each of us had to offer, and what each of us required or desired in the wake of the earthquake. A new sense of empathy and a new interest in "building bridges" between the wetland stakeholders and the urban residents seemed to emerge from the recognition that all were affected by the earthquake; this solidarity was exemplified in the Pathways to Sustainability Game, described in greater detail in the "Innovation and alternative pathways" section of this chapter.

Phase 4: T-Lab workshop 2

The second T-Lab focussed on a plan of action directed and initiated by the non-academic participants. The action plan was based on a previously collectively articulated cognitive map of the "problem" of Xochimilco. The research team intentionally refrained from taking leadership in this last T-Lab, other than serving as facilitators and conveners and advocating for framing whatever strategy participants decided to pursue in line with transformative pathways to sustainability. We hoped that the accumulated evidence that the group had acquired considerable agency and capacity would be motivating to the participants to act on the values they now knew they shared, and the knowledge they had gained over prior activities in terms of possible action-pathways. First, the research team summarized ideas that had emerged over the course of the two years:

- 1 the need to create bridges between the two worlds of the urbanizing core and the livelihoods dependent on wetland conservation and agriculture,
- 2 the need to "reactivate" the agroecological traditions of Xochimilco as a means of halting urbanization,
- 3 the idea that informal residences could be made more compatible with the ecology of the area through innovations in construction and design.

What emerged as an output of this T-Lab was the desire to develop a project proposal that mimics, in some way, the understanding and empathy that has developed across T-Lab participants and different zones of the wetland. The group specifically wanted to develop a pedagogy for questioning and understanding the complexity of the water problem in Xochimilco through programmes or workshops in which people come together to carry out particular technical projects to improve – on a small scale – water quality or quantity. Their idea was to meet people where they are: find what connects them to the place of Xochimilco and the water issue and, through specific capacity building projects, enhance that connectivity and mobilize action.

Post T-Lab workshop 2

After T-Lab workshop 2, in individual interviews, we met with each participant and again applied the ANA methodology to assess whether: (a) ego-nets had expanded or changed; (b) links between participants had been created or

strengthened; (c) practices in the action-nets had changed in terms of relations between collaborators-practices (we expected this to change after the earthquake) and (d) cognitive maps changed in the way they represent the issues in the system (reasons for degradation), or in the perception of the issue itself (this would imply reframing, since even if the cognitive map does not change per se, the way they explain or frame the problem could change). We also applied the Q-Method to assess whether the participants had changed their perspective on what attributes were meaningful to them in the wetland.

Following the proposal of T-Lab workshop 2 for a pedagogical initiative and participants' interests on learning facilitation and participatory tools and techniques, we held a 1-day workshop where participants reflected on transformative learning and planned this initiative. Our team participated on equal terms as the rest of the core participants and we hired external professionals to facilitate the workshop. The outcome was a T-Lab facilitator's toolkit and guide to assist others in replicating our process of fostering collective agency (see Ruizpalacios et al. 2019).

Innovation and alternative pathways

Though innovation was not a key theme in our work, a central aspect of our T-Lab was that it opened the possibility to construct a new pathway in which *chinamperos* and urban dwellers could come and work together. This pathway may be thought as *socially* innovative in itself. These are groups that have positioned themselves as antipodes to each other, both in terms of what Xochimilco means to them and also in terms of who is perceived as responsible for the degradation of the area or unmet needs. By the end of the project, the participants had altered their discourse, and were emphasizing the pursuit of activities that would “build bridges” and solidarity towards common goals.

While the entire process of the T-Lab was oriented towards problem reframing and questioning of prior assumptions, there were several exercises specifically aimed at such social innovation and exploring alternative pathways. For example, we designed an interactive role-playing game that we called the “Pathways to Sustainability Game” (Ruizpalacios et al. 2018) to help the participants move towards the idea of thinking about a strategic intervention and how it might play out in a complex system such as Xochimilco. The game simulated collaboration in a planning context (role playing a committee with a budget for implementation) as well as enabling the players to monitor and reflect on the strategies they pursued as they affect the system over time. In another activity implemented in the months following the earthquake, participants prototyped miniature models of new settlements that would maintain the core values identified in T-Lab workshop 1 (aesthetic, self-sufficiency, and identity) and set new pathways towards desired scenarios where agriculture on the *chinampas* and urbanization might coexist. The models depicted well-conserved *chinampas* and included houses that were smaller, built with lighter materials and eco-technologies. These imagined designs are radically different from the ones currently being built.

Through exercises such as the ones described above, the participants and research team began to see that ecosystem health and human well-being are not separate issues, and that residents in the urban areas and in the wetlands may share common ambitions about system change. While the activities of the T-Lab may be only partially responsible for this realization, now there is acknowledgment that any action must involve efforts from both sides, and this represents a success in opening new pathways for Xochimilco.

As a result of the second T-Lab, the participants concluded that they wanted to pursue the idea of “bridging” worlds: that of urban/*chinampa*, as well as the highland/lowland parts of the system. As they formulated the focal activities in this pathway of change, they emphasized education: interventions to change perspectives, attitudes and behaviours around the issue of water, concluding that water linked the different parts of the system that have not been in coordination. They envisioned the creation of bridges through outreach and innovative education between actors with different roles in the system: *chinamperos* and non-*chinamperos*, those in the urban core versus the wetland, and between generations. Essentially, participants recognized the scaling of T-Lab-like pedagogical process as a main transformative pathway towards sustainability in Xochimilco. They advocated for more transformative methods and pedagogy for engagement, drawing the recognition that the arts, as well as technical expertise, might be mobilized towards transformative ends. At their request, we produced a “guidebook” that captures the essence of the different methods and approaches to engagement that we used in the project: *The Transformation Laboratory of the Social-Ecological System of Xochimilco, Mexico City: Description of the Process and Methodological Guide* (Ruizpalacios et al. 2019) for use not only by the participants in their own activities and advocacy work, but also for public dissemination.

Networks, alliances and collective agency

The aim of the T-Lab process was, in essence, to create conditions that would give rise to a sense of collective agency. Our decision, at the start of the project, to invite individuals to join the T-Lab who had limited, if any, prior connection to each other, was strategic. Our aim was to see if the activities we engaged in would be conducive to forming a new network of individuals with diverse capacities, interests and stakes in the system, but who nevertheless could collaborate towards a common goal. In this objective, we noted significant changes: the Agency Network Analysis we conducted with the participants illustrated to them and us that many of them saw their social collaborative networks expand.

We established a WhatsApp group and Facebook page that facilitated continued communication among participants during the entire process, not only about project sponsored activities but also about information that individual participants wanted to share with the group, and even for informal social and friendly chatting – building social bonding within the group. At present, as we are writing this chapter (2019), they continue to interact through social media

and in person. While they have not focussed on a single, specific project, they have met to support each other in political action. Recently, e.g. after the formal T-Lab project had come to a close, one member of the T-Lab group called other members through social media to a critical situation in the wetland: the wetland's water in one area had simply evaporated, leaving the *chinampas* desiccated. With subsidence and problems in water management, this occurrence is increasingly likely. The T-Lab group mobilized collectively, without our support to address the situation through civic action. Events such as this suggest that the primary goal of the project – to create conditions in which collective agency could emerge among relative strangers – was achieved.

While the T-Lab process ultimately did not incorporate new actors over the course of the two years, the activities that we conducted as a group such as the Pathways to Sustainability Game and discussions following the September 2017 earthquake emphasized to the participants the need to build bridges to communities not well-represented in the T-Lab process. Hence the effort of the group on learning and developing capacities in pedagogies that could “build bridges” across different social and ecological divides that mark the Xochimilco wetland.

Concluding insights

The T-Lab of Xochimilco was designed under the assumption that transformations of social-ecological systems cannot be engineered from outside since such human-dominated systems are extremely complex and not amenable to controlled manipulation. Instead, social-ecological transformations require cultivating changes in the system's main driving component; human individuals and collectives. Consequently, we did not attempt to catalyse a specific, pre-conceived pathway or strategy of change but rather focussed on creating a space for reflection, reframing and exploration with the hope that such a space might affect transformative processes. Due to the project's own limitations, we could only involve a reduced number of people with limited influence in the whole social-ecological system. While this constrained the possibility of effecting an actual system-level transformation, by selecting participants who were not already intensively collaborating we were able to experiment and learn important lessons about cultivating transformative intentionality through the nurturing of individual and collective components of a system (Manuel-Navarrete et al. 2019). We achieved this experimenting and learning by providing a space in which people could reflect on their agency and what they might be able to do together that they could not achieve alone, or within their siloed networks. Ultimately, transformative spaces must be community-building spaces: spaces that cultivate collective agency (Pereira et al. 2018). In such spaces the relationships of actors to other system elements through livelihood activities are potentially disrupted, and connections are built on shared values, histories and futures. The project was able to create conditions in which collective agency emerged among relative strangers, and was self-sustained by them after the project was concluded.

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