

Understanding Urban Water Sustainability Transitions to One Water Using Science-based Expert Interviews

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November 30, 2022

Abstract

Water management practices in cities around the world are faced with growing social and environmental pressures. Unfortunately, the linear “take-make-waste” approach, previously recognized as the most conclusive practice to address water-related issues, has been found to be unsustainable due to its dependence on the limited availability of energy and resources. It is, therefore, necessary to change the current linear approach dominant in most cities across the world to one that utilizes a high degree of reuse and recycling that is known as “One Water”. The goal of this study is to evaluate a series of expert interviews that were conducted with utilities across the US and Canada to gain insights into implementing One Water principles. Interpreting several interviews is the key step to provide water managers with an understanding of the perspective and required actions towards transitions in urban water management. The results indicated that although several pressures were described in the expert interviews responses, climate change was the most frequently described pressure, followed by water quality impairments and population growth. Moreover, it has been identified that the studied cities have implemented several strategies such as green infrastructure, recycled water, desalination, and stormwater management to achieve this holistic approach. The thematic analysis revealed that all cities demonstrated the importance of cultural change to break down silos and support various technological solutions. Further investigations revealed that cities encounter several barriers that inhibit the One Water transition. One of the most frequently discussed barriers was related to financial challenges in most cities, especially in light of the pandemic when substantial cities lost their revenue. In addition to the financial challenges, lack of regulatory process and framework, institutional barriers for expanding One Water strategies, short-term thinking, lack of collaboration, community resistance to change, lack of public support, and water rights were mentioned by participants as the top barriers.

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Background & Objectives

Problems:

- Urban water management across the world has been plagued by various challenges including a growing population, extreme events along with climate change, aging and inadequate infrastructures, sea-level rise, combined sewer overflows (CSOs), water supply limitations, and reliance on imported water.
- The previously known best practice, the linear “take-make-waste” approach, has been found to be unsustainable because of its dependence on the unlimited availability of energy and resources (Novotny et al., 2010; Kennedy et al., 2011; Ferguson et al., 2013).

Solutions:

- Change the current linear approach dominant in most cities across the world to one that utilizes a high degree of reuse and recycling that is known as “One Water”.

Objective:

- The goal of this study is to evaluate a series of expert interviews that were conducted with utilities across the US and Canada to gain insights into implementing One Water principles.

Materials & Methods

- The One Water Cities (OWC) interview was designed to collect input on a variety of One Water topics, including “One Water drivers”, “institutional collaboration”, “leadership and organizational culture”, “finance strategies”, “stakeholder and community engagement” and “barriers to implementing One Water principles”.
- The research took a qualitative multiple-case study approach interviews with key informants from utilities across the US and Canada.
- The Expert Interviews were conducted via zoom between July 2020 to May 2021 by three members of the research team. Table 1 includes the list of cities that participated in the research effort and represents various organizational stages on the journey towards implementing One Water approaches.

Table 1. List of participating cities included in the interview process

Case studies	Participants
Honolulu, HI	Honolulu Board of Water Supply
Philadelphia, PA	Philadelphia Water Dept
Los Angeles, CA	LA Sanitation & Environment
Fort Collins, CO	City of Fort Collins Utilities
Virginia Beach, VA	Hampton Roads Sanitation District
San Francisco, CA	San Francisco Public Utilities Commission
Houston, TX	Houston Water
Tucson, AZ	Tucson Water
Ashburn, VA	Loudon Water
New York, NY	New York City Dept. of Environmental Protection
Oklahoma City, OK	Oklahoma Water Resources Board
Denver, CO	Denver Public Works
Miami, FL	Miami Dade Water & Sewer Department
Seattle, WA	Seattle Public Utilities
Vancouver, Canada (BC)	City of Vancouver, British Columbia
York, Canada (Ontario)	Regional Municipality of York
Vancouver, WA	City of Vancouver (WA)



Figure 1. The geographic locations of participating cities included in the interview process

Results

One Water drivers

Among several drivers that were mentioned, climate change and the impacts of climate change are the most important drivers. This is followed by water quality impairments and population growth.

Moreover, OWC interviews revealed that social-environmental justice and regulatory drivers such as consent decree for upgrading aging infrastructure could be considered effective motivations for organizations to encourage a One Water approach.

Institutional Collaboration

While some of the cities which are at the beginning of their journey are dealing with institutional barriers, cities that are progressive in adapting One water principles are trying to facilitate institutional collaboration with the implementation of a memorandum of understanding (MOUs) or a memorandum of agreement (MOAs) and sometimes a consent decree which might impose some levels of institutional collaboration.

Moreover, these cities are making more efforts to attain a shift in thinking and institutional culture through relationship building, alignment, and accountability around common goals.

Finance Strategies

Most cities that are at the beginning of their journey unlike the progressive ones haven't had joint funding and mostly relied on siloed funding mechanisms from water rates, sewer rates, as well as property taxes.

However, some cities could attain financial capacity and even haven't dealt with financial barriers. The examples of successful strategies of these cities include cost-sharing between departments on multi-benefit projects, partnerships, and diverse finance strategy including grants, revenues, and bonds.

Stakeholder and Community Engagement

Cities have different strategies for community and stakeholder engagement. Cities that are progressive in adapting One water principles have implemented several successful strategies in this realm including developing stakeholder engagement plans, establishing advisory groups, steering committees, technical focus groups. Also, many cities have relied on several digital strategies.

Leadership and Organizational Culture

The OWC interviews revealed several key characteristics of an organization that advances a One Water culture. Among several attributes, fostering One Water mindset/culture among staff, community, and regulators is the most frequent key characteristic mentioned by the participants, followed by supportive leadership, collaboration and building relationships, and striving for innovation and creativity.

Results

Barriers and Pathways

The comprehensive OWC Literature Review and the Expert Interview efforts both identified several barriers impeding the progress toward One Water, suggesting the identification of barriers and potential pathways is vital for fostering this transition.

Barriers

Financial barriers	Community and institutional	Legal and regulatory
<ul style="list-style-type: none"> Financial constraints due to the global pandemic Combining funding sources when conducting multi-benefit projects Availability of governmental and public funds 	<ul style="list-style-type: none"> Coordination and cooperation among water and linked agencies and organizations Staff buy-in Public acceptance Delineation of responsibilities among the urban water and linked organizations 	<ul style="list-style-type: none"> Water rights Resistance to approving green infrastructure proposals due to preference for applying traditional gray infrastructure. Enforcement of laws and regulations Pollution control regulations

Pathways

<h4>Technological Pathways</h4> <ul style="list-style-type: none"> Fit-for-purpose use of alternative water sources Resource recovery Green infrastructure Implementation of conductivity sensors Satellite leak detection Seawater desalination plants
<h4>Institutional Pathways</h4> <ul style="list-style-type: none"> Partnerships between departments and collaborating organizations Developing strategic, master, and comprehensive plans Convene informal staff/organizational gatherings Strong leadership from senior positions Interdisciplinary working groups Agreements with tribal associations Transparent engagement with the community and stakeholders
<h4>Financial Pathways</h4> <ul style="list-style-type: none"> Partnerships (e.g. with academia and non-profit organizations) Cost-sharing between departments on multi-benefit projects Private incentive programs to build green infrastructure on private property Identify grants, partnerships, and local coalitions Creative grant funding (e.g., with non-water sectors like transportation) Diverse finance strategy including grants, revenues, bonds

Figure 2. Examples of pathways to facilitate the transition towards the One Water approach

Discussion & Conclusions

- Although several cities have implemented several technological solutions such as green infrastructure, recycled water, and stormwater management, OWC interviews revealed that the obstacles to achieve the paradigm shift do not always stem from the inaccessibility of technological solutions and scientific knowledge, but instead the social and institutional change process as well as a cultural shift, are necessary to support any directional shifts.
- The OWC literature review revealed that institutional barriers and the issue of path dependence and lock-in are the greatest impediments (Arabi et al., 2021). In addition, the OWC expert interviews indicated that financial and regulatory challenges are among other important barriers inhibiting transitions towards the One Water approach in North America. In fact, nowadays, not only have many cities lost revenue but also cities that are progressive in terms of adopting One Water strategies have faced financial challenges when attempting to combine funding resources when implementing multi-benefits projects.
- In this context, the OWC interviews also identified several financial pathways to overcome financial barriers. Therefore, it seems that regulatory and institutional barriers are the greatest impediments in the adoption of One Water strategies for many case studies.

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Acknowledgment

This work was supported by the Water Research Foundation (WRF) project #4969 “One Water Cities: Development of Guidance Documents and Assessment Metrics.”