WORLD RESOURCES INSTITUTE

MIT MANAGEMENT Sustainability Initiative

TECHNICAL NOTE

MAPPING PUBLIC WATER MANAGEMENT BY HARMONIZING AND SHARING CORPORATE WATER RISK INFORMATION

JULIAN KÖLBEL, COLIN STRONG, CINDY NOE, PAUL REIG

SUMMARY

In response to water crises across the globe, data on biophysical conditions associated with water risk have increasingly been collected and understood. However, a complete assessment of water risk also requires an understanding of public water management. Currently there is a lack of global comparable data on public water management, leading to incomplete assessments of risk and suboptimal risk mitigation activities. To fill in that gap in data, this Technical Note proposes the creation of a global comparable geodatabase of public water management indicators to spur tangible improvements in water management. The geodatabase will be populated by crowdsourcing data through the risk assessments of multinational companies that are incentivized to share anonymized public water management as an innovative risk reduction practice.

CONTENTS

Technical notes document the research or analytical methodology underpinning a publication, interactive application, or tool.

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INTRODUCTION

Background

Water crises are among the greatest challenges the world is facing (WEF 2017). In response, many organizations mitigate the associated risks by improving the state of knowledge about global water resources. There is a wealth of global data about biophysical conditions: water availability, water consumption, water scarcity, groundwater levels, and much improved information about water pollution, as well as predictions of how climate change will affect hydrological conditions (Gain et al. 2016). Nevertheless, data on one critical aspect remain relatively scarce: the capacity of public institutions to manage available water resources.

This lack of available data characterizing public water management indicates that current assessments of water-related risk may be incomplete and, as a result, inaccurate. For any water user—industrial, agricultural, or domestic—water-related risk hinges on three variables: the user's dependency on water, the user's exposure to contextual water challenges, and the user's response to those contextual water challenges (Ceres 2015). How water is being managed at any given location is part of the external context and therefore critical to determining water-related risks for any water user. Furthermore, unlike the biophysical attributes of shared water challenges, public water management can be reformed. This makes the availability of public water management data critical to highlighting specific, actionable opportunities to help mitigate shared water challenges and increase water security.

Singapore, Australia, and Brazil are good examples. Biophysical analysis using World Resources Institute's (WRI's) Aqueduct Water Risk Atlas reveals contextual conditions of extreme water stress in both Singapore and Australia. Yet, robust public water management—whether through enforced allocation limits or mandated recycling requirements—helps reduce the exposure to risks associated with conditions of water stress. São Paolo, Brazil, on the other hand, is in an area of low water stress, but despite that, water users often face significant water-related risks. These risks are driven, in great part, by inadequate public water management that in times of drought represents a threat to industrial, agricultural, and domestic water provision. Thus, it is only by combining biophysical and management data that water users can fully determine their exposure to water-related risks and to catchment water security more broadly.

Current efforts to measure the state of public water management can be grouped into two broad categories. First, there are efforts to measure certain aspects of water management globally by deriving comparable information from national statistics, such as the efforts of

Table 1 | **Related Initiatives, Highlighting Potential Synergies**

RELATED INITIATIVES	DESCRIPTION	SYNERGIES BASED ON THE AVAILABILITY OF PWM DATA
CDP Water	Voluntary disclosure of company water metrics	PWM data provides a context of public water management to pair with disclosed company data
OECD Water Governance Programme	Principles of water governance for government self-assessment and application	Triangulate OECD data with PWM data
AWGI (and similar indices)	National assessment of water governance, collected by surveying water experts	Incorporate PWM data into future index calculations
WWF Basin Report Card	Ground-up, science-based assessment of local conditions and priorities of basin stakeholders	Track progress across regions by using indicators of PWM data
World Bank Atlas of SDGs	Global and national SDG data tracking and data visualizations	Incorporate PWM data to improve measurement and to add local background to national statistics
IBNET Tariff Database	Database of water tariffs by country or utility	Extend PWM data with IBNET data to include pricing as an additional aspect of water management

Source: Authors.

the World Health Organization/United Nations Children's Fund (WHO/UNICEF) Joint Monitoring Programme (JMP). Second, there are place-based efforts that aim to characterize water management at a certain location by collecting information through multistakeholder processes, such as the Basin Report Card effort by the World Wildlife Fund (WWF) and the University of Maryland. These efforts respond to specific needs, but do not provide detailed, globally comparable, and actionable information on the state of public water management.

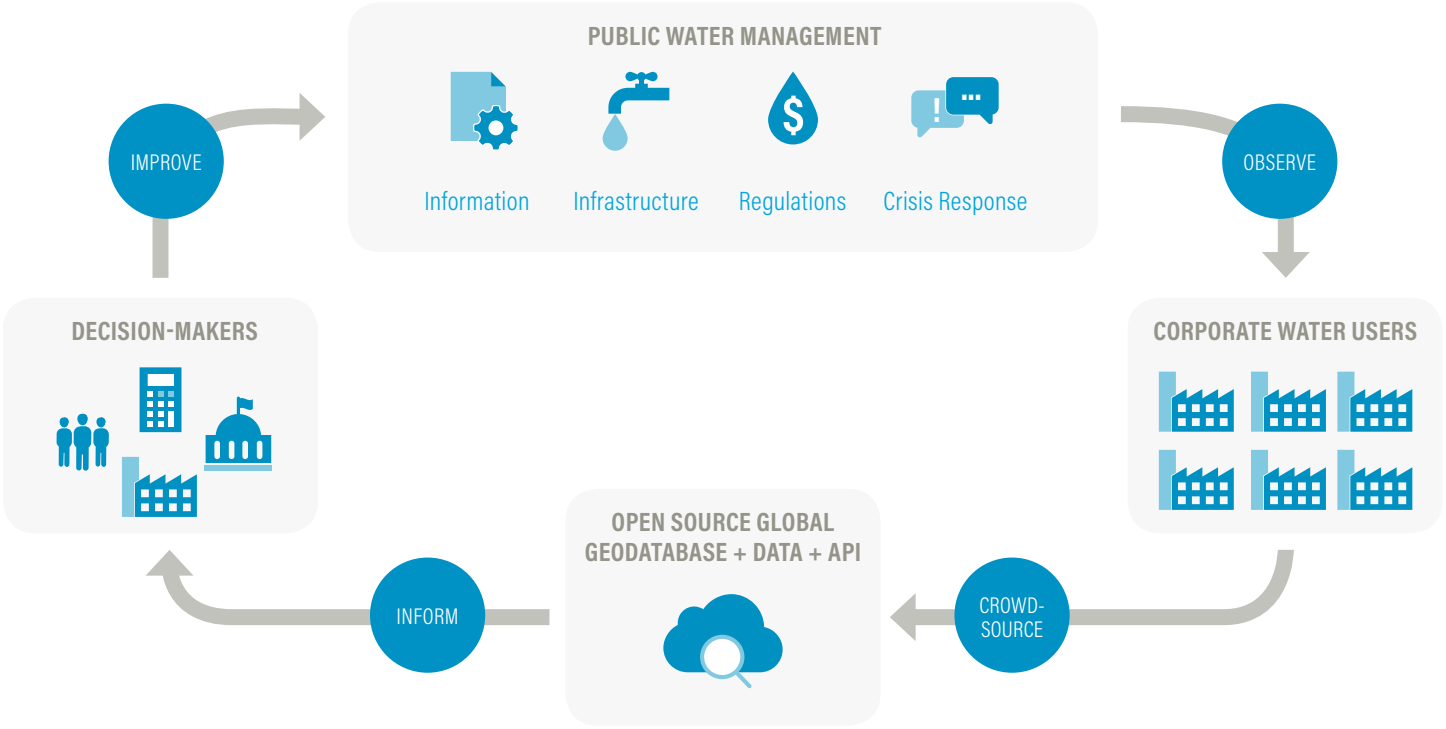
Objectives

In response to the gap in data, this Technical Note sets out to identify indicators that can help characterize and communicate the state of public water management in a comparable and comprehensive way and to propose a method to collect, share, and distribute the data generated by the indicators.

The proposed indicators and method improve on existing efforts (Table 1) by creating an approach to collect and share data that is globally comparable, informed by empirical place-based observations, and scalable. The indicators allow *global stakeholders* to compare public water management across geographies and to prioritize engagements and investments, and *local stakeholders* to identify gaps in public water management and develop appropriate place-based solutions.

If successful, the resulting data could make a significant contribution toward improving water management (Figures 1 and 2). For example, by providing companies and investors with access to information that would allow for more targeted investments in water management solutions and engagements in public water policy, by allowing nongovernmental organizations (NGOs) to better identify opportunities for building capacity with local governments, and by enabling the public sector to better understand regulatory effectiveness, increasing transparency between the national and subnational levels.

Figure 1 | **Impact Process**



Note: Improving public water management is contingent on putting actionable information into the hands of decision-makers and developing a dynamic process to drive long-term improvements in water management.
Source: Authors.

METHOD

As reflected in published literature (Wada et al. 2016), remote sensing and modeling are not suited to generate the type of information required to evaluate water management regimes. Therefore, generating data on the state of public water management calls for empirical, place-based observations. Additionally, while information on water management may be publicly available, it is often fragmented, difficult to access, or out of date.

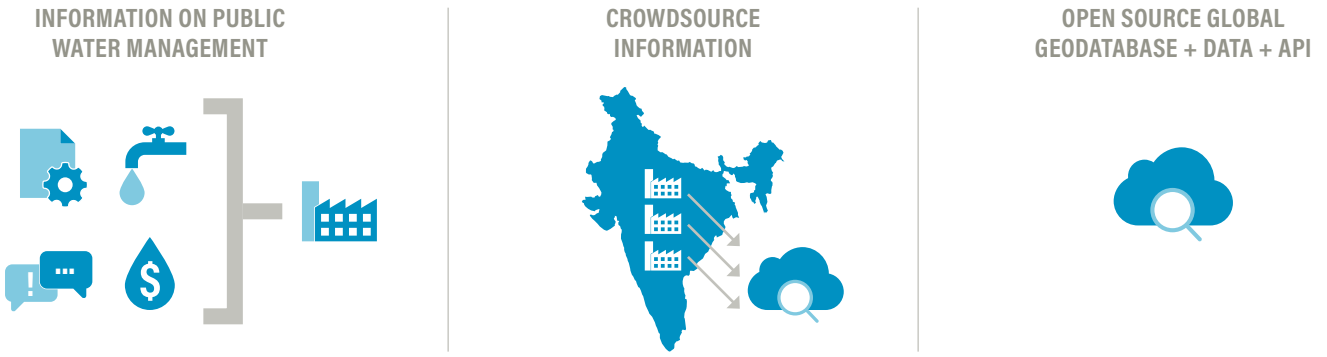
Because of this, a growing number of companies in water-intensive industries assess the state of public water management on a regular basis to evaluate the capacity of existing management and governance regimes to provide stable water supplies and treatment services. Collectively and over time, these companies gather a tremendous amount of place-based observations on the state of public water management. Generally, the data are collected and distributed internally by local staff (e.g., facility managers, and environmental health and safety [EHS] and sustainability officers) as part of enterprise risk assessment processes.

Through engagements across a wide range of water-intensive industries, WRI and the Massachusetts Institute of Technology (MIT) Sloan Sustainability Initiative identified corporate water risk assessments as a potential source of data to complement existing information on public water management. The information being collected by many companies is already empirical, detailed, and place-based, and if collected via a standardized mechanism, would easily yield comparable data and scale to produce thousands of observations, one for each participating company facility worldwide.

Harmonizing corporate water risk assessments and sharing the results in a global database could quickly close the existing information gap and provide globally comparable and detailed data characterizing public water management (Figure 2). For example, if 12 companies provide data corresponding to three catchments each year, the database could hold data on the world's 100 most populated river catchments within three years. The specific information this approach aims to collect includes the following:

- Availability and accessibility of water-related information
- Performance of water supply and treatment infrastructure
- Existence and enforcement of water caps, allocations, and monitoring and pricing schemes
- Local capacity to respond to and address water crises

Figure 2 | **Data Collection Mechanism**



Note: Corporate water users have information on public water management and collect this in standardized facility water risk assessments. This information is crowdsourced from a large number of facilities across a geography and (after anonymization) is made accessible in an open-source geodatabase.
Source: Authors.

The data collected could serve as a proxy to help characterize and compare broader water governance regimes, while also providing enough detail to help local stakeholders identify and respond to existing water challenges.

Given that the catchment context is the same for all water users and that the indicators measure key attributes of the water governance and management regime and not company performance, the data generated will benefit nearly all water users, and not just the companies collecting and distributing the data. Because of the range of data beneficiaries, this Technical Note aims to inform the following:

- All stakeholders interested in this method, the proposed indicators and data collection mechanisms, and resulting data
- Companies interested in contributing to the data collection process

Rather than prescribing fixed solutions, this Technical Note admits that the pathways to influencing public water management are diverse, and improved data benefit an entire ecosystem of actors driving water management improvements (Figure 3). Recognizing that the data would be collected only by companies, the proposed method calls for third-party validation and could serve as a foundation to be supplemented with additional observations provided by local governments, utilities, civil society, and/or academia.

PROPOSED INDICATORS

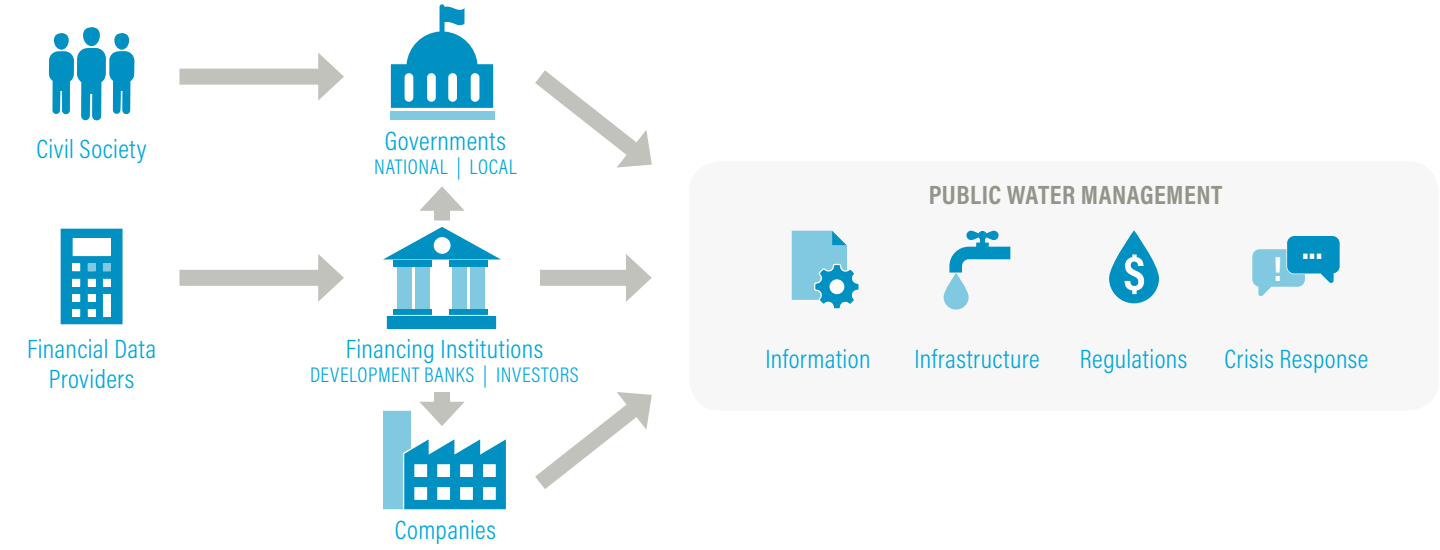
Indicator Selection Process

WRI and the MIT Sloan Sustainability Initiative identified indicators of public water management following a three-step process:

STEP 1. Review of existing indicators of public water management, by evaluating water risk assessment questionnaires currently used by companies to assess public water management; and relevant water management literature and assessment frameworks, including the following:

- Organisation for Economic Co-operation and Development (OECD) inventory of indicators (OECD 2015a)
- OECD Principles on Water Governance (OECD 2015b)
- Indicators of Sustainable Development Goal (SDG) 6 on Water and Sanitation (UN 2010)
- United Nations Development Programme (UNDP) guidance on assessing water governance (UNDP 2013)
- Guidance provided in the Alliance for Water Stewardship (AWS) International Water Stewardship Standard (AWS 2014)
- Sustainable Water Index (Iribarnegaray and Seghezzo 2012)
- Asia Water Governance Index (AWGI) (Araral and Yu 2010)
- WRI Environmental Democracy Index (Worker and de Silva 2015)

Figure 3 | **Theory of Change**



Note: The global geodatabase would drive a variety of users to influence and improve public water management on a local or utility level. Rather than offer a fixed set of activities that actors could take, this Technical Note documents the ecosystem of actors at play and focuses primarily on companies, as they are the primary data collection mechanisms.
Source: Authors.

STEP 2. Indicator selection by WRI and the MIT Sloan Sustainability Initiative, with guidance from subject matter experts and informed by a series of selection criteria. The criteria must be: Relevant, Feasible, Credible, Comparable, Actionable and Noncompany specific.

- **Relevant**: Indicators must measure issues that have clear implications for public water management and, thus, for water-related business risk.
- **Feasible**: Indicators must be populated with information that company staff already possess or can easily obtain.
- **Credible**: Indicators must be credible for all stakeholders, despite being collected and shared by a company, and must rely on objective and verifiable data.
- **Comparable**: Indicator values must be comparable across political and hydrological boundaries.
- **Actionable**: Indicators must refer to specific aspects of public water management that can be modified and improved—given the necessary political will and funding are in place.
- **Noncompany specific**: Indicators must measure critical aspects of public water management in the catchment in which a facility operates (i.e., not company performance or management practices), allowing companies to share the data freely, and the public to benefit from them.

STEP 3. Formulate questions and response guidance for each selected indicator to inform the way in which the indicator will be measured and shared, and compile all questions in a questionnaire for distribution to participating companies.

The resulting questionnaire was shared with subject matter experts for feedback and to validate that the selected indicators aligned with the selection criteria. After incorporating feedback, a final questionnaire was developed (Appendix A) containing the proposed indicators and selection criteria (Appendix B).

Indicator Description

The three-step process resulted in seven indicators, grouped in four categories: availability of information, state of infrastructure, water access regulations, and crisis response (Table 2), all of which are supported by specific terminology (Appendix A) and selection criteria (Appendix B).

PROPOSED APPROACH TO DATA COLLECTION AND SHARING

Collecting empirical data on public water management requires place-based engagements and knowledge; therefore, compiling a dataset with global coverage is challenging for any one institution working alone. The approach proposed in this Technical Note relies on companies conducting enterprise water risk assessments to generate the required data by incorporating the proposed indicators into facility-level water risk assessment surveys and sharing the results in a central database managed by WRI and the MIT Sloan Sustainability Initiative. There are multiple benefits to this approach, including:

- The combined reach of multinational companies affords a way to achieve global coverage for the information collected.
- Companies that actively manage water as a material business risk have an invested interest in evaluating and monitoring public water management over time, allowing for the data generated to be updated regularly over time.
- Many companies already collect data on public water management, so by using standardized indicators and a consistent data collection mechanism, the resulting data can yield comparable results with global coverage to be shared and used easily.

Incentives for Participation

There are several incentives for companies to join and contribute to this effort:

- Companies can rely on a well-developed, consistent approach to collecting information on public water management, with indicators selected for company use and aligned with current thought leadership and water management frameworks.
- Companies can support and lead other companies (e.g., in their value chain and industry) to aid the development of a database that will generate new data on public water management and extend their field of vision beyond their own facilities, helping evaluate exposure to poor water management across the value chain and in future siting due diligence.
- Companies can help generate data that, if used by other companies, policy makers, investors, and advocacy groups, can build momentum toward collectively resolving water management issues that might negatively affect company growth, thereby reducing exposure to water-related business risks.

Table 2 | **Proposed Indicator Category, Name, and Predefined Value**

INDICATOR CATEGORY	INDICATOR NAME	INDICATOR PREDEFINED VALUE
1. Availability of Information	1.1. Quantitative information on water availability and demand	Yes, publicly available Yes, privately available No
	1.2. Quantitative information on water quality	Yes, publicly available Yes, privately available No
2. State of infrastructure	2.1. Reliability of water supply	Number of service interruptions per year
	2.2. Availability of wastewater treatment services for businesses	Collection and treatment Collection and partial treatment Collection and no treatment No services available
3. Water Access Regulations	3.1. Existence of water access regulations (differentiated by delivered water, self-abstracted groundwater, and self-abstracted surface water)	Permit required (Y/N) Volumetric limits (Y/N) Mandatory metering (Y/N) Costs increase with volume (Y/N) Other (Y/N)
	3.2. Consistency of enforcement (differentiated by inspections, sanctions, and compliance)	Consistently Somewhat consistently Not consistently
4. Crisis Response	4.1. Existence of a mechanism to limit or prioritize allocations	Yes No
	4.2. Effectiveness of mechanism during actual crisis	Yes Partly No

Source: Authors.

Data Collection and Sharing

The data collection mechanism relies on company staff to populate the indicator values outlined in the questionnaire (Appendix A). The assessment process many companies already use is typically conducted with a survey questionnaire that each facility is asked to complete on a regular basis, anywhere from every one to five years. Companies often prioritize assessments at locations exposed to high water stress or of relatively higher importance compared to other sites. The results are typically shared internally to inform site-specific action plans and broader risk mitigation activities, and include information related to any or all the following areas:

- Facility location, characteristics, and key performance indicators (KPIs)
- Water use (e.g., water withdrawals, wastewater discharge, and percentage of recycled water)
- Water quality (e.g., at the source, wastewater, and at the discharge point)
- Water-related crises and/or disputes with local stakeholders
- Internal company water management challenges and opportunities
- Water-related compliance violations and penalties

The proposed questionnaire builds on information requested in existing facility water risk assessment surveys, and can easily be incorporated into them in the future. In contrast to enterprise-level water risk assessments, the proposed questionnaire only includes indicators specific to public water management and is designed to require minimal time and effort for facility staff to complete.

During the initial rollout of the questionnaire, facility staff can complete the stand-alone questionnaire to help build the database. In subsequent years, this effort aims to include the proposed indicators in a company's facility risk assessment surveys. Since the water risk assessments already include several components that encompass public water management, in some cases this may consist of mapping the questionnaire's indicators to the company's existing assessment or making only slight modifications to existing questions. Responses to these indicators will help continue to build and update the database over time, and to standardize public water management indicators across companies and industries.

A critical part of the data-sharing component is to ensure companies aren't subject to competitive disadvantage or negative impacts associated with sharing data collected on public water management. Two measures will be put in place to mitigate such risks:

- Indicators rely on contextual information that is public knowledge (i.e., information on how water is managed in a catchment), and not on company-specific information.
- Company names will be anonymized, and the exact locations will be masked so that data consumers cannot identify facility locations or a participating company's name.

EXPECTED RESULTS

The data generated through this approach will be processed and stored in a geodatabase, providing open access to globally comparable, detailed, and empirical data on public water management. The following section outlines the likely coverage, spatial resolution, validation, limitations, and distribution and uptake of the resulting data.

Coverage

Leveraging company facilities, suppliers, and partners to collect and share data offers a scalable mechanism capable of quickly generating a dataset with global coverage. Assuming 50 companies contribute to the data collection, with an average of 20 facilities participating, this approach would yield regularly updated data for 1,000 locations worldwide.

The data will likely be for catchments with water challenges, given that companies typically prioritize water-related risk assessments at facilities facing water-related risks. Therefore, the dataset will likely not provide coverage for every catchment in the world, but the dataset will likely cover catchments that are most critical from a social, economic, and environmental perspective.

Spatial Resolution

One of the most challenging elements of this approach is to determine the correct spatial resolution to visualize and communicate the resulting information. Indicators will be populated with information for the geography managing water resources at that location, and thus could represent an administrative boundary (i.e., a municipality, province, or water provision service area) or a hydrological boundary (i.e., catchment or subcatchment).

As such, the spatial resolution of the results plays a critical role in communicating the results, by ensuring it matches the scale at which water is managed and understood by local stakeholders. Furthermore, several data points within the same area could be aggregated to increase the reliability of the results, and data points for adjacent areas could be aggregated to evaluate a larger area of interest.

Determining the spatial resolution is also necessary to ensure that locations of participating companies remain anonymous. This can be achieved by sharing data points within areas large enough to prevent data consumers from identifying the exact location of a participating facility.

WRI and the MIT Sloan Sustainability Initiative will collect a representative sample of data from a pilot study to help determine the most suitable spatial resolution to deliver valuable insight, while maintaining the anonymity of participating companies.

Validation

The proposed indicators and approach to data collection and sharing require testing and validation to ensure they deliver the type of information required to meet project objectives. For that reason, the proposed method is being tested as part of a pilot to confirm

- *the feasibility of the data collection mechanism* (i.e., Is there enough interest from companies and can facility staff easily populate the indicators?); and
- *the validity of the data* (i.e., Do the reported data reflect local conditions and align with the perspectives of other stakeholders in the same area?).

Several companies saw value in the generation of a public water management database and offered to pilot test the questionnaire at various locations. Pilot data are being collected by six companies for a total of 41 locations, representing a wide range of conditions (i.e., stressed and not stressed catchments, developed and developing countries, large and small facilities, and a variety of industries). The number of companies volunteering to pilot this approach indicates strong interest from companies, and the experience of collecting the data will provide the basis for evaluating and confirming the feasibility of the data collection mechanism.

The data collected during the pilot will be compared to data for the same locations collected separately by an independent third party. A researcher from MIT will independently evaluate the state of public water management for a sample of the pilot locations through desktop research, field trips, and interviews with local stakeholders. Contrasting the data collected through the pilot with the data collected by the independent in-depth assessment will allow WRI and the MIT Sloan Sustainability Initiative to answer the following questions and evaluate the value of the data generated:

- Do indicators capture the elements most relevant to public water management?
- What are the limitations to each indicator? In what ways can the indicators be improved?
- Are the data provided by participating companies objective characterizations of public water management?
- Do the data provided by participating companies match the observations of the independent third party?
- Do the data provided by participating companies match the perspectives of other stakeholders at that location?

The answers to these questions will inform the extent to which the proposed methodology is successful in providing an objective description of public water management. Furthermore, they will highlight which additional data might be helpful in increasing the value and reliability of the effort. Finally, these questions will also help inform how to incorporate quality control mechanisms in the data collection process.

Limitations

The following limitations have been identified in the proposed approach to collecting and sharing data on public water management:

- **High reliance on company participation**. The data generated through the proposed approach rely exclusively on companies to source and share information, and therefore may not be representative of the experience or perspectives of other water users in the catchment. There are three measures that can help address this challenge:
  - Validation during the pilot will help determine the consequences and implications of relying solely upon companies to generate contextual data by evaluating to what extent the public water management concerns of companies represent the concerns of other stakeholders.
  - The data collected in the pilot can be compared with self-reported data on public water management from municipalities or regulators (see Table 1 for examples).
  - If successful with company participation, this effort can be extended to include other data contributors, such as local governments, utilities, civil society, and academia.
- **Single data collection mechanism**. The geodatabase relies on data collected from companies and also requires anonymization for the privacy of data providers. Given these features, it is important to ensure data quality for end users. There are several considerations to ensure the validity and quality of the data:

- The indicators will often be incorporated into companies' risk assessments, which demand accurate data to appropriately prioritize risk and investment across facilities.
- The results of the pilot will flag which indicators and instances might require additional verification; for example, where multiple sources of data for the same location are inconsistent.
- In those cases, facility staff populating the indicators will be encouraged to provide references and citations to help verify the information collected.

- **Information gaps**. The proposed indicators provide a snapshot of certain aspects of public water management but ignore others that are subjective or difficult to measure. For example, measures of water access and sanitation and hygiene are excluded because facility staff lack the knowledge to appropriately measure such variables, and the price of water and wastewater services is excluded, given the challenges of evaluating its effectiveness in covering the associated costs and investment requirements. Furthermore, the proposed indicators provide limited visibility into the effectiveness of existing public water management regimes but rather characterize key attributes of public water management for specific stakeholders to evaluate and determine their appropriateness in addressing shared water challenges.

Distribution and uptake

The resulting data will be compiled and stored in an open-source database hosted by WRI. The data can feed into existing tools hosted by WRI, such as the WRI Aqueduct Water Risk Atlas or Resource Watch Platform, and will also be made available via download links and an application programming interface (API) allowing any organization to make use of the data and include it in its service offerings and products.

Much of the value in the resulting data lies in its global comparability, improving significantly on current efforts, as follows:

- Providing empirical observations that are comparable across geographies worldwide
- Increasing the coverage and availability of public water management data in catchments with significant water challenges
- Disseminating public information that might otherwise not be accessible
- Providing data that can be used to
  - construct composite indicators to inform high-level hot spot analysis and identify local-level issues to drive targeted actions and investments on the ground; and
  - conduct derivative analysis by combining with other data to increase transparency and accelerate the rate of improvement in water resource management.

APPENDIX A: INDICATOR QUESTIONNAIRE

This is a questionnaire intended for facility staff to assess the state of public water management in the area that concerns their facility. It contains questions about the availability of information, the state of infrastructure, water access regulations, and crisis response.

The questionnaire is part of a project that is run jointly by MIT Sloan Sustainability Initiative and the World Resources Institute. The vision is that this questionnaire could become part of water risk assessments at the facility level and that sharing the responses would create a global dataset of water management practices. At this stage, we are piloting the questionnaire with a limited number of participants.

All data will be kept confidential and are not linked to your personal identity. Research based on the data will not disclose the exact location of your facility. Also, responses will not be linked to your organization unless we obtain explicit permission to do so.

The questionnaire will take 5 to 10 minutes to complete. We appreciate your support.

General Guidance

○ (Circle) indicates a question with one answer (select only one)

☐ (Square) indicates a question with multiple possible answers (select as many boxes as apply)

— (Line) indicates a question with free text answer

Location and Area

Please provide either your facility address OR the coordinates of your facility.

Street address: _____

City: _____

Postal code: _____

Country: _____

Latitude* (e.g., 44.968046): _____

Longitude* (e.g., –94.420307): _____

**Latitude and longitude: We recommend using a website such as http://www.latlong.net/ or https://gps-coordinates.org/ to identify these coordinates.*

The following questions are about the public water management of water resources in your area, related to:

- Availability of information
- Infrastructure
- Water access regulations
- Crisis response

Please specify the area to which your responses will refer. It is important that the area is relevant for your facility's water supply and that you have knowledge of the water management practices in the area. All questions that follow should be answered with respect to this area.

Name of the Area (e.g., City of Alexandria, VA, USA):

_____

What is the type of the area you have entered above?

○ Municipality

○ Province or county

○ Service area of water provider

○ Catchment, basin, or watershed

○ Other type (please specify): _____

1. Information Availability

For your location and area, do you have quantitative information* on the following? Please select all that apply.

	YES, INFORMATION IS PUBLICLY AVAILABLE	MY FACILITY AND/OR COMPANY COLLECTS ITS OWN INFORMATION	NO, THERE IS NO QUANTITATIVE INFORMATION
1.1. Water availability and demand (e.g., ground and surface water availability and demand)			
1.2. Water quality (e.g., wastewater treated; drinking and environmental water quality)			

**Quantitative information: Refers to estimates, studies, catchment management plans.*

If information is publicly available, please specify from where and provide a link if available:

- ○ Water availability and demand information: _____
- ○ Water quality information: _____

2. Water Infrastructure

2.1. Over the last year, on how many days did the local water service provider provide intermittent supply* of water to your location? Please select one answer.

- ○ Never
- ○ Up to 7 days
- ○ Up to 30 days
- ○ Up to 90 days
- ○ Up to 180 days
- ○ More than 180 days

*Intermittent supply: Refers to low pressure or no water supply.

2.2. Which wastewater services* are available in your location?

- ○ Collection and treatment of wastewater
- ○ Collection, but only partial treatment
- ○ Collection, but no treatment
- ○ Neither collection nor treatment

*This refers only to services offered by a local provider. The question does not refer to wastewater collection or treatment performed by the facility itself, because the focus of the survey is public water management.

3. Water Access Regulations

Filter question: Please select all of the water sources used at your facility.

☐ Delivered water (supplied by a water service provider)

☐ Self-abstracted surface water

☐ Self-abstracted groundwater

3.1. Which water access regulations apply to the water sources listed below? Please check all boxes that apply.

	PERMIT REQUIRED*	VOLUMETRIC LIMITS*	MANDATORY METERING*	COSTS INCREASE WITH VOLUME*	OTHER*
Delivered water (supplied by a water service provider)					
Self-abstracted ground water					
Self-abstracted surface water					

If responses include "other," please specify which additional water access regulations are in place:

Note: In the online version of the survey, only the options selected in the first part of the question are displayed for this question.
**Permit required: Answer yes, if you need any form of authorization to use this source. Such authorizations may be called, for example, permits, water rights, allocations, or licenses.*
**Volumetric limits: Answer yes, if there are any limits on daily, monthly, or yearly volumes that may be withdrawn. Answer no, if there are no limits.*
**Mandatory metering: Answer yes, if you are required to measure and report the amount of water that is taken from the source.*
**Costs increase with volume: Answer yes, if the volume of water affects the total cost of water. For example, if there is a volumetric tariff.*
**Other: Select this option if you would like to supply information that is not offered in the question.*

3.2. The following statements characterize the extent of enforcement and compliance with water regulations. Please indicate to what extent the statements reflect the reality in your area.

	USUALLY TRUE	OCCASIONALLY TRUE	USUALLY NOT TRUE
There are **inspections** of, e.g., meters, pipes, and permits			
Noncompliance with regulations is **sanctioned**			
Water users **comply** with existing regulations			

4. Crisis Response

Filter question: Has a water crisis* occurred in the past five years?

- ○ Yes
- ○ No

**Water crisis: Refers to human-caused or environmental events in your area (e.g., drought, contamination incident, refugee crisis) with a substantial effect on the availability, quality, or demand for water resources.*

4.1. Are there any mechanisms* to limit and prioritize water access during a water crisis in your area?

- ○ Yes
- ○ No

**Mechanisms: Any mechanism that establishes limits or priorities during a water crisis; for example, contingency plans by water service providers, legal norms that specify priority, or administrative bodies that are tasked with allocating water under crisis conditions.*

You stated there is a mechanism to limit and prioritize water access during a water crisis. Please provide a brief description.

4.2. Did the mechanism you described above work as expected during the last water crisis?

- ○ Yes
- ○ To some extent
- ○ No
- ○ Mechanism was not yet in place at the time

APPENDIX B: INDICATOR JUSTIFICATION

Availability of Information

Indicators

- Quantitative information on water availability and demand
- Quantitative information on water quality

The criteria must be: Relevant, Feasible, Credible, Comparable, Actionable and Noncompany specific.

a. Relevant: One of the requirements for effective public water management (outlined in OECD Principles on Water Governance, Principle 5) is information on local water quantity and quality (OECD 2015b). Sound data on water quantity and quality allow for more informed decision-making, more effective investments, and stronger action on the most pressing water challenges.

Water is also a common pool resource. Transparency and public access to water quantity and quality information is therefore essential to ensure that water management is implemented in line with the interests of all stakeholders (also outlined in OECD Principles on Water Governance, Principle 5). Access to transparently gathered water quantity and quality information also allows stakeholders, including companies operating in the area, to hold water authorities accountable for management of water. The OECD Principles on Water Governance, Principle 9 explicitly includes the "right to information" as a critical factor in ensuring greater accountability and therefore effective decision-making of water management authorities (OECD 2015b).

b. Feasible: Whether it is available publicly or generated by the company, facility managers require information about water availability and demand and water quality information to adequately manage the facility. They either would have this information available or would be able to obtain it with reasonable effort.

c. Credible: The existence of information on water availability, demand, and quality is already publicly known in the catchment context in which a facility operates; therefore, there is no incentive for companies to misrepresent existing and known public information.

d. Comparable: These indicators allow the same interpretation in different contexts.

e. Actionable: If data indicate that information generated by the regulatory authority is not publicly available, it immediately suggests a potential action the authority can take: generating and/or releasing information about water availability and demand and water quality.

f. Noncompany specific: The question asks for publicly available information about the facility's context. If the information is generated by the company for internal use, the specific data are not requested and therefore do not reveal proprietary information.

State of Infrastructure

Indicators

- Reliability of water supply
- Availability of wastewater treatment services

The criteria must be: Relevant, Feasible, Credible, Comparable, Actionable and Noncompany specific.

a. Relevant: The reliability of infrastructure is key to ensuring an uninterrupted supply of water and wastewater services to businesses and is an important indicator of effective water management. Service disruption represents a capacity gap in the ability of the public water management authority to fulfill its objective. The Alliance for Water Stewardship Standard 2.3.6 includes the status of water-related infrastructure within a catchment as a priority item because water infrastructure and service delivery function as part of facility supply chains (AWS 2014).

b. Feasible: Facility managers are aware of both water supply to the facility and wastewater treatment services because both are critical to business operations. They either would have this information available or would be able to obtain it with reasonable effort.

c. Credible: Knowledge of the state of infrastructure is already publicly known in the catchment context in which a facility operates; therefore, there is no incentive for companies to misrepresent existing and known public information.

d. Comparable: These indicators allow the same interpretation in different contexts.

e. Actionable: If data indicate intermittent water supply or lack of wastewater treatment services, there is a direct action the authority can take to improve this result—given the necessary political will and funding—by improving service levels or enhancing wastewater treatment services available.

f. Noncompany specific: These indicators refer to the catchment context in which a facility operates and to factors and events outside of the facility itself.

Water Access Regulations

Indicators

- Existence and characteristics of permits and pricing
- Consistency of enforcement

The criteria must be: Relevant, Feasible, Credible, Comparable, Actionable and Noncompany specific.

a. Relevant: The existence and enforcement of permits, water rights, caps, and/or allocations on water services—both self-abstracted and utility provided—is a critical indicator of the state of public water management. Enforced regulatory frameworks reflect the ability of the water regulatory authority to match water consumption with the resources available. The UNDP's Cap-Net implementation guide to integrated water management identifies water allocation as a key indicator to identify the state of catchment level water management (UNDP 2008). OECD Principles on Water Governance, Principle 7 identifies "the use of regulatory tools" and "setting clear, transparent and proportionate enforcement rules" as basic aspects of a sound water management regulatory framework (OECD 2015b).

Within water access regulations, the existence and sophistication of a pricing scheme tailored to the local context is a vital aspect of local water management. The adequacy of pricing systems reflect the capacity of a management system to fund the capital, operations, and maintenance costs required for service delivery. The Asia Water Governance Index identifies a country's water pricing approach as a vital component of the policy dimension of water governance (Araral and Yu 2010).

The existence and enforcement of regulatory frameworks and pricing is also an important indicator for companies because there is a direct business cost of regulatory changes, especially price volatility. This type of regulatory risk is repeatedly referenced in the Alliance for Water Stewardship Standard and motivates company contingency planning that includes alternative sourcing options (AWS 2014).

b. Feasible: Facility managers are aware of regulatory frameworks and enforcement because both are critical to business operations. They either would have this information available or would be able to obtain it with reasonable effort.

c. Credible: Information on the existence and types of permitting and permitting characteristics is already publicly known in the catchment context in which a company operates; therefore, there is no incentive for companies to misrepresent existing and known public information. Quality of enforcement is a risk for businesses (i.e., low enforcement creates higher regulatory and reputational risks and increases the long-term risk of stranded assets); therefore, businesses are incentivized to accurately report enforcement conditions.

d. Comparable: These indicators allow the same interpretation in different contexts because they specify the type of water source being evaluated and provide multiple specifications for regulations and enforcement.

e. Actionable: If data indicate lack of regulation or pricing, there is a direct action the authority can take to improve this result—given the necessary political will and funding—by introducing regulation or pricing schemes.

f. Noncompany specific: These indicators refer to the catchment context in which a facility operates and to factors and events outside of the facility itself, and do not seek to verify the facility's regulatory compliance.

Crisis Response

Indicators

- Water crisis in the last five years
- Existence of a mechanism to limit or prioritize allocations
- Effectiveness of a mechanism during actual crisis

The criteria must be: Relevant, Feasible, Credible, Comparable, Actionable and Noncompany specific.

a. Relevant: The ability of a water management institution to respond to shocks is a critical measure of adaptive management and therefore also indicates the authority's operational resiliency and effectiveness. OECD Principles on Water Governance, Principle 2 identifies adaptation to local conditions as a key pillar of effective governance, emphasizing the need to "manage water at the appropriate scale(s) within integrated catchment governance systems to reflect local conditions," and "promote adaptive and mitigation strategies . . . that are consistent with national policies and local conditions" (OECD 2015b). Further, the Alliance for Water Stewardship Standard 3.3.1 recommends knowledge of a catchment's risk scenarios so that a facility can be "responsive and resilient to water-related issues and/or risks facing the site" (AWS 2014). Understanding the public response plan is critical to obtaining this information.

For stakeholders within a catchment, a coordinated crisis response is critical to managing risk and to supporting community water needs during a crisis, as highlighted in Alliance for Water Stewardship Standard 1.6.1 (AWS 2014). If there is no prioritization mechanism in place, a water crisis can lead to an uncoordinated response that wastes resources and violates the community's right to water. For companies specifically, a lack of a clearly communicated public mechanism to manage a water crisis makes it difficult to plan their response, since a situation of water stress may result in unexpected higher prices, allocation curtailments, or social unrest.

b. Feasible: Facility managers are aware of crises and management response because these are critical to business operations. They either would have this information available or would be able to obtain it with reasonable effort.

c. Credible: Information on local management institutions and responses to water crises is already publicly known in the catchment context in which a company operates; therefore, there is no incentive for companies to misrepresent existing and known public information.

d. Comparable: These indicators allow the same interpretation in different contexts because they assess the existence of a crisis response plan—an essential role for management institutions.

e. Actionable: If data indicate a lack of a management institution's response to a water crisis, there is a direct action the institution can take—given the necessary political will and funding—by instituting standard water crisis response protocol.

f. Noncompany specific: These indicators refer to the catchment context in which a facility operates and to factors and events outside of the facility itself.

ABBREVIATIONS

API	Application programming interface
AWGI	Asia Water Governance Index
AWS	Alliance for Water Stewardship
EHS	Environmental health and safety
IBNET	International Benchmarking Network
JMP	Joint Monitoring Programme
KPI	Key performance indicator
MIT	Massachusetts Institute of Technology
OECD	Organisation for Economic Co-operation and Development
PWM	Public water management
SDG	Sustainable development goal
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
WEF	World Economic Forum
WHO	World Health Organization
WRI	World Resources Institute
WWF	World Wildlife Fund

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Nestlé	Carlo Galli	World Resources Institute	Luiz Amaral
Nestlé	Cedric Egger		

ABOUT THE AUTHORS

Julian Kölbel is a Postdoctoral Fellow at MIT Sloan School of Management.

Cindy Noe is a Dual Masters in Business and Public Administration Candidate at MIT Sloan and Harvard Kennedy School.

Paul Reig is a Senior Associate at the World Resources Institute.

Colin Strong is a Water Stewardship Analyst at the World Resources Institute.

Contact: Colin.Strong@wri.org

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Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

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We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

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We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

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We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

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