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MONITORING THE IMPROVEMENT OF WATER SECURITY

Toolkit #6

This series of toolkits presents an effective and efficient process to address risks to water security, both long-term water stresses that constrain socio-economic development and threaten political stability, as well as sudden shocks that can endanger the health and livelihoods of vulnerable populations. These toolkits aim at disseminating the practice of water management. Local decision-makers as well as development specialists should use these toolkits as guidelines to engage water users in a collaborative process that results in improved water resources management.



The CEO Water Mandate



Water security is
essential to humankind
as it supports public
health, economic
growth, environmental
sustainability,
political stability and
disaster risk reduction.

PREFACE

Water Security Is Essential to Life and Humankind, by Supporting:



Public health: Safe drinking water, sanitation, and hygiene (WASH) are the most fundamental human needs.



Economic growth: Income generation and poverty alleviation heavily rely on water availability for agriculture, energy production, transportation and other livelihood activities.



Environmental sustainability: Natural ecosystems rely on water; they rapidly deteriorate when deprived of natural flows, directly affecting public health and livelihoods.



Political stability: When basic health and livelihood needs are not met, the strain on populations affects the legitimacy and sustainability of governing authorities and can lead to civil unrest.



Disaster risk reduction: Floods, landslides, droughts, tsunamis, and harmful algal blooms can be catastrophic events that claim lives, affect local economies, and may multiply due to climate variability and change.

Population growth, urbanization, industrialization, rising living standards and Westernized diets are likely to further increase the over-extraction and pollution of water resources. This will raise insecurity and uncertainty over water access and the vulnerability of communities and infrastructure to natural disasters.

This **series of toolkits** presents an effective and efficient process to address water risks, including long-term water stresses that constrain social and economic development and sudden shocks that can quickly jeopardize the health and livelihoods of vulnerable populations.

Improving water security is about focusing actors and resources on key water risks. It is also about collaboratively planning and implementing specific activities to mitigate risks and provide tangible benefits to water users. Water security activities should combine gray and green infrastructure (including improved operation and maintenance of existing infrastructure), awareness raising and behavior change campaigns, management, as well as policy and institutional improvements (such as better data and better informed decision-making).

Improving water security must be a cross-sectoral theme. Development strategies and investments that ignore water security usually fall short of their objectives when water issues and conflicts undermine political and social cohesion, supply and value chains, public and environmental health, and service delivery and infrastructure operation.

The Water Security Improvement (WSI) Process



Confirm and initiate



STEP 1

Define geographic/technical/
institutional/temporal space
(Toolkit #1)



STEP 2

Assess water risks
(Toolkit #2)



STEP 3

Prepare water security action
plan (Toolkit #3) and fund it
(Toolkit #4)



STEP 4

Implement water security
actions (Toolkit #5)



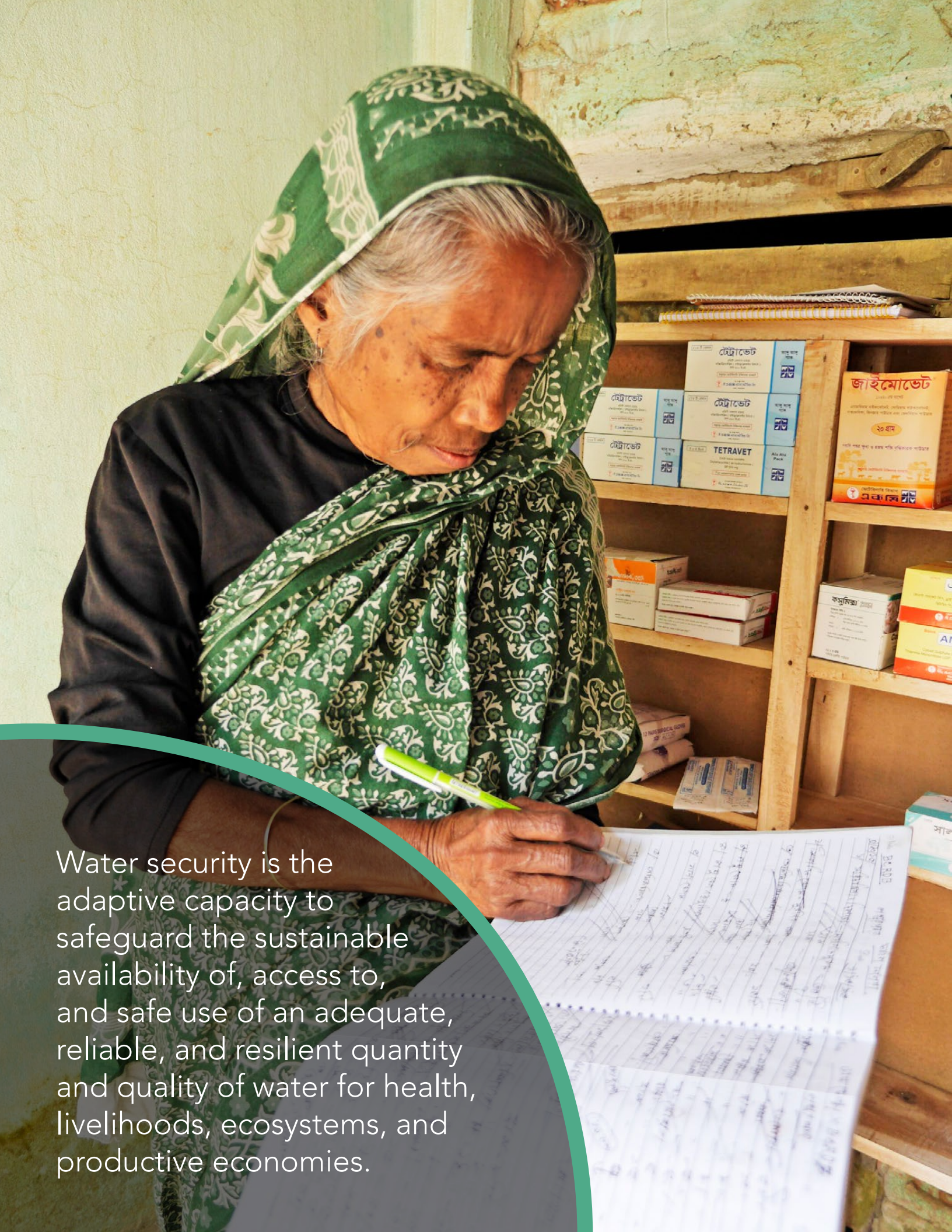
STEP 5

Monitor, evaluate and adapt
(Toolkit #6)



TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
INTRODUCTION.....	2
WHAT TO MEASURE AND WHY	4
Monitoring and Evaluation	4
Monitoring Water Security	4
HOW TO MEASURE WATER SECURITY AS AN OVERALL GOAL.....	6
Measuring scarcity	6
Measuring Basic Needs	7
Water Security Indexes	7
Displaying Water Security Risks to Raise Awareness	10
HOW TO MEASURE WATER SECURITY AS A PHYSICAL CONDITION.....	12
Water Quality Monitoring	12
HOW TO MEASURE ACTIONS MEANT TO IMPROVE WATER SECURITY	15
Macro-level Monitoring of Water Outcomes	15
Micro-level Monitoring of Water Activities	16
HOW TO MEASURE WATER MANAGEMENT	18
Macro Level (Country or Basin)	18
Micro Level (For a Specific Water Actor)	19
Water utilities	19
Irrigation management agencies	20
Water management agencies.....	20
HOW TO EVALUATE AND ADAPT	23
RESOURCES	24
Generic water security monitoring:	24
References on key water indicators	24
Other References	25



Water security is the adaptive capacity to safeguard the sustainable availability of, access to, and safe use of an adequate, reliable, and resilient quantity and quality of water for health, livelihoods, ecosystems, and productive economies.

EXECUTIVE SUMMARY

Monitoring is a process of continuous assessment. It involves collecting data on the current situation (baseline) and on changes that are brought about through activities, projects and policies, or caused by socioeconomic and natural trends and events. Evaluation uses indicators to reflect on such measurable change, compare it to goals and targets, and use the information to learn from experience, adjust implementation, and better plan for the future.

Within the context of water security, monitoring and evaluation (M&E) is meant to support and improve the definition, selection, design, implementation of water actions by:

- Providing information on the status of water and associated resources
- Building the capacity of stakeholders to understand water risks and make informed decisions
- Providing evidence that supports the review and comparison of alternative approaches and solutions
- Detecting implementation delays and issues early on
- Learning from experience through documentation of both successes and failures

The overall goal of M&E is to improve decision-making and performance over time to achieve better results. It also empowers and builds the capacity of all actors through transparency and accountability. For this reason, it may be resisted by partisans of the status-quo such as low performing water agencies and entrenched interests.

Monitoring measures progress towards goals. **Societies improve water security when they manage their water resources and services to:**

- Satisfy drinking water and sanitation needs
- Support productive economies in agriculture, industry, and energy
- Prevent or mitigate water-related disasters
- Preserve healthy ecosystems
- Build resilient communities that can adapt to change

Different indicators are available to monitor progress towards these different water security goals. Comprehensive water security indexes try to measure overall water security by aggregating various metrics, but these indexes tend to be cumbersome and rely on expert opinion. Also, water security remains a question of perspective because different water users will have different priorities and expectation levels.

The best approach is to focus on what can be reasonably measured:

1. The status of water **resources**, which provides periodic snapshots of the physical water situation
2. The progress and achievements of water **projects and activities**, (i.e., the actions meant to improve the situation)
3. The performance of water agencies, which are the **actors** managing water resources and activities

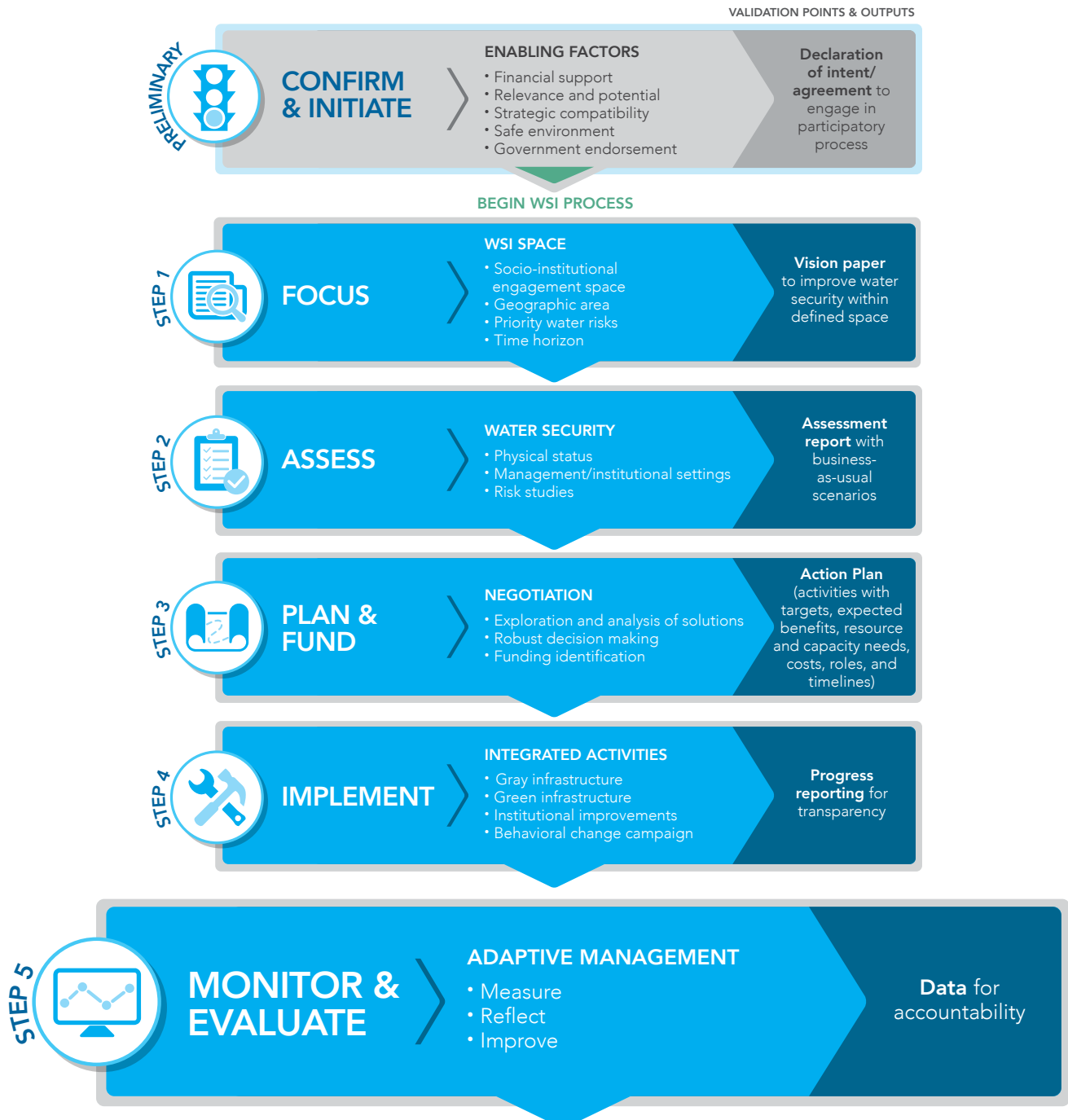
As risks to water security grow and becomes more complex, the management response (i.e., the capacity to address these risks) must improve accordingly. Evaluation supports this learning process by comparing results with expected targets and against international standards and benchmarks.

Adaptive Management is the systematic process of adapting or improving management policies and practices by regularly reflecting on and learning from their outcomes. It also involves building the capacity of all stakeholders to deal with uncertainties.

INTRODUCTION

The WSI process involves an inception phase and five steps: define the WSI space; assess the situation; plan and secure financing; implement water activities; and monitor progress. This toolkit covers Step 6: Monitoring and is designed to improve stakeholder capacity to measure the progress and performance towards better water security. The toolkit **has six objectives:**

1. Introduce monitoring and evaluation approaches and purpose
2. Discuss how to measure water security as an overall goal
3. Describe how to measure water security as a physical condition
4. Explain how to monitor water security activities
5. Present how to assess water management
6. Finally, discuss how to use monitoring and evaluation for learning and adaptive management



– REPEAT, DISSEMINATE, SCALE UP –

The Three Main Themes of Water Security Monitoring

1. Focusing on the status of water resources (quantity and quality, surface and groundwater, availability, and uses), now and in the near future (trends), and on the magnitude and likelihood of issues and/or risks
2. Measuring progress and performance of water activities against targets and expected outputs/outcomes
3. Assessing the performance of water institutions and actors (regarding resource allocation, service delivery and regulation, risk mitigation, etc.)

In the WSI process, evaluating resources and actors often begins at the assessment stage to contribute to the identification, evaluation, and prioritization of water risks. Indicators and targets for the three dimensions of monitoring should be defined during the planning stage and used during implementation.





WHAT TO MEASURE AND WHY

» We cannot manage what we do not measure.

Monitoring and Evaluation (M&E)

Monitoring is a process of continuous assessment that uses regular measurements known as indicators. It involves collecting data on the current situation and on changes caused by implementing policies and activities, or socioeconomic and natural trends (stressors) and events (shocks). Evaluation helps stakeholders reflect on monitoring data, compare it to goals and targets, and use the information to learn from experience, adjust implementation, and improve future planning.

The purpose of M&E is to improve water security decision-making and performance to achieve tangible results. It also empowers and builds the capacity of all actors by increasing transparency and accountability.

Monitoring Water Security

For water security, M&E should support and improve the definition, selection, design, and implementation of water actions by:

- Providing information on the status of water and associated resources
- Building the capacity of stakeholders to understand water risks and make informed decisions
- Providing evidence that supports the review and comparison of alternative approaches and solutions
- Detecting implementation delays and issues early on
- Learning from experience through documentation of both successes and failures

M&E may be hindered by:

- Influential/favored user groups who do not want to reveal and relinquish their advantages;
- Poorly performing entities who prefer the status-quo; and
- Dogmatic actors who value “learning” less than the protection of their own beliefs.

Choice of Indicators

To be useful and reliable, indicators should be:

- Relevant and accurate
- As objective as possible
- Clearly defined with respect to targets, standards, or thresholds
- Basic and informative (for raising awareness) or integrative/composite (for decision-making)
- Predictive (to alert on stresses and shocks)
- Regularly updated (to track changes)
- Clearly delineated in terms of geographic coverage



All monitoring efforts should avoid the common trap of gathering too much data without a clear focus. Unfocused data collection can consume much needed resources (funding, time, staff), while less attention is devoted to actual data verification, analysis and use. **Defining data needs must be based on:**

- What to monitor? To support what information/decision need?
- What changes are expected and how can these be concretely measured?
- What data should and can be reasonably be collected for that purpose?
- Who and how to collect, validate, and organize data?
- How to make use of the information gathered?
- How and to whom to communicate findings? In what form(s) will information be communicated/disseminated?
- What resources/capacities are needed to support the entire data/information process?

Collecting data can be a time and resource-intensive effort. It should be guided by and focused on actual information needs. What decision-making will be informed? Being practical is important – data should be collected regularly and in an affordable manner.

HOW TO MEASURE WATER SECURITY AS AN OVERALL GOAL

» We measure what we value, and we come to value what we measure.

Achieving water security has many different goals: water for health, food, livelihoods and ecosystems, energy, and socioeconomic development, and ultimately political stability, as well as mitigating the impacts of water-related disasters.

Measuring progress toward water security goals is complex because:

- 1. Security is a relative concept, its perception varies among water users and decision-makers
- 2. Measuring, qualifying, and quantifying water security is subjective
- 3. Security can vary significantly (spatially or over time), aggregation or comparisons can be deceiving
- 4. Many uncertainties (due for example to limitations in knowledge and science) can confound predictions

Measuring scarcity

Water scarcity indexes are often calculated at the country level, without considering geographic or seasonal variability. The Falkenmark physical availability index (annual renewable freshwater per person) is the most widely used measure.

FI (m ³ /person/year)	STRESS LEVEL
> 1,700	No Stress
1,000-1,700	Stress
500-1,000	Scarcity
< 500	Absolute Scarcity

The Falkenmark Index (FI) is the ratio of (average) available freshwater (more or less constant, until longer trends and/ or climate change impacts can be determined) per population. As population grows, the index score inevitably decreases, unless human solutions intervene to improve it. So it can only represent physical scarcity, not water management performance.

A similar index is the water vulnerability index (adjusted or refined as the water exploitation index, baseline water stress, or water stress indicator). This is the annual ratio of water withdrawn over total available freshwater (average surface flows plus renewable groundwater). A threshold of 40% is where ecosystems are at risk of degradation. Because withdrawals can be controlled (e.g., by increasing water use efficiency), this index can measure performance to some extent.

A Matter of Perspective: What Is (Flood) Security?

To design flood protection structures, the first step is to define a “design flood” (a hypothetical flood guiding the design). This is the threshold under which protection will be provided. More extreme flood events will be only mitigated, due to higher and higher costs of protection and the decreasing likelihood of their occurrence.

Hydrologists can define the flow of flood events, such as the “10-y flood,” which has a 10% chance of happening in a year, or a “100-y flood,” which has only a 1% chance of happening within a year.

But which to choose as a design flood?

For urban areas, the 50-y or 100-y flood are often chosen; while for rural areas, protections are either ignored or limited to the 10-y flood.

Comparing protection costs to estimates of potential damage can help decision-makers, but deciding the level of protection (or level of security) is ultimately a judgement call.

Measuring Basic Needs

Some of the recently finalized Sustainable Development Goals (SDGs), which have replaced the Millennium Development Goals, can measure water management, usually at the country-level. **SDG 6 ensures availability and sustainable management of water and sanitation for all and has several sub-goals:**

- 6.3 Improve water quality (percent water bodies with good water quality)
- 6.4 Increase water-use efficiency across all sectors and ensure sustainable withdrawals (level of water stress: freshwater withdrawal in percentage of available freshwater resources)
- 6.6 Protect and restore water-related ecosystems (area covered by water-related ecosystems)

Additional indicators are currently being developed.

Water Security Indexes

Attempts have been made to integrate the dimensions of water security into single scores. Most have been applied at the country level, and have relied on quantitative measurements, qualitative expert opinions, or a combination of both.

In its Asian Water Development Outlook, produced every year since 2013, **The Asian Development Bank proposes a composite National Water Security score (0-100) based on five key indicators:**

1. **HOUSEHOLD WATER SECURITY**, based on WHO/UNICEF data on access to water and sanitation
2. **ECONOMIC WATER SECURITY**, a composite indicator of agriculture, industry, and energy
3. **URBAN WATER SECURITY**, combining water supply, wastewater treatment, and urban flooding
4. **ENVIRONMENTAL WATER SECURITY**, addressing river basin health
5. **RESILIENCE TO WATER-RELATED DISASTERS**, addressing risk, vulnerability, and the capacity to cope

These indicators are complex, relying on several datasets that must be updated annually. They also rely on expert opinion, which remains subjective. Although input from experts is useful to compare countries, index variations over time can be attributed to changes in subjective opinion as much as to real changes in management capacity or performance.

NATIONAL WATER SECURITY SCORE	DESCRIPTION
>96 Model	Universal access to drinking water and sanitation; economic activities not constrained by water availability; water quality meets standards; acceptable water risks
76-95 Effective	General access; little constraint on economic activities; water risks significantly mitigated
55-75 Capable	Widespread access; decent availability/delivery for economic activities; main water risks being addressed
36-55 Engaged	Decent access; economic activities somewhat constrained
0-35 Hazardous	Limited access; water availability/delivery constrains economic activities; degraded water quality and ecosystems; significant vulnerabilities to water risks



The International Water Management Institute proposes a similar water security index that is the sum of five simpler indicators:

1. Basic household needs: based on percent access to drinking water (source: WHO)
2. Food production: based on freshwater availability and on water use (both as m³/person/year) (source: FAO)
3. Environmental flows
4. Risk management, based on storage capacity (source: ICOLD)
5. Water independence (percent of water coming from other countries, source: World Resources Institute)

Many other attempts have been made to aggregate water security dimensions at the basin level. The resulting indexes incorporate access to water services, hydrology and environmental status, health and economic conditions, and even policy considerations, such as the level of water user participation. All aggregating water security indexes tend to rely on expert opinions, require time and resources to collect the necessary data, and require consistent use over time to prove their worth.

Measuring Satisfaction

A simple user satisfaction survey is often the easiest tool to evaluate if water security improvements are effectively addressing water users' concerns and priorities. Users must be reasonably aware of the benefits received and their causality (e.g., health benefits from clean water). Such household surveys can also monitor the level of knowledge/awareness of water users and help define and focus behavior change campaigns.

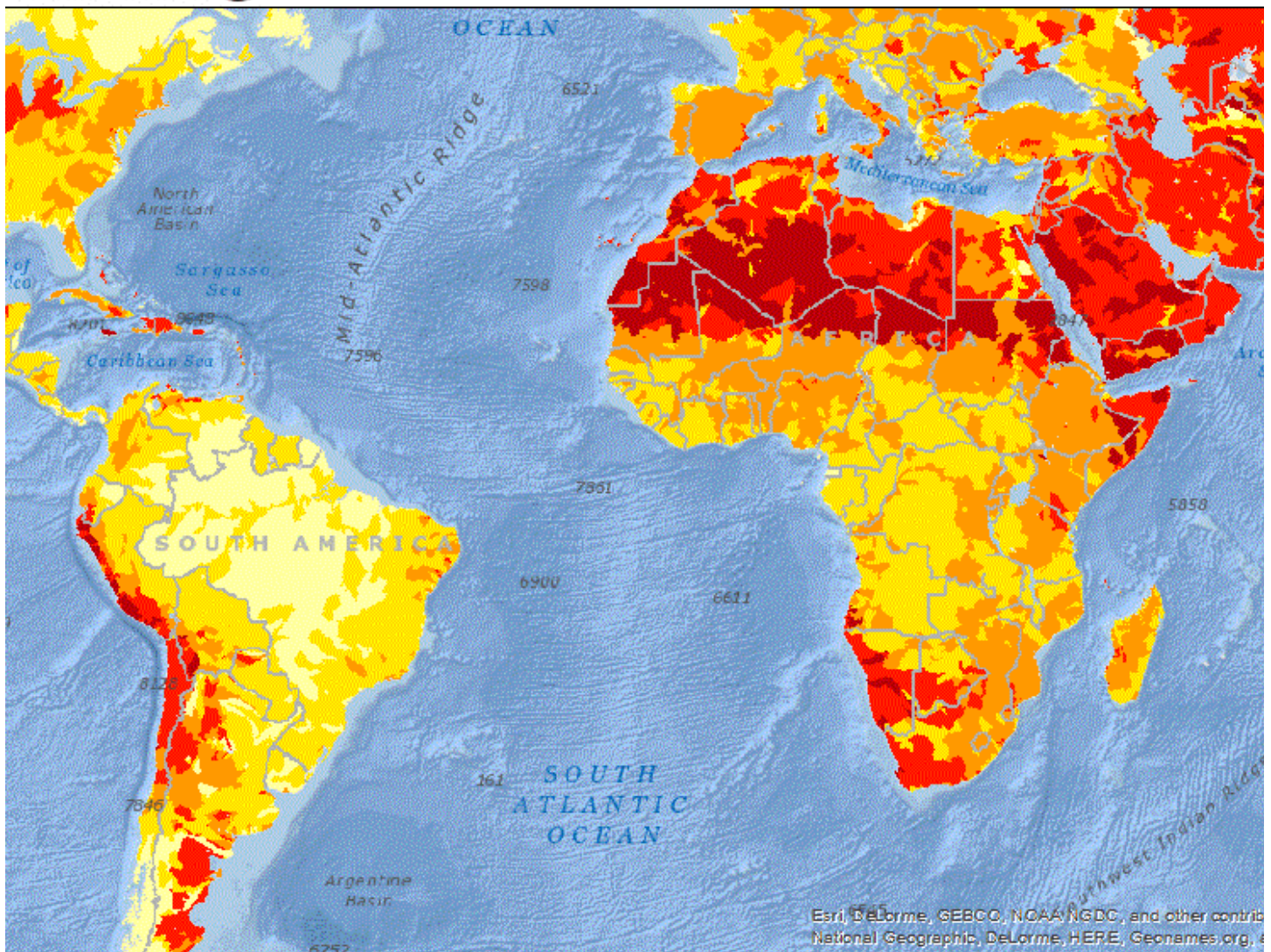


Displaying Water Security Risks to Raise Awareness

Raising awareness is an essential preliminary to addressing water risks. The most compelling evidence often provides comparisons over time and geographies, using simple water security dimensions.

Aqueduct is an interactive online resource designed by the World Resources Institute (<http://www.wri.org/our-work/project/aqueduct>). It is a global water risk mapping tool that gives investors, governments, and the public a visual understanding of worldwide water risks. Interactive maps show five water risk indicators for countries and river basins: baseline water stress, inter-annual and seasonal variability, flood occurrence, and drought severity.

AQUEDUCT



Overall Water Risk

Legend:





HOW TO MEASURE WATER SECURITY AS A PHYSICAL CONDITION

Water resource monitoring involves regular measurement of the quantity and quality, availability, and uses of surface water and groundwater resources with reasonable spatial and temporal resolution. Measurements should occur at a sufficient number of fixed locations and at regular intervals (hourly or daily for automated measurement; weekly or monthly otherwise).

Water Quality Monitoring

Water quality monitoring focuses on the condition of rivers, lakes, aquifers as well as distributed waters and raw or treated effluents. It uses different types of indicators: physical (e.g. temperature, conductivity, turbidity), chemical (e.g., pH, oxygen demand, presence of heavy metals, phosphates and nitrates), and biological (e.g., biodiversity, inventories of invertebrates and insects), which all have significance for public or environmental health.

These technical measurements can be aggregated for a certain location and time, using a water quality index, which calculates water quality value, using a simple 0 (worst) to 100 (best) score. Even if generalized and unscientific, such a score can be more easily understood by water users and the public at large.

MEASUREMENT	SOURCES	SIGNIFICANCE
Temperature	Domestic sewage and industrial activities	Negatively affect suitability for human uses (agriculture, domestic uses)
pH (acidity-alkalinity)		
Fecal coliforms	Domestic sewage and livestock	Propagate disease
Nitrogen and phosphorus	Agriculture (pesticides, fertilizers) and sewage (domestic, industrial)	Negatively affect aquatic life, purification capacity, suitability for human uses
Dissolved oxygen	Sewage (domestic and industrial)	
Suspended sediment – turbidity		
Heavy metals (chromium, arsenic, cadmium, mercury, lead)	Industrial activities	Carcinogens or causing nervous/ degenerative diseases

Water Quality Indexes

Water quality indexes are used to aggregate water quality parameters into a single score, usually on a 0-100 scale. Most are based on physical and chemical characteristics, though recent ones use biological assessments to monitor the impacts of heavy metals and other toxic organic materials.

The National Sanitation Foundation, the US Environmental Protection Agency, and the Canadian Environmental Quality Guidelines are just a few examples of well-known water quality indices.



Water Quantity Monitoring

Water quantity monitoring refers to measuring the levels and flows of rivers, aquifers, reservoirs, other bodies of water, and associated weather conditions.

Water quantity measurements can also focus on uses and withdrawals through metering (bulk and individual). This is again essential information to better understand where water resources are conveyed and used, to enforce allocations, regulations and permits, and to improve water use efficiency.

MEASUREMENT	TOOL	PURPOSE
Rainfall	Rain gauge (possibly automated)	Informs water availability, groundwater recharge, etc.
Weather (temperature, wind, humidity, evapotranspiration)	Weather station (possibly automated)	Informs crop water needs for farmers
River flows	Gauging stations record river levels, punctual flow measurements translate levels into discharges	Informs water availability and design of water structures, real-time information for water operations, flood/drought forecasting, etc.
Aquifer levels	Observation wells record aquifer levels	Informs water availability (current and future)



HOW TO MEASURE ACTIONS MEANT TO IMPROVE WATER SECURITY

Methods to measure project activities (such as water security actions) are well documented and are the traditional focus of monitoring and evaluation. These measurements are routinely carried out for development programs, and a wide range of indicators exist.

This monitoring can be carried out at a strategic/macro level or be more focused at the level of specific water activities.

Macro-level Monitoring of Water Outcomes

Several SDGs can be used to aggregate data over a geographic area and measure tangible outcomes:

SUB-SDG	INDICATOR
6.1 Achieve universal and equitable access to safe and affordable drinking water for all	Percentage of population using safely managed drinking water services
6.2 Achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations	Percentage of population using safely managed sanitation services including a hand washing facility with soap and water
6.3 Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and increasing recycling and safe reuse globally	Percentage of wastewater safely treated



Micro-level Monitoring of Water Activities

Activity monitoring involves defining indicators that will be used to report on progress and performance. Activity monitoring focuses on outputs and outcomes. Outputs include direct products from water activities, such as completed construction; outcomes are changes that occur as a result of water activities, such as a 20% increase in delivered water volumes.

Specific indicators can be developed for each of the four main types of water security activities:

WATER SECURITY ACTIVITY	EXAMPLE INDICATORS
<p>GRAY INFRASTRUCTURE</p>	<p>Actual construction can be monitored based on progress (compared to initial timetable) and construction quality (compared to national/international standards).</p> <p>Operation can be measured in terms of actual outputs (compared to planned/intended outputs):</p> <ul style="list-style-type: none"> • Number of people actually served • Number of hectares actually irrigated • Number of hectares effectively protected from flooding
<p>GREEN INFRASTRUCTURE</p>	<p>Progress and quality can be measured during construction, along with:</p> <ul style="list-style-type: none"> • Number of hectares reforested or protected from erosion • Number of hectares under improved land use, better cropping patterns, etc. • Number of hectares of protected wetlands, etc.
<p>SOCIAL BEHAVIOR CHANGE CAMPAIGNS</p>	<ul style="list-style-type: none"> • Number of households/people applying water saving practices • Number of farmers applying improved irrigation techniques • Number of households/people with improved awareness of water risks (e.g., floods, droughts)
<p>INSTITUTIONAL IMPROVEMENTS</p>	<ul style="list-style-type: none"> • Percent of operations/maintenance costs actually being recovered • Number of risk plans (flood maps, vulnerability assessments, etc.) • Percent of disadvantaged groups involved in water decision-making • Number of local water user associations organized or strengthened





HOW TO MEASURE WATER MANAGEMENT

Evaluating water management involves assessing the institutional capacity to address water risks, and to:

- Provide access to drinking water and sanitation
- Plan, allocate, and manage water resources
- Organize and regulate water uses
- Manage risks such as floods and droughts

Assessing water management can be politically sensitive, when it involves reporting on the performance of water management agencies and water providers. This evaluation can be done at the macro level (country or river basin) or at the micro level for specific water entities.

Macro Level (Country or Basin)

Water services and management can first be measured through Sustainable Development Goal 6.1 (universal access to drinking water), as well as Sustainable Development Goals:

- 6.5 Implement integrated water resources management at all levels, including through transboundary cooperation as appropriate
- 6.b Support and strengthen the participation of local communities in improving water and sanitation management

Indicators for these two sub-goals are being developed.

Macro level water management can also be measured with indicators such as:

- Number or percent of river basins managed through basin-level committees that involve local leaders representing communities and businesses
- Number of basin action plans being implemented

Measuring the water governance framework, that is the overall setting within which water management operates, is also possible. It includes examining water laws, policies, and agencies. Here again, such evaluation is based on expert opinion, thus being time-consuming and subjective. Institutional or policy reforms and governance changes may be difficult to evaluate as they may not directly translate into actual water security improvements.

Micro Level (For a Specific Water Actor)

Several types of water entities can be monitored. These include service providers such as water supply utilities, which can also collect and treat wastewater; irrigation agencies; and water management entities, such as river basin organizations.

WATER UTILITIES

Key Performance Indicators relate to:

THEME	EXAMPLE OF INDICATOR
WATER USE EFFICIENCY	Volumes sourced, supplied, used
QUALITY OF SERVICE	Number of hours of service per day, number of complaints, or customer satisfaction survey
SERVICE COVERAGE	Percent water supply coverage Percent treated wastewater
OPERATIONAL EFFICIENCY	Number of staff per 1,000 connections Non-revenue water (i.e., water produced but physically lost through leaks or not paid due to poor metering, billing, or collection)
WATER QUALITY PERFORMANCE	Number of regular tests
FINANCIAL PERFORMANCE	Percent failure to comply with quality standards Percent bill collection, revenues/costs, energy costs, etc.

The number of indicators tends to increase with the maturity of the utility, its capacity to collect data, and its willingness for transparency.

IRRIGATION MANAGEMENT AGENCIES

These agencies usually have few, if any, indicators to monitor their performance. **Possible indicators include:**

THEME	EXAMPLE OF INDICATOR
WATER USE EFFICIENCY	Volumes mobilized/diverted, conveyed, delivered Ratio of crop water needs to gross abstracted volume Crop water productivity (tons per m ³)
QUALITY OF SERVICE	Number of complaints or customer satisfaction survey (on reliability of delivery)
FINANCIAL PERFORMANCE	Percent fee collection, revenues/costs, energy costs, etc.

WATER MANAGEMENT AGENCIES

Indicators relate to water management functions such as planning, allocating, regulating water uses, and forecasting risks (e.g., floods, droughts):

THEME	EXAMPLE OF INDICATOR
WATER MONITORING	Number of locations with water quality/quantity monitoring
WATER INFORMATION/COMMUNICATIONS	Number of public datasheets produced and frequency Number of people reached through water awareness campaigns Percent of people aware of water issues, etc.
REGULATION	Percent of withdrawal volumes covered by water rights/permits Percent of effluent releases covered by permits Percent of water quality tests complying with standards Percent of illegal wells/total withdrawals
STAKEHOLDER PARTICIPATION	Number of public meetings Number of local leaders involved in water decisions Number of local water user associations/federations
PLANNING/MODELING	Production and implementation of annual allocation plans (including contingencies such as drought plans)
RISK FORECASTING	Existence of early warning systems Number of flood/drought forecasts, flood maps
FINANCIAL PERFORMANCE	Percent fee collection

More detailed sets of indicators have been developed to assess decision-making, planning, financial processes, organizational structures, training and capacity building mechanisms, information, and monitoring. However, these tend to be qualitative binary indicators (yes/no), because it is difficult to define measurement scales to record progress along these dimensions except through expert opinions.



Adaptive Management

Adaptive management involves embracing uncertainties and accepting the impossibility of predicting outcomes with absolute certainty. These factors include:

- Limited knowledge (observations often insufficient or lacking)
- Complex causalities inside systems (which can also change over time)
- Complex interactions between water activities meant to improve water security
- Variabilities (linked to climate change and variability, but also to political and socioeconomic circumstances, etc.)

Government organizations, notably in developing countries, tend to be ill-equipped for adaptive management since they rely on proven administrative and technical processes with limited impetus to improve over time (unlike private entities when they face marketplace competition).

Adaptive water management is also about social learning—building the capacity of water agencies, managers, and water user groups to collectively manage water resources and respond to emerging circumstances. Therefore, the design and implementation of some water activities should address information gaps through monitoring and/or testing of hypotheses (preferably on a small-scale, pilot basis).

Water managers may oppose adaptive management due to a reluctance to acknowledge uncertainties. As uncertainties challenge their predictive approaches, they may feel that this will undermine their authority and credibility. Water agencies may also resist M&E because it increases transparency and accountability.



HOW TO EVALUATE AND ADAPT

» To err is human, to persist is foolish.

Improving water security is more than addressing water risks. It also involves improving the capacity of managers, institutions, and communities to become more efficient (less wasteful of resources) and effective (achieving intended results). As populations continue to grow, their demands on water resources also grow—and so do water issues and challenges. The human capacity to address these must improve too.

Monitoring (i.e., data collection and analysis) of water resources, water activities, and water actors serves that purpose of capacity improvement through evaluation:

- Comparing outcomes with expectations or targets at different stages reveals the progress and performance of water activities. This helps to:
 - Detect changes in underlying assumptions (“We assumed that the trend would be this, but it is that instead.”)
 - Adjust (or cancel) activities as needed during implementation
 - Better allocate resources to support successful activities and actors
 - Better predict the expected results
 - Be better informed—and more able to select and implement future water activities
 - Inform water users of achievements, raise their awareness, and legitimize the water management process
- Comparing monitoring data with international standards and benchmarks reveals what is realistic and achievable, and helps get reasonable and acceptable goals and targets.



Such systematic evaluation enables implementers to learn from experience and adjust activities when necessary. This **adaptive management**, adapting or improving management policies and practices by learning from their outcomes, builds capacities to select better activities and develops the ability to deal with uncertainties.

RESOURCES

Water security monitoring:

Asian Development Bank (ADB) (2016). Asian Water Development Outlook 2016: Strengthening water security in Asia and the Pacific.

Proposes a complex indicator that combines household, economic, urban, and environmental dimensions of water security, relying on both annual datasets and expert opinions, which are subjective. Although useful to compare countries, some of the index changes over the years can be attributed to changes in expert opinions as much as to real management/structural changes.

Brown, A., & Matlock, M. D. (2011). A Review of Water Scarcity Indices and Methodologies.

A rapid review and discussion of several water scarcity indices.

GWP (2014). Assessing Water Security with Appropriate Indicators.

Seven papers presenting different approaches to measuring water security. Although thoughtful, the papers are more conceptual than practical.

Lautze, J., & Manthrilake, H. (2014). 29. Water Security: Converging toward common understanding through quantification. *Global Water: Issues and Insights*, 167.

Presents a straightforward index that sums five simple and available indicators, each scored 1 to 5.

Organization for Economic Co-operation and Development (OECD) (2015). Inventory of Water Governance Indicators and Measurement Framework.

Exhaustive listing of water and related indicators; does not provide comments or feedback on their relevance, accuracy, or feasibility/applicability.

References on key water indicators

Dunn, Gemma (2009). Canadian Approaches to Measuring Water Security: An inventory of indicators.

The report discusses water monitoring. Its first appendix lists 140 common freshwater-related indicators used at Canada's federal and state levels.

Cap-Net (2009). Implementing Integrated Water Resources Management at River Basin Level.

Provides a minimum set of 24 indicators to monitor the performance of river basin organizations. These indicators cover the main water resource management functions: water resource allocation, pollution control, monitoring, stakeholder participation, economic and financial management, information management, basin planning, and flood and drought management.

UN-Water Task Force on Indicators, Monitoring and Reporting (2010). Monitoring Progress in the Water Sector: A selected set of indicators.

Proposes a set of 15 key water sector indicators (using data from FAO, UNESCO, UNICEF, WHO, and others) that cover water availability (context), water use intensity (function), water use effectiveness (performance), and environmental sustainability (environmental performance). Also includes a discussion on assessing water governance performance.

Gender-disaggregated data

Pangare, V. (2015). Guidelines on How to Collect Sex-Disaggregated Water Data. *UNESCO Publishing*.

Seager, J. (2015). Sex-Disaggregated Indicators for Water Assessment, Monitoring and Reporting. *UNESCO Publishing*.

WWAP Working Group on Sex-Disaggregated Indicators (2015). Questionnaire for Collecting Sex-Disaggregated Water Data. *UNESCO Publishing*.

Other References

USAID (2015). WASH Sustainability Index Tool.

Offers a framework to assess the sustainability of 14 different types of WASH activities from institutional, management, technical, financial, and environmental perspectives. The framework uses a list of 100 close-ended questions to provide overall sustainability scores.

