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Water Resources and Decision-Making Systems

Edited by
Cecilia Tortajada and Kevin Parris

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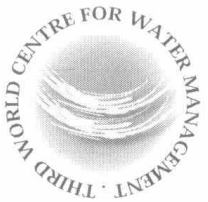

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Water Resources and Decision-Making Systems

Water data and information are essential to support efforts to understand, manage, allocate, utilize and protect water resources. The linkages between Water Information Systems and needs of decision makers are complex, but can be encapsulated in a Driving Force (Policy Needs) – Monitoring – Data Management – Reporting framework.

The rapid development in water policy reforms in many sectors and growing emphasis on demand-side policy solutions to water resources management has created an information imbalance. This imbalance can be characterized in terms of an inverted pyramid with implementation of many water policy initiatives supported by little data and information, especially related to economic and financial elements, to help guide decision makers toward more effective and efficient water resources management strategies. Additionally, as stress and demands on water systems increase and water becomes a more valued resource, this tends to increase the value of water information both for water providers and users. Nevertheless, many countries are reporting that the capacity to collect water information is being undermined by a lack of resources, while expertise to collect, analyse and interpret water data for decision makers is being lost. Finally, the impact of climate change on hydrological regimes represents a key potential stress on water systems. This issue could be the catalyst for adapting policies to provide more efficient and effective use and management of water resources and advance institutional and governance reforms in the water sector.

This book is based on a special issue of the *International Journal of Water Resources Development*.

Cecilia Tortajada is President of the Third World Centre for Water Management, working on public policy aspects of natural resources management, especially water.

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Routledge Special Issues on Water Policy and Governance

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James Nickum (WI) – International Water Resources Association, France

Most of the world's water problems, and their solutions, are directly related to policies and governance, both specific to water and in general. Two of the world's leading journals in this area, the *International Journal of Water Resources Development* and *Water International* (the official journal of the International Water Resources Association), contribute to this special issues series, aimed at disseminating new knowledge on the policy and governance of water resources to a very broad and diverse readership all over the world. The series should be of direct interest to all policy makers, professionals and lay readers concerned with obtaining the latest perspectives on addressing the world's many water issues.

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Do the Virtual Water and Water Footprint Perspectives Enhance Policy Discussions?
Dennis Wichelns
International Journal of Water Resources Development, volume 27, issue 4 (December 2011) pp.633-646

Chapter 3

Changing Roles in Canadian Water Management: A Case Study of Agriculture and Water in Canada's South Saskatchewan River Basin
Darrell R. Corkal, Harry Diaz & David Sauchyn
International Journal of Water Resources Development, volume 27, issue 4 (December 2011) pp. 647-664

Chapter 4

Drivers of Economic Information in River Basin Planning
Josefina Maestu & Carlos Mario Gomez
International Journal of Water Resources Development, volume 27, issue 4 (December 2011) pp. 665-676

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Consequences of Increasing Environmental Complexity in the Water Domain
Rudy Vannevel
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Challenges for Integrated Water Resources Management: How Do We Provide the Knowledge to Support Truly Integrated Thinking?
Rachael A. McDonnell
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Chapter 7

Advances in Decision Support Systems for Flood Disaster Management: Challenges and Opportunities
Jason K. Levy, Chennat Gopalakrishnan & Zhaohui Lin
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Preface

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This book focuses on the importance of timely and reliable information to guide decision-making in the water sector. It contains all the papers of the Thematic Issue on "Information for Improving Water Resources Decision Making" from the *International Journal of Water Resources Development* and two additional papers from the same journal from different issues.

Overall, the papers submit that there is an information unbalance in the water sector in most developed and developing countries, with implementation of water policy initiatives many times supported by data or information that are grossly inadequate for adequate decision-making. There is also the limitation of multiple countries to collect water information due to lack of resources and loss of expertise to collect, analyse and interpret water data (Parris, 2011).

A good example of serious information unbalance is in the area of water quality management in most of the developed and developing countries. In general, OECD countries have addressed a number of environmental challenges by implementing policies that protect human health and ecosystems, and which tend to use resources more efficiently and aim at preventing further environmental degradation. Regarding water resources, planning and management practices have improved during the last decades both in terms of quantity and quality. Nevertheless, the statistics and core data and information on which they are sustained are still far from representing solid tools for decision-making (Tortajada, 2013). Spain, Greece and Portugal represent examples of this situation in the case of groundwater pollution (EASAC, 2010).

There have been many global attempts to improve water quality still with mixed results where data and information play key roles. The Republic of Korea launched a stimulus package in 2009 which allocated $30.7 billion for water and waste management, renewable energy projects, energy-efficient buildings and low-carbon vehicles. In the United States, an innovative scheme for Chesapeake Bay includes water quality trading programmes which allow wastewater treatment plants to buy nutrient "credits" generated by other plants or by farms that reduce the nutrients they release to receiving water bodies. Its implementation is very challenging because of the large number of actors and interests involved, and because it could have an impact in the economic growth of the states (Maroon, 2011).

In the case of developing countries, China represents an example where water quality challenges have been growing for decades. The Chinese State Environmental Protection

Administration and the World Bank (2007) have estimated that water scarcity and pollution are costing the country as much as 2.3 percent of GDP—1.3 percent due to water scarcity and the rest as a direct impact of water pollution. Although the impact of water pollution on health is very serious, it is extremely difficult to quantify because of lack of reliable data both on the pollutants and the households that use poor quality water.

According to new regulations, from July 2012, drinking water treatment plants in China have to measure up to 106 quality parameters compared with only 15 previously. If properly implemented, this could significantly improve the quality of drinking water in the country. Nevertheless, the success of the new regulations will depend on multiple issues, which include unifying the fragmented monitoring system; ensuring that there are enough personnel and laboratory facilities to properly test all the 106 parameters; guaranteeing reliable collection, analysis and interpretation of data; making sure a well-oiled infrastructure is in place to supply safe drinking water; and ascertaining that officials in charge of plants not complying with all the norms are made accountable.

Both developed and developing countries and their populations deserve the fruits of economic growth. Nevertheless, water and environmental-related problems, if not solved, could undermine their future course of development. In these cases, water information and data systems that are accurate and reliable represent fundamental tools for improved policy- and decision-making.

Topics analyzed in this publication include an overall framework on water information systems and how they are impacted by multiple economic, social and environmental drivers that, in turn, affect both the efficiency and effectiveness of water resources management. The much questioned paradigms of virtual water and water footprint perspectives and how, or if, they enhance policy discussions is also comprehensively discussed. Changing roles in water management decision-making in Canada; drivers of economic information in river basin planning; and consequences of increasing environmental complexity in the water domain are further discussed providing valuable lessons.

A very well argued case on how to provide the necessary knowledge to support integrated thinking is presented. The author argues that, in many ways, the new challenges are not so much data collection but data analysis and usefulness of information for decision making. Last, but not least, this book includes a solid analysis on the advances in decision support systems for flood disaster management.

This book aims at addressing the role of water information and data systems for effective water policy and management. We trust the different experiences will represent valuable lessons and will also contribute to further discussions and analyses.

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Contents

Improving the Information Base to Better Guide Water Resource Management Decision Making

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ABSTRACT *This paper presents the main messages as well as the key recommendations presented during the OECD workshop on information base and water resource management decision making, in Zaragoza, Spain, May 2010. Findings include fundamental issues to which further attention should be paid. There is an information imbalance in many countries, with implementation of water policy initiatives often supported by little data or information. There is also the limitation of many countries to collect water information due to lack of resources and loss of expertise to collect, analyze and interpret water data.*

Introduction

The OECD organized a workshop on "Improving the Information Base to Better Inform Water Resource Management Decision Making" (OECD, n.d.). It was hosted by the Government of Aragon, in Zaragoza, Spain, 4–7 May 2010. The workshop assembled world-class experts across a mix of disciplines.

The main objectives of the workshop were to:

- identify decision makers' priorities for policy-relevant water data and information;
- review recent national and international experiences and future plans for water information systems;
- identify decision makers' priorities for developing and using policy-relevant water resource management data and information;
- review the extent to which the current work in OECD and non-OECD countries in developing water resource management data and other related information meets the needs of decision makers;
- discuss possible areas of improvement in water resource management data-sets and information that can serve the future needs of decision makers; and
- outline key ways forward for countries, the OECD Secretariat and other water system stakeholders that will be needed in order to make progress in future water resource management data collection and dissemination.

The present paper provides the main findings and some of the important recommendations of the workshop. It is followed by four papers that were presented at the workshop. These

have been substantially modified by their authors in the light of the discussions at the workshop and peer reviews.

Key Messages from the Workshop

Across many countries water information systems (WIS) are impacted by several key drivers:

- Technical-based (supply) policy paths to improving the economic, social and environmental efficiency and effectiveness of water resource management (WRM) are being complemented with greater emphasis on demand-side economic and institutional and governance policy solutions.
- Some countries have undertaken major changes in their water basins through national WRM policies or are in early stages of reform programmes, most often in response to water stress or crisis (OECD, 2009). In many cases there is a legal requirement, as part of the package of water policy reforms, that requires maintenance and improvements in water data collection and reporting. Lessons are being learned from these policy reform experiences (both successes and failures), which will be useful for other countries attempting to proactively reduce exposure to their own water risks and vulnerabilities.
- With the rapid development in water policy reforms in many situations, and growing emphasis on demand-side policy solutions to WRM, this has created an information imbalance. This imbalance can be characterized in terms of an inverted pyramid, with implementation of many water policy initiatives supported by little data or information, especially related to economic and financial elements, to help guide decision makers toward more effective and efficient WRM strategies (OECD, 2010).
- As stresses and demands on water systems increase and water becomes a more valued resource, this tends to increase the value of water information both for water providers and users. But many countries are reporting that the capacity to collect water information is being undermined by a lack of resources, while expertise to collect, analyze and interpret water data for decision makers is being lost.
- The impact of climate change on hydrological regimes is a key potential stress on water systems. This issue could be the catalyst for adapting policies to provide more efficient and effective use and management of water resources and to advance institutional and governance reforms in the water sector.

The linkages between WIS and the needs of decision makers are complex, but can be encapsulated in a *driving force* (policy needs)–*monitoring*–*data management*–*reporting* framework (Figure 1). WIS also operate from the global down to the national and local (water basin to an individual property) levels (Figure 2), involving a complex web of governance and institutional structures, including:

1. many international organizations, with around 26 UN bodies and many other international agencies involved with water issues;
2. multiple national and sub-national ministries and government bodies; and
3. a large community of business interests (Aquafed [The International Federation

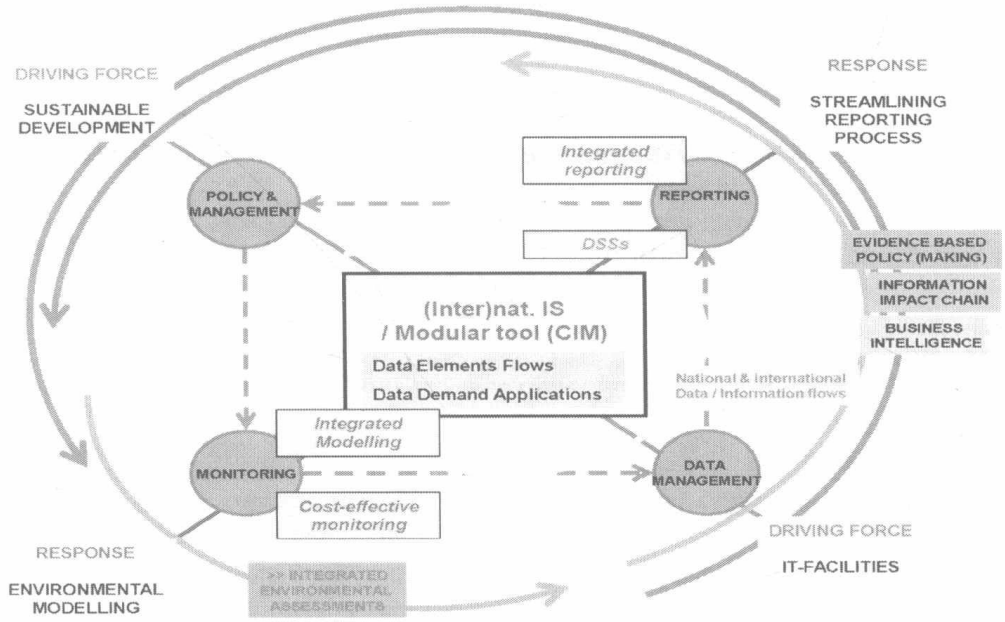

Figure 1. The complexity of water information systems in meeting policy demands. *Source:* Adapted from Rudy Vannevel, Flemish Environment Agency, Belgium (see OECD, n.d.).

of Private Water Operators], the OECD Business and Industry Advisory Committee [BIAC], the World Business Council for Sustainable Development, McKinsey); non-governmental organizations (Global Water Partnership, World Wildlife Fund, International Water Management Institute); and other water system stakeholders (e.g. researchers).

The demand for water data and information comes from water system users and operators, resource managers, environmental agencies and public officials. WIS support efforts to understand, manage, allocate, utilize and protect water resources, in particular to:

(1) enhance scientific knowledge and technical understanding of water systems, stocks and flows;

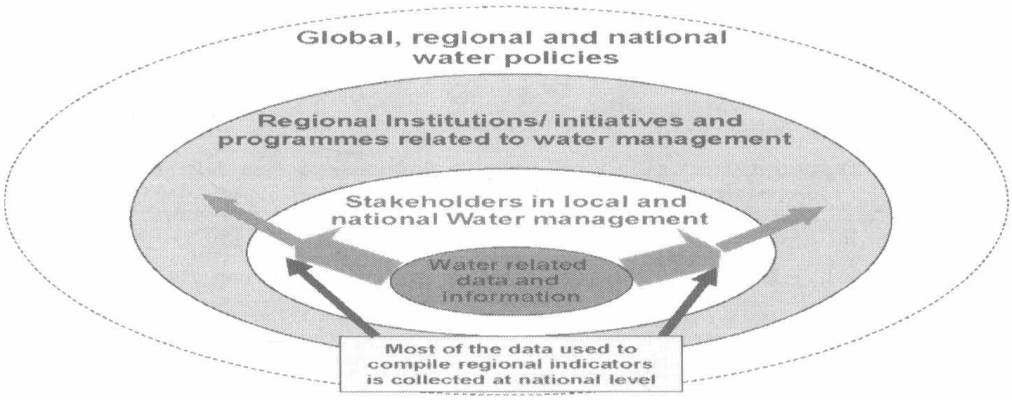

Figure 2. Multi-scale stakeholders in the water information system. *Source:* Adapted from Paul Haener, International Office for Water, France (see OECD, n.d.).

(2) promote the physical, environmental and economic productivity of water use;
(3) improve water allocation (and water quality) decision making between competing uses (e.g. urban, industry, agriculture) and for environmental needs;
(4) address social, governance and institutional issues, paying particular attention to the fact that national and regional approaches have local relevance for efficient water policies; and
(5) contribute to long-term anticipatory yet flexible planning (e.g. climate change and development scenarios) to guide future policies and priorities for water security and sustainable use, especially considering climate change and altering hydrological regimes.

Recent and planned changes in water policy settings, priorities and demands across many countries have highlighted that:

(1) many international and national WIS are maintained without sufficiently addressing the policy relevance of the data and information being regularly collected;
(2) deficiencies in the policy relevance of WIS apply not only to more highly structured systems (e.g. national and international systems of environmental and economic accounts for water), but also to those more pragmatic data collection efforts, such as those by OECD, Eurostat, Aquastat, many countries and non-governmental organizations (e.g. Water Footprint Network); and
(3) there is a need for clarity and determination of the fitness-for-purpose of the data and information generated by WIS.

In most national cases, the main purpose and objectives for WIS are to provide the data and information for monitoring, reporting, and evaluating national water policies (Figure 1).

The limitations and constraints of WIS can be broadly summarized as follows.

(1) Data concerning the economic and institutional aspects of water systems are much less developed than physical data and are only partially covered in the regular updates of most national and international WIS.
(2) Current databases are not always adequate to support:
    i. integrated water management;
    ii. efficient design and implementation of water policies and related performance assessments;
    iii. economic analysis of integrated water management and related pricing policies; and
    iv. international water policy monitoring, analysis and evaluation.
(3) There is a need to highlight data gaps and identify deficiencies of data and data collection systems, especially with regard to the most pressing current and emerging policy issues.
(4) The expertise to collect and analyze water data and information needs to be expanded.

Despite these limitations of WIS, progress is being made in many countries to upgrade water monitoring systems and data collection efforts. These efforts are being supported, in part, through the use of new information technologies, such as global positioning systems

(GPS), geographic informations systems (GIS), and web-based communication. However, recent severe fiscal constraints confronting many nations and international organizations pose a threat to the progress being made in improving WIS.

The key challenges and opportunities for WIS, which were recognized at the workshop, are summarized in Figure 3 in terms of data quality issues, and in Figure 4 in relation to different dimensions of WIS. While from a statistical viewpoint the terms and definitions related to mainly physical dimensions of water have been largely harmonized (e.g. through the UN International Recommendations for Water Statistics (UN, n.d.)), two important challenges identified in Figure 4 are to ensure precise definitions of the economic and financial dimensions of WIS (e.g. water prices) and to ensure that historic time series data-sets are retained and continue to be developed where they are policy relevant.

Recommendations Toward the Overall Improvement of Water Information Systems

The workshop recognized that to make significant progress in improving WIS, the overall political value of water and water policy issues must be elevated from a low to high political priority that requires the attention of heads of state and relevant ministers, taking into account longer-term considerations, especially climate change. More specifically, if WIS are to better meet the demands of decision makers, the workshop identified the need to:

(1) Improve the integration of social and economic dimensions with environmental data and indicators for policy guidance throughout the water sector.
(2) Assist political priority-setting for the water sector relative to other sectors by evaluating the costs and benefits of additional expenditure for water sector infrastructure investment, management and maintenance.
(3) Assess how well current national WIS respond to policy needs, priorities and future plans as well as how well they comply with existing statistical standards (e.g. the UN International Recommendations for Water Statistics), coupled with the identification of core water information and indicators common to all countries that could guide international water information and data collection efforts.
(4) Undertake a cost-benefit analysis of existing WIS at both national and international levels, to determine how current water information and data are

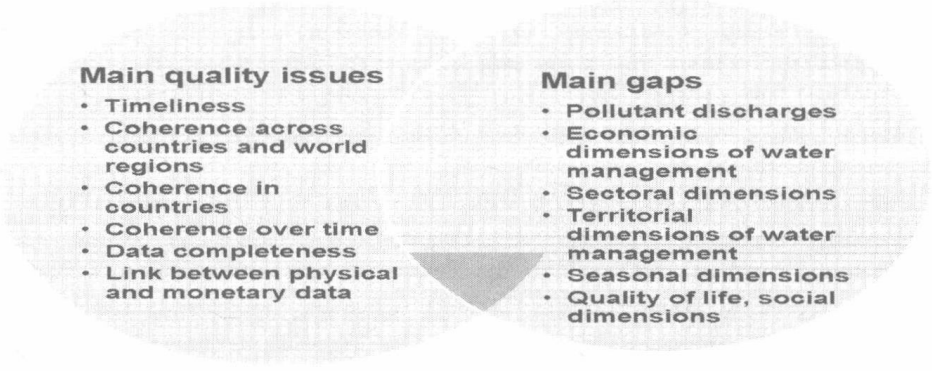

Figure 3. Challenges to improve water data quality and address data gaps in water information systems. *Source:* OECD, n.d.