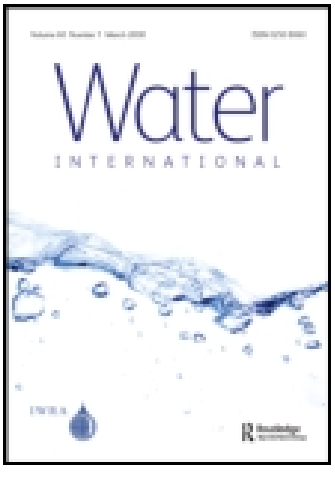

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Integrated water resources management: balancing views and improving practice

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Integrated water resources management: balancing views and improving practice

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Integrated water resources management is a conceptual framework that is meant to describe the complexity of water decisions and the importance of balancing stakeholder viewpoints. Implementation is difficult because of institutional barriers and because of definitional confusion over the precise meaning of IWRM. Improved governance is required to overcome institutional barriers. Specific and unambiguous language may reduce confusion, but it may oversimplify the complexity. The present paper offers a brief definition of integrated water resources management and a list of seven elements for integration. Brief examples are then given from different countries in order to illustrate each of these elements. Coordination across geographic areas is recognized as a special challenge of integration and emerging efforts toward integration in some countries will bear close scrutiny to measure their success. Regardless of the ultimate success in promoting the concept of integrated water resources management, it communicates to stakeholders the notion that water decisions require balance and the promotion of shared values, such as conservation and the alleviation of poverty. If institutional barriers and confusion about the concept are overcome, actual improvements in water stewardship may result.

Keywords: water management; integrated water resources management; policy; planning; coordination; decision support; integration

Introduction

Water decisions can be complex and controversial. The phrase "integrated water resources management" (IWRM) has evolved in order to communicate how the complexity and conflict should be handled. While IWRM has been embraced in international forums, it has not been accepted everywhere as a paradigm for water management.

This paper explains why the term has been introduced, how people define it, and how it can be applied to water management practice. It also presents an analysis of why the term has not been applied more extensively and presents ideas for how its purposes can be advanced in all countries.

Due to page limits, the paper uses only brief examples to explain why IWRM concepts are needed. These examples are mainly from the United States, but include a few references to Latin America, where river basin management is being promoted within the context of national IWRM requirements. Additional case studies and information about IWRM are available from the Global Water Partnership (GWP) web page (www.gwpforum.org) and in other places.

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Development of IWRM concepts

As with other intellectual frameworks, it is hard to identify the exact origins of the term "integrated water resources management". Each word in the phrase is broad and used widely among planners and researchers. In particular, the word "integrated" is often used to communicate the need to consider policy complexity. The origins of the IWRM concept are similar to those of related terms such as "integrated planning", "integrated environmental management", "integrated risk management", or integration in other policy sectors. Over the years, related terms were introduced and, while some were simply trendy, some have endured. Figure 1 shows a partial view of how today's IWRM evolved.

How long has the term been in use? The question is probably moot, as similar concepts have evolved as society and public affairs became more complex. Biswas (2004) wrote that it has been around for 60 years. In the United States, similar ideas date back to at least 1917, when the Flood Control Act called for "a comprehensive study of the watershed" (Holmes 1972, 1979).

The New Deal in the United States featured advances in comprehensive planning, and its successor efforts led to the Water Resources Planning Act (1965), which required comprehensive, coordinated, joint planning. These were ancestors of IWRM, along with other ideas of integration in planning and management.

Disciplinary integration is important in IWRM. In an effort to foster interdisciplinary water studies, the Universities Council on Water Resources (UCOWR) was formed during the 1960s under the influence of the Water Resources Research Act. By the 1970s, civil engineers and others saw the need for interdisciplinary treatment of water resources, and so created, within ASCE, a division of Water Resources Planning and Management, which sought to promote integration in the practice of water resources management (Grigg 1996).

Coordination is a central element of IWRM. In a 1988 study at Harvard, Foster and Rogers (1988) identified coordination as one of the three main planks of federal water policy, along with development and regulation. They also noted that the policy theme of coordination has been addressed over and over again by study commissions.

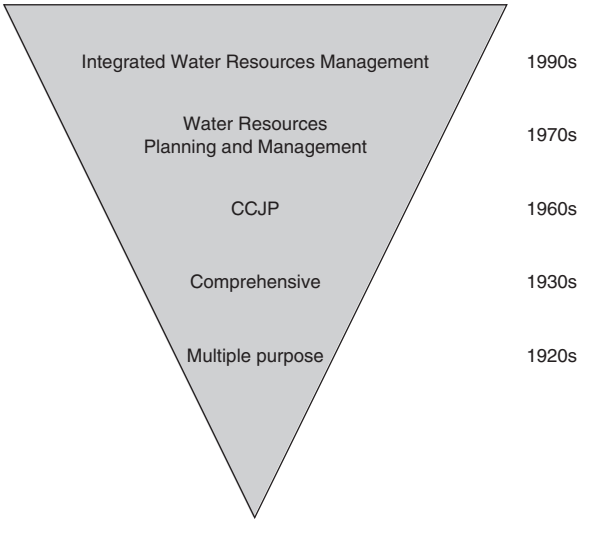

Figure 1. Evolution of IWRM concept.

Over the years, groups introduced various phrases, all of which meant essentially the same thing. The American Water Works Association (AWMA) developed the concept of "Total Water Management" as "an attempt by the water supply industry to assure that water resources are managed for the greatest good of people and the environment and that all segments of society have a voice in this process". Despite its different name, the concept of "Total Water Management" seems very close to IWRM. "Holistic water management" was another phrase used to outline a comprehensive framework for water management (Kirpich 1993). The World Bank's (1993) "comprehensive policy framework" advocated features that included many of the same elements being advocated for IWRM. These include:

- Comprehensive or holistic frameworks
- Cooperation and coordination
- Reliance on market mechanisms
- Decentralization and grass-roots participation
- Capacity-building
- Full cost pricing with social rates where needed
- Public or private enterprise
- Watershed focus for planning and management
- Partnering to achieve role coordination and regional cooperation
- Dedication to stewardship of environment

Recently, the GWP has produced a number of documents written to explain IWRM. "An IWRM approach", reads one of them (Global Water Partnership 2004):

> seeks to address a country's key water-related development problems – water for health, for food, for energy, for environment – more effectively and efficiently than is possible using traditional approaches [. . .] Integrated approaches, of course, will imply deliberately moving away from fragmented approaches. On the natural system front, they might involve integration of land and water management, of surface water and groundwater management, of quantity and quality, and of upstream and downstream water-related interests. On the human system front, they might involve ensuring that policies and priorities take account of water resource implications, that there is cross-sectoral integration in policy development, that macro-economic effects of water resource development are properly accounted for, or that water management considerations are integrated in city planning [. . .] Inherent in an IWRM approach is the recognition that truly sustainable water resources management involves managing demand, not just supply.

To further explain these concepts, GWP has developed a "Toolbox" of IWRM methods.

A number of writers have attempted to explain the many facets of IWRM. Generally, they approach the facets of integration from different vantage points, such as those represented in the definitions and explanations of the Global Water Partnership. Mitchell (1990), for example, wrote that integrated water resources management deals with "problems that cut across elements of the hydrological cycle, that transcend the boundaries among water, land and environment, and that interrelate water with broader policy questions associated with regional economic development and environmental management".

In Latin America, Garcia (1998) and Duorojeanni (1994) have written extensively about the application of IWRM. Falkenmark *et al*. (2004) recently argued that IWRM needs mechanisms for multi-stakeholder advocacy and for building compromises. With this significant level of attention, the conclusion must be that improving water management is an urgent priority and that the concepts of IWRM are evolving in order to illustrate the central role of government in meeting society's water needs.

How to overcome problems with the IWRM concept

Clearly, the goals of IWRM are important, but implementing it is difficult. This is because of institutional barriers and because of confusion about precisely what IWRM is.

Institutional barriers have been recognized for a long time. Two famous advocates of water management, Jacques Costeau and Abel Wolman, explained the problems associated with coordinated, cooperative, collective actions. At a ceremony for an intergovernmental agreement in 1983, Jacques Costeau warned about political disincentives to collective action through inter-jurisdictional cooperation (Chinchill 1988). Similarly, Abel Wolman (1980) wrote that "basin approaches come into criticism by some on the score that basins are essentially non-economic or social units. Viewed by themselves, they represent artificial spheres of action irrelevant to societies needs. The engineer-planner finds them convenient, because he sees them as continuous hydrologic worlds."

As explained by recent experiences and reports, IWRM creates confusion because it is too complex and involves so many facets of water management. The same experience continues to repeat itself. Simply put, IWRM means different things to different people. Participants need time to discuss it in order to develop a common understanding. Biswas (2004) wrote that the IWRM concept looks attractive, but has many problems. He believes that the definition is amorphous and forces no agreement on fundamental issues like what to integrate, by whom, and how. He offered a list of some 35 issues that need to be integrated within the concept. Writers in the GWP group are struggling with the same issue: how to make IWRM more than a lofty idea and translate its noble concepts into practice?

One would expect that confusion about IWRM can be overcome by moving away from academic ideas toward practical implementation. This requires a clear definition of the concept and a clear view regarding its implementation.

Framework for IWRM

In dictionaries, definitions are presented briefly, and it should, in turn, be possible to derive a clear and brief definition of IWRM. If experts were constrained to about 25 words, they would be forced to converge on shared ideas. This is my proposed definition, which could be a starting point for debate about it:

> Integrated water resources management is a framework for planning, organizing and operating water systems to unify and balance the relevant views and goals of stakeholders.

In the definition, the concepts of planning, organizing, and operating water systems should be taken broadly; that is, planning can include multiple phases from concept to conflict resolution; organizing means all activities that are definite in nature, including construction; and operating means all activities that take place in a finished system.

Another issue in the definition is the concept of balancing the views of stakeholders. If the views are too widely divergent, as they sometimes are between water users and environmentalists, then the verb "to balance" must be taken broadly to include levels of conflict resolution that may stray far from a desired consensus.

Notice also that the definition does not mention the elements that should be integrated. To mention them would make the definition too cumbersome and complex. However, it should be possible to decide on the elements that require integration. Biswas (2004) presented 35 categories, but any such list can be compressed. This is my proposal for a list of elements to integrate.

- Policy sectors
- Water sectors
- Government units

- Organizational levels
- Functions of management
- Geographic units
- Phases of management
- Disciplines and professions

Further discussion of the elements to integrate follows.

Integration across policy sectors

Integration across policy sectors is a core issue of IWRM. Experts agree that IWRM should coordinate the development and management of water, land and other resources in order to improve economic and social welfare, social equity, and environmental sustainability (GWP 2004). This recognizes the inherent interdependencies in nature and in the economic and social sectors. The GWP (2004) wrote that the "IWRM approach seeks to address a country's key water-related development problems – water for health, for food, for energy, for environment – more effectively and efficiently than is possible using traditional approaches".

These goals are implemented by governments through principal policy sectors. The ones most closely related to water are: natural resources, environment, public health, energy, agriculture, transportation, and emergency management. Each of these policy sectors can have its own "integrated management". For example, we can conceive of paradigms for "integrated natural resources management", "integrated environment management", "integrated public health management", and so on. In each one, the "integration" would include elements that also belong to IWRM.

While this is a simplification, integrated water resources management by policy sectors is really an attempt at connecting each water purpose with its main sector (see Figure 2). The other linkages are *interdependences* between sectors. These are not shown on the figure in order to avoid clutter and excessive complexity.

Integration across water sectors

In addition to integration across broad policy sectors, IWRM requires integration among water sub-sectors, expressed as the "purposes" of water management. These are: water supply, water quality, environmental water control, irrigation, flood control, navigation, hydropower, and recreation. Figure 2 also shows this interconnectivity.

This category of integration can be expanded to include all aspects of hydrologic integration, such as conjunctive use, surface- and ground- water integration and managing water quantity and quality jointly.

Geographic units

Integration across geographic units involves basin management and management between basins. Figure 3 shows this connectivity and illustrates the "inadvertent" transfer of water between basins, where water supply from one basin becomes wastewater to another.

Integration across government units

The concept of integration across government units includes the national, regional, and local levels (vertical levels) and government units at the same level (horizontal dimension). In the United States, this issue is sometimes called "intergovernmental coordination". The

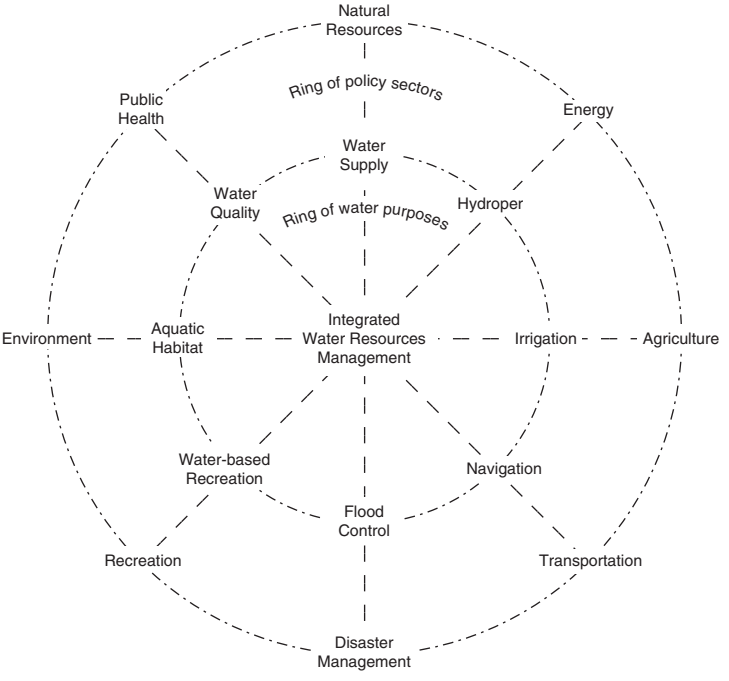

Figure 2. Integration of water management by sectors.

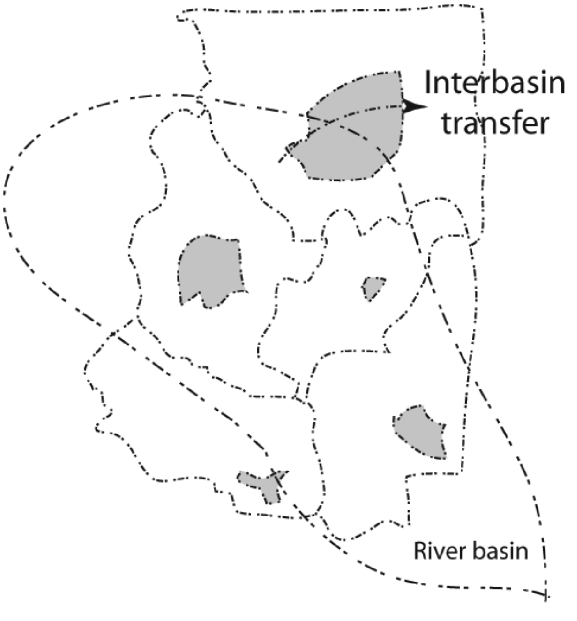

Figure 3. Integration of water management across geographic units.

United States has an independent, bipartisan agency that was established under Public Law 86–380 in 1959. The mandate of this agency is to study federal intergovernmental relationships and the nation's intergovernmental mechanisms. Called the "Advisory Commission on Intergovernmental Relations", its mission is "to strengthen the American federal system and improve the ability of federal, state, and local governments to work together cooperatively, efficiently, and effectively" (ACIR 2004). It has issued a number of reports, but is not currently very active.

Figure 4 illustrates both the vertical relationships among governments and how horizontal coordination will be needed among national, regional, and local governments and their programmes. International water treaties, interstate compacts, and inter-local agreements are examples of coordination instruments designed to implement this coordination.

Organizational levels

Organizational levels include policy, management, and operational levels. In management terms, integration across these levels is "alignment"; that is, workers at all levels must understand both the goals and language or the organization's mission. So, integration of the work of a reservoir operator, for example, must involve compliance with policy directives. Integration among levels is illustrated in Figure 5.

Functions of management

Integration across managerial functions requires alignment among engineers, planners, finance staff, and other members of the organization. To achieve this, the sharing of language, goals, and organizational activities is required. This integration can be seen from an organizational chart, such as the simple one shown on Figure 6.

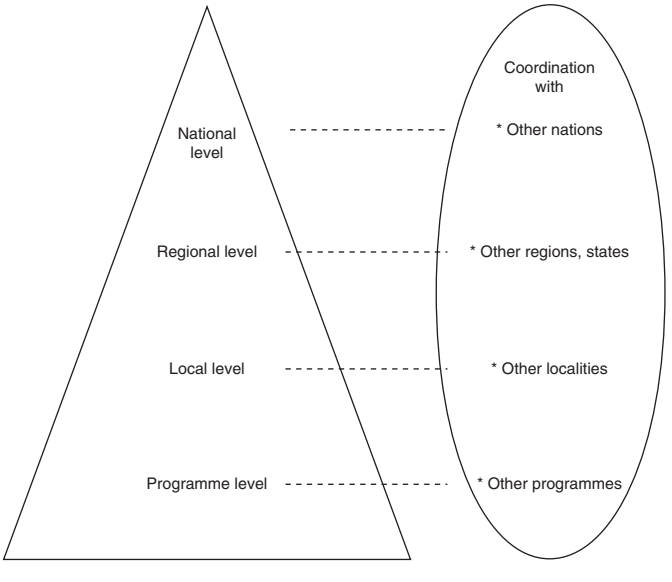

Figure 4. Integration across government units.

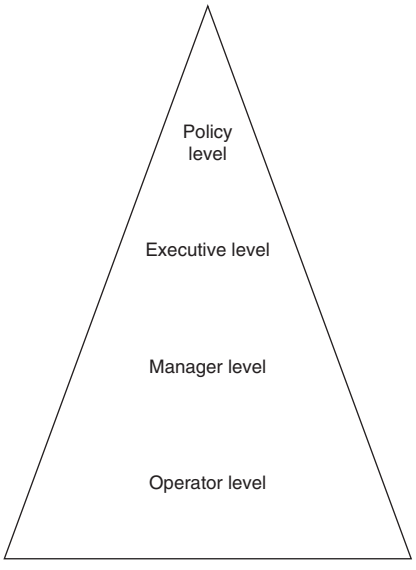

Figure 5. Integration across organizational level.

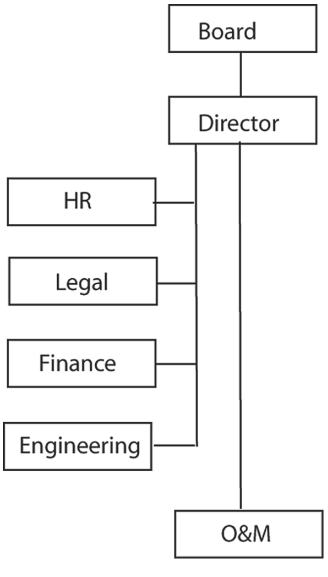

Figure 6. Integration across organizational functions.

Phases of management

Integration across phases of management requires water managers to consider the life cycle of management facilities, that is, planning, construction, operation, renewal, and so on. An example of this integration is the carrying of the original purposes of a project in its planning stage through to the operational phase. This is illustrated in Figure 7.

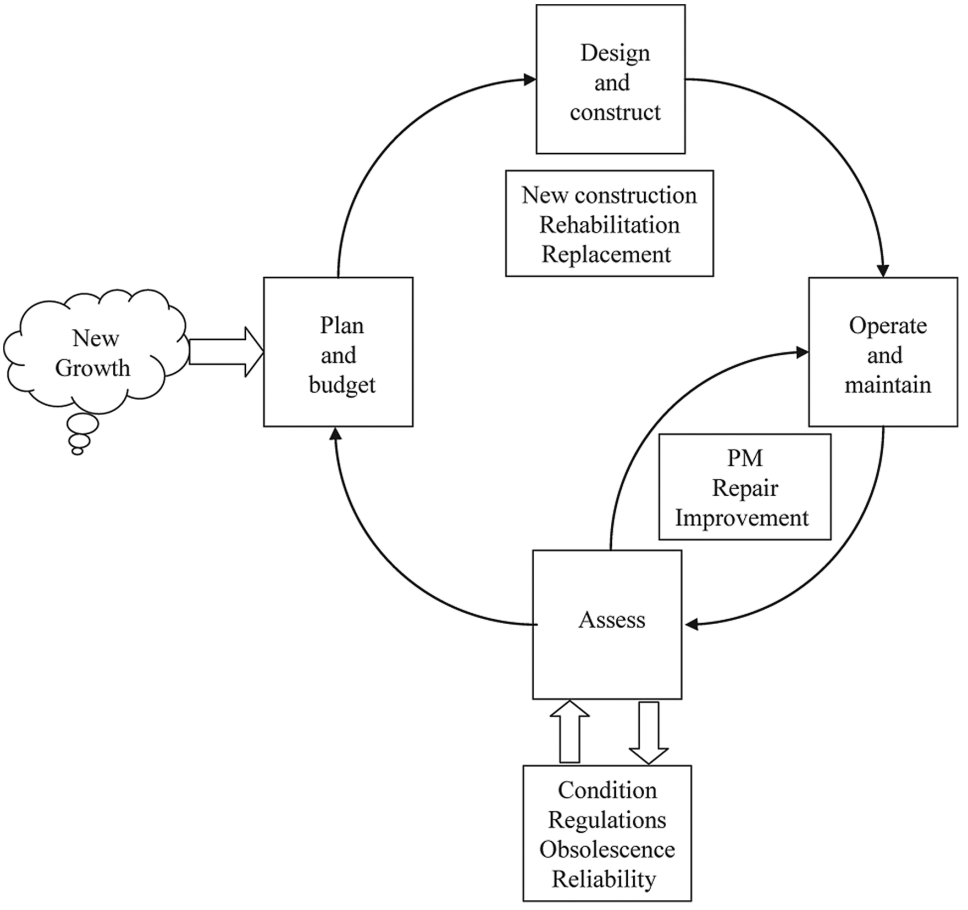

Figure 7. Integration across phases of management.

Disciplines and professions

Disciplines and professions are included in order to illustrate, as simply as possible, that water resources management is *interdisciplinary*.

Examples

The length of the paper does not allow full case studies, but brief examples are presented. These are not exhaustive, but do illustrate how the concepts of IWRM can be used in representative management scenarios. First, I give references for several examples published in a 1999 paper about integrated water resources management (Grigg 1999). Next, brief US examples are presented for each element of integration. Then, three scenarios of geographic integration are presented: one for interstate coordination, one for area-wide coordination of water quality, and one for river basin commissions to coordinate within geographic areas.

Brief examples of issues requiring IWRM

Tables 1 and 2 give examples that illustrate integrated management in a range of situations that require an integrated approach, as opposed to simpler cases where success might be obtained without much integration. The examples are presented according to their level of complexity. References are provided for readers who would like more information.

Table 1. Cases of issues requiring IWRM.

Issue	Geographic scope	Main players	Issues
Idealized watershed	Watershed scale	Local water and power utilities, federal agencies, irrigators, recreation agencies	To coordinate reservoir releases, new facility development, and water management in order to minimize costs, conflict, and regulatory friction in a watershed
Jamaica Bay (Wagner 1995)	Estuary in New York metro area	City, federal agencies, local interests in New York	To develop a comprehensive water quality plan for 25 square miles of water, wetlands, and lowlands within New York City, to link six environmental and urban objectives
Virginia Beach water supply (Walker and Bridgemen 1985)	City and region near Virginia Beach	Va. Beach, two state governments, water utilities in region, federal agencies, federal court	To provide water supply for large, growing city, to resolve inter-basin, interstate water transfer issue with many players and issues
Two Forks (Adams 1998)	Denver metro region	Denver Water Dept, local water utilities, federal agencies, Governor, environmentalists	To provide water storage for metro region in the face of environmental protests, to organize coordinated regional project, to deal with disputes over impact and need for water supply in a western context
Albemarle-Pamlico Sounds (Albemarle-Pamlico Estuarine Study 1988)	Large estuary in coastal area of North Carolina, largely rural	Regional cities, county governments, industries, two state governments, federal agencies	To resolve serious estuary water quality and fish problems, to achieve agreement among states, local governments and industries about policies
Platte River (Nebraska Natural Resources Commission 1985)	Platte River in Nebraska	Local irrigation and power districts, FERC, state governments, environmentalists	To re-license hydropower projects and resolve disputes over endangered species, to coordinate studies, negotiations, court actions and a recovery plan
California's Bay-Delta (Calfed 2008)	Large scale Bay-Delta region in California.	Federal, state, local agencies, water users, environmentalists	To balance urban, agricultural, environmental water uses, and water quality for 19 million Californians, to achieve best mix of policies, to understand a complex system

Table 2. Examples of elements of integration.

Integration element	Example
Policy sectors	Policy sectors are the same in different countries, but may be organized in ministries or cabinet departments with different names. For example, water, energy and environmental policy are combined in the US Federal Power Act, which requires comprehensive river basin planning before a hydroelectric license can be renewed.
Water sectors	Water sectors are the same in all countries. A number of US state governments, as well as the national Environmental Protection Agency (EPA), have combined water supply and wastewater management into unified programmes. At the local level, a public service authority may combine water supply and wastewater management.
Government units	Coordination among government units is specific to different countries. In the US, for example, the EPA delegates authority to operate wastewater permit programmes to state governments. In Colombia, water policy requires coordination between the Ministry of Environment, Housing, and Territorial Development and a set of autonomous regional corporations.
Organizational levels	Organizational levels are the same in all countries. For example, monitoring programmes to be executed by the operational staff of a water utility should be aligned with reporting requirements of the overall utility.
Functions of management	Management functions are universal and the same in all countries. For example, the engineering and financial staff of a water utility should work together to develop the capital improvement programme.
Geographic units	While geographic integration requirements are the same everywhere, political organization varies. For example, France uses river basin associations to manage financial outlays for system improvement. In the US, a water district may provide raw water to a number of local ditch companies and coordinates their use of water.
Phases of management	The phases of management are the same everywhere. For example, the operating staff of a water utility company collects information used by planners to develop the capital improvement programme.
Disciplines and professions	The need for interdisciplinary integration in water management is well established. In fact, the IWRA itself is based on interdisciplinary cooperation.

Coordination across geographic areas – a recurring issue in IWRM

One of the most important elements of IWRM is coordination across geographic areas. River basins and watersheds are thought to be the appropriate unit for water management, but they encompass different political entities. This aspect of IWRM often presents the greatest difficulty. A few examples shed light on this issue.

In the United States water management is highly decentralized. State and local governments manage water under federal policies. This creates a fragmented situation that often requires negotiation and formal intergovernmental agreements. For example, the Pecos River interstate compact was the subject of a Supreme Court lawsuit between 1973 and 1988. For the past 15 years, that decision has served as River Master to resolve conflicts. If river basin planning

and management were successful, no lawsuit or river master would be required. Another US example is the area wide coordination of water quality. In the Clean Water Act, Section 208 authorized regional water quality studies, but little came of this substantial effort.

In a number of countries, river basin commissions are being implemented to improve coordination within geographic areas. France and Spain have used this mechanism for a number of years. In Colombia, where the writer recently assisted with a new water law, the government expects the autonomous regional corporations to provide institutional solutions to geographic conflicts. In Mexico and Brazil, basin advisory commissions have been organized to perform the same function.

Summary and conclusions

While the phrase "integrated water resources management" fills an important need in explaining the complexity and conflict of water issues, it creates confusion and has not been universally accepted. Rather than being an entirely new concept, it is the latest in a series of conceptual frameworks used to convey the notion that water resources decision making is complex and requires the balancing of many stakeholder viewpoints.

To confront this complexity, the literature contains many documents that stress the importance of balanced decisions and improved management. These two goals – balancing viewpoints and improving management – embrace the main aims of IWRM. Reports about IWRM contain mixtures of these two goals. The World Bank's (1993) report, for example, includes concepts such as comprehensive or holistic frameworks, cooperation and coordination, decentralization and grass-roots participation, partnering, public or private enterprise, and watershed focus for planning and management, all of which are integrative concepts. Other concepts, such as capacity-building, full cost pricing, and reliance on market mechanisms are recommended management methods. Such management improvements have been recommended by a number of authors, but the main challenges are institutional – to establish correct policies, viable political institutions, workable financing arrangements, self-governing and self-supporting local systems, and a variety of other institutional arrangements (Frederiksen 1992, Viessman and Welty 1985, Grigg 1996).

Implementing IWRM is difficult because of institutional barriers and because of confusion about what exactly IWRM is. Institutional barriers, which draw in the political and geographic challenges, have been recognized for a long time. Confusion is created because the IWRM concept is complex and involves many facets of water management.

There is no easy way to overcome the institutional barriers to IWRM, but the concept of "governance" is widely recognized as a key to the solution. Effective governance is needed to address most of society's problems and is, arguably, the main challenge facing the human race.

In the world of management, two concepts – leadership and financial responsibility – tend to focus questions. Lack of clarity about these responsibilities is responsible for some of the lack of interest in the concept of integrated management. Simply stated, when many parties share responsibility, it is not clear who has the lead role or who should pay.

To address the confusion, specific and unambiguous language will at least reduce the "noise" that occurs in communication about IWRM. If words are too general, they can be interpreted in different ways and are unlikely to be used by groups that have not participated in developing the phraseology of their use.

The implementation of specific and unambiguous language may create its own hazard by simplifying complexity too much, but it is necessary to move away from academic ideas toward practical implementation. In an attempt to introduce specific language, the paper recommends this brief definition of IWRM: "*Integrated water resources management is a framework for*

planning, organizing and operating water systems to unify and balance the relevant views and goals of stakeholders".

The paper offers a second concept to list the elements for integration in seven categories: policy sectors, water sectors, government units, organizational levels, functions of management, geographic units, phases of management, and disciplines and professions.

In the paper, brief examples are given from different countries in order to illustrate each of these elements.

Coordination across geographic areas is recognized as a special challenge in IWRM. In particular, emerging efforts in Latin America will reveal the level of success associated with the introduction of IWRM in river basins.

Is there an ultimate benefit in use of the concept of integrated water resources management? If nothing else, it communicates to stakeholders that water decisions require balance and that approaches to management that promote shared values such as conservation and alleviation of poverty are essential. If institutional barriers and confusion about the concept can be overcome, benefits in fostering actual improvements in water stewardship will certainly follow.

Afterword: avenues for further research

As a final point, the comments made by a reviewer of the paper offer interesting avenues for further research on IWRM. The reviewer wanted additional clarification about the definition of IWRM. This request points out that the concepts embedded in the definition of IWRM require amplification precisely because they are complex. The reviewer also pointed out that the public might rate water problems lower than development experts do and that stakeholders have conflicting goals and incentives. These two issues clarify for us why it is important to be able to talk to the public in clear language and why, even with the best efforts of experts, it may not be possible to unify the views and goals of all stakeholders.

The reviewer also suggested that the list of seven elements for integration of water resources management (policy sectors, water sectors, government units, organizational levels, functions of management, geographic units, phases of management, and disciplines and professions) be explained insofar as how they apply to conflicts over water between groups in society. This offers an opportunity for someone to prepare another paper to elaborate on these elements and conflicts. It is the writer's opinion that you would need detailed case studies to explain them.

Finally, the reviewer pointed out how recent advancements in economics, such as our understanding of incentives for coordination and cooperation and of institutions, can be brought to bear on the issues surrounding water management. The writer applauds these suggestions and notes that they offer fertile ground for new research.

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