

The United Nations World Water Assessment Programme

Insights

IWRM Implementation in Basins, Sub-basins and Aquifers: State of the Art Review

Keith Kennedy, Slobodan Simonovic, Alberto Tejada-Guibert, Miguel de França Doria and José Luis Martin

International Hydrological Programme of UNESCO



United Nations
Educational, Scientific and
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INSIGHTS

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International Hydrological Programme (IHP)

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Executive summary

A state of the art review (SAR) was one of the tasks carried out during the Sixth Phase of the International Hydrological Programme of UNESCO (IHP-VI), from 2002 to 2007, in its Focal Area 2.4 on methodologies for integrated river basin management (IRBM) and updated at the start of the Seventh Phase of IHP (IHP-VII). It consisted of reviewing case history literature related to integrated river basin management (IRBM) and Integrated Water Resources Management (IWRM). The findings suggest that (i) there are few publicly available detailed references on this topic and (ii) coordination of global – and in some cases regional – efforts to collect case histories of integrated water resources management in basins, sub-basins and aquifers (BSA) can be improved. The following is a summary of the principal conclusions and recommendations presented in the SAR:

1. Case histories should be adequately documented, collected and disseminated

Recommendations:

- An electronic library should be developed and well publicized to collect and freely disseminate documents on BSA case histories.
- A model for case histories should also be developed.

2. Information on current IWRM actions should be better coordinated.

Recommendations:

- Regional databases of BSAs may be useful to share information and coordinate actions.
- The scale of the efforts should be distinguished as to basins, sub-basins and aquifers.

ACRONYMS

AfDB	African Development Bank Group	IRC	International Water and Sanitation Centre
APFM	Associated Programme on Flood Management	ISARM	International Shared Aquifer Resource Management
ANBO	African Network of Basin Organizations	IsDB	Islamic Development Bank Group
AsDB	Asian Development Bank	IWA	International Water Association
BSA	Basins, sub-basins and aquifers	IWLRI	International Water Law Research Institute
CAP-NET	Capacity Building for Integrated Water Resources Management	IWMI	International Water Management Institute
CBD	Convention on Biological Diversity	IWRA	International Water Resources Association
CEH	Centre for Ecology and Hydrology, Wallingford, UK	IWRM	Integrated Water Resources Management
DEWA	Division of Early Warning and Assessment	LAC	Latin America and the Caribbean
ICLEI	Local Governments for Sustainability (founded as International Council for Local Environmental Initiatives)	NARBO	Network of Asian River Basin Organizations
EGM	Expert Group Meeting	NGWA	National Ground Water Association
ESCWA	United Nations Economic and Social Commission for Western Asia	OAS	Organization of American States
EU WFD	European Union Water Framework Directive	OMVS	Organisation pour la mise en valeur du fleuve Sénégal
FAO	UN Food and Agricultural Organization	SAR	State of the art review
GEF	Global Environment Facility	IADB	Inter-American Development Bank
GEMS	Global Environment Monitoring System Water Programme	UNDESA	United Nations Department of Economic and Social Affairs
GIWA	Global International Waters Assessment	UNDP	United Nations Development Programme
GWP	Global Water Partnership	UNEP	United Nations Environment Programme
HELP	Hydrology for the Environment, Life and Policy Programme	UNESCO	United Nations Educational, Scientific and Cultural Organization
IAEA	International Atomic Energy Agency	UNESCO-IHP	International Hydrological Programme of UNESCO
IAH	International Association of Hydrogeologists	WB	World Bank
IAHS	Association of Hydrological Sciences	WB-WSP	World Bank Water and Sanitation Programme
IETC	International Environmental Technology Centre	WBCSD	World Business Council for Sustainable Development
IGRAC	International Groundwater Resources Assessment Centre	WHO	World Health Organization
INBO	International Network of Basin Organizations	WRI	World Resources Institute
IPTRID	International Programme for Technology and Research in Irrigation and Drainage	WSSCC	Water Supply and Sanitation Collaborative Council
IRBM	Integrated River Basin Management	WWAP	World Water Assessment Programme
		WWF	World Wildlife Foundation

3. Tools for IWRM should be developed

Recommendations:

- An appropriate scale for problem description should be developed. Distinction should be made between comprehensive (identification and understanding of all variables and relationships) and integrated (consideration of key or selected variables) representations.
- Support linking social and economic development with the protection of natural ecosystems: Build on experience of the systems approach with special focus on feedback relationships between physical and socio-economic subsystems.
- Involve all stakeholders: promote for participation that will verify feedback relationships and assist to develop policy scenarios for analyses. Each policy scenario is a combination of physical (climatic, hydrologic, hydraulic) and socio-economic (operational, budgetary, development, managerial) system variables.

4. Enhance Institutional arrangements to facilitate the IWRM approach at BSA level.

Recommendations:

- Clarify the difference between institutions and organizations. In this context, institutions can be defined as sets of rules, decision-making procedures, and programmes that define social practices assign roles to the participants in these practices and guide interactions among the occupants of individual roles. Organizations can be construed as material entities with employees, offices, equipment, budgets and (often) a legal personality.
- Provide guidelines for the development of institutions for IWRM implementation at BSA level.

5. Promote broader recognition that the 'integrated' approach is feasible and beneficial.

Recommendations:

- Organize an 'IWRM Works' campaign in cooperation with those committed to carry forth the message related to IWRM needs at BSA stakeholder levels.
- Prepare guidelines for operational implementation of IWRM. Special focus should be on tools for operational implementation and their use.
- Illustrate the implementation of IWRM at BSA level. Use selected examples and case studies with the detailed presentation of the process, data collection and analyses for implementation. Provide access to the BSA organization actually involved and to representatives who are very familiar the example used to illustrate the process.
- Build partnerships to take this message forward prominently and in plain view.

1. Background and objectives

The recently concluded Sixth Phase of UNESCO's International Hydrological Programme (IHP-VI, 2002–2007), on the theme of 'Water Interactions: Systems at Risk and Social Challenges', included a focal area, concerning 'Methodologies for Integrated River Basin Management' (IHP-VI 2.4, see Annex 1). Today, responding to a more comprehensive approach, this is more broadly interpreted as a programme targeted at improving IWRM implementation methods and practices for the organizations tasked to manage water resources in river basins, sub-basins and aquifers (BSAs).

With developments in this area over the last seven years, it became evident that the objectives of IHP-VI 2.4 were pertinent not just to river basins but also to catchments, watershed components (sub-basins) and aquifers. Since IHP-VI 2.4 was first defined, the World Summit on Sustainable Development (Johannesburg, 2002) has more broadly addressed some of the related issues, and many nations have agreed to develop country-related IWRM and water efficiency plans. Many of these national plans are currently underway.

IHP-VI 2.4 was directly supportive of, and concurrent to, such national IWRM plans. It is believed that there is a need to identify and further develop practical guidance, methods and tools and to support instruments that are more closely in tune with and aligned to the BSA organizations mandated to manage their water – and to develop these as a set of widely distributed and readily and freely available resources for them. Within this perspective, UNESCO intends to actively assist the development and maintenance of such a set of practical guidance resources for BSA organizations and their stakeholders. This is within the scope of its mandate of expanding the scientific and management knowledge-base on water resources for the benefit of its Member States.

It is recognized that there are many entities that are working in related areas and whose experience and knowledge would directly benefit the practical guidance resource products that will emerge from the programme. UNESCO conducted this work using an expert group (Annex 2). The expert group has been selected from those working at different scales, in varying physical, ecosystem and climatic settings, and among changing and variable cultural and economic backgrounds.

2. Conceptual approach

It was agreed to leave the IHP-VI 2.4 global project scope as 'general' at the outset until we had learned and synthesized 'what was happening' and, as a group of experts working in the field, had met for the appropriate debate and dialogue to provide further direction on how to best act to meet the needs of the BSA organizations and their stakeholders in the context of the Focal Area 2.4 programme objectives.

It was also recognized that the programme's principal focus was to be on developing countries and specifically those organizations responsible for management of the water based on 'hydrologic/hydraulic units' as opposed to administrative institutional boundaries. These were believed to typically take the form of institutional entities such as river basin organizations, watershed or catchment development agencies or commissions, or aquifer authorities.

UNESCO intends to provide the materials, resources and knowledge to help 'build the bridges' to put in place a practical set of end products that will be works in progress highlighting good practice and providing resources for BSA organizations and their stakeholders. The final 'practice products and services' are expected to be used effectively as resource tools for those working daily on, and intimately involved with, developing and implementing methods for effective integrated management practices in BSA settings, emphasizing developing country demographics and locations. The continuing activities will focus on preparing a strategy document that will better define exactly what these Practice Products and Services should be to assist in developing practice guidelines and related resources. They will be decided upon based on the continued guidance of the experts in the group meeting and also from this SAR and other pertinent resources from not only within but external to UNESCO.

UNESCO brought forward useful input from three specific IHP actions from the outset. First, the UNESCO HELP (Hydrology for the Environment, Life and Policy) programme provided results from some of its members' actions pertinent to the BSA practice guidelines. Second, a series of actions and reports from the UNESCO ISARM project and related IAH actions in shared groundwater management and resource evaluation investigations, provided useful examples of technical approaches emerging from shared aquifer management programmes that could, technically and from a management standpoint, benefit BSA management activities in later stages of the project. Third, the Latin America and the Caribbean (LAC) region has begun specific actions that relate to documenting where and when IWRM implementation is being carried out. This has provided an opportunity to understand how Global Environment Facility (GEF) projects, in particular, are developing methods for broader interdisciplinary studies. Further input from the IHP project HELP, and from the IHP Latin America and Caribbean experiences and other regions, is expected to provide invaluable elements that relate to IWRM implementation actions and practices in those areas of the world at future stages of this project.

3. State of the art review

This section describes the scope, method, findings, conclusions and recommendations of the work done to carry out the state of the art review (SAR).

3.1 Scope

The SAR was designed to review currently available information on cases related to IWRM and IRBM and to summarize these findings with conclusions and recommendations concerning what the next steps should be for the project. It was considered a starting point in the accumulation of information for further development during the project activities, not an exhaustive review of all materials potentially available. However, the fundamental aim of this project is to promote public dissemination of freely available, pertinent water management (and supporting discipline) data. Resources that did not fit this general scenario were not included at this stage. If this situation changes, it would be appropriate to augment the resources at some future stage in the project. It is unlikely, however, that there are key milestone studies that are not already in the public domain, except perhaps some legal studies which we hope could be included in FAO's water regulations database in the near future.

3.2 Method

The SAR was carried out in four stages:

- Readily available web- and literature-based resources related to IWRM, IRBM and (CBD) Ecosystem Approach terminology were sought and reviewed;
- People and entities with knowledge in the field, were contacted to ascertain what additional resources might be available for inclusion in the project database, resulting in a list of entities and resources of potentially useful input to the project;
- Key elements of five principal contributions, believed at this stage to be the most pertinent to the project objectives were summarized;
- Other emerging resources that are emerging with potential future contributions were identified for later consideration.

3.2.1 Data collection

A preliminary overview of sources of information and project references was compiled, associated with the materials that have been collected to date (see References). Rather than a complete list of available resources, it provides people who are interested in published case histories in the topic area with readily available resources. Publications in scientific journals which are not easily available were not included in the research for the SAR.

A list of documents was obtained from the www.catchment.com (RefMan) file of IWRM publications, compiled by Dr Bruce Hooper (University of Illinois, USA). UNESCO-IHP is evaluating how the

list and the documents can be made publicly available for a wider audience. It is a valuable resource, and both the list and the documents in it would be a worthwhile contribution to the area of IWRM and IRBM. At this stage, however, the list is not in the public domain.

The context of IWRM is large in terms of scale, disciplines and different socio-economic settings. It would present an enormous and potentially overwhelming task without targeting key priority areas. A useful starting point was selected from the '3 E's' (i.e. ecosystems, economics and equity) within the context of the IWRM triangle, which also correspond to those used in sustainable development.

The changes in process that have been identified by several authors and organizations, in terms of what has to be modified from an institutional and management perspective, are still under debate, a situation that is likely to continue. For the purposes of this review, we considered the 3 E's, and from the interaction and interdependencies of those key areas, evaluated where IHP-VI 2.4 could potentially best work to improve implementation of IWRM in terms of practical needs.

3.2.2 Contact with, and compilation of, knowledgeable entities

Early on in the project, we looked at the extent to which different entities were active in various key aspects of IWRM process disciplines. We considered activities in different regions of the world and the scales of settings investigated. This resulted in a 'mapping' exercise of the extent of engagement and coverage. This effort continued with the development of a 'knowledge base' which identifies and outlines those entities that can, or currently are, publicly providing a variety of inputs and experience.

3.3 Main findings

The resources with case histories are limited, which may be due to inadequate incentives to produce them. The scale of assessment varies widely (as is to be expected with such limited information), yet a number of common general concerns and considerations are emerging.

3.3.1 Limited published and available pertinent and consistent case-history knowledge

Many entities are conducting or involved with water management projects. Despite this, only a few case histories have been published to date that focus on water management practices with an IWRM perspective. Those increasingly relate to new and advancing methods and approaches in integrated processes and multi-disciplinary issues. Most of these that are publicly available have been collected as part of this SAR. The results from about 70 cases from five entities were reviewed as part of this SAR, and it is likely that this represents a majority of published practice description pertinent to recent work in IWRM and IRBM. However, it is hard to determine if these cases are representative of the situation globally or

regionally, and it can be hypothesized that there are situations for which no case history or adequate description has been prepared.

1. It is likely that additional case studies exist, particularly in printed grey literature, such as reports and other documents of government and donor aid-related programmes. In addition, there are probably many unpublished cases developed both by BSA organizations and individuals. This situation is to some extent being remedied by the emerging UNESCO HELP basin programme descriptions, which are now being put on-line and may in the future be searchable by key common areas.
2. Language is a frequent barrier to effective knowledge sharing and dissemination. There are case histories published in languages other than English that could not be included at this stage in this assessment, but which should be taken into account in regionally-based programmes. It would be useful for UNESCO and other organizations to continue supporting the translation of key documents into multiple languages.
3. More importantly, it was noted that there is not a broad or consistent approach that encompasses IWRM description. However, the World Bank Studies (Bhat et al., 2005; Blomquist et al., 2005a-f; Johnsson and Kemper 2005a-b) and to some extent the 2003 reported WWF cases are highly instructive and useful in terms of thoroughness and pertinent issues to consider when reporting the critical aspects of integrated water management. They, along with the other sources reviewed, provide directions that can be of great assistance towards developing a structured approach for BSA organizations. In addition, there is ongoing work related to indicators for IWRM which is being developed in several settings. It is likely that decades of experience will be needed before this multidisciplinary field achieves standardization.
4. There are several local actions taking place in water management in BSAs. Some have cases that are unpublished or not disseminated. One emerging example consists of cases compiled as part of the preparation for national IWRM plans. Additional reviews of some practices are also being completed in academic settings.

3.3.2 Lack of incentives for documenting case histories

It is infrequent for project bodies to take the time to 'tell their story' consistently or in detail. They may compile or consolidate existing knowledge into progress and final reports, but most of this work does not result in an in-depth discussion of meaningful practices and methods/techniques assessments that are constructive for future learning.

3.3.3 Scale of assessment

The review of case descriptions leads to the conclusion that the scale of the assessments – in terms

of regional, socio-economic, physiographical, and geographical conditions – varies widely. The eight studies presented by the World Bank (Bhat et al., 2005; Blomquist et al., 2005a-f; Johnsson and Kemper 2005a-b) are of relatively large basins, two of which are well known and have provided already valuable lessons in developed country settings (Murray-Darling and Fraser Basins). The WWF (2003) and Both ENDS and Gomukh (2005) cases are typically smaller, and the GWP cases vary considerably.

3.3.4 Common concerns and considerations

Table 1 provides an overview of the most important issues – in terms of conclusions, concerns and ‘lessons learned’ – from studies in approximately 60 BSAs. The results illustrate that there has been a

considerable effort to identify what steps have been taken and how these are understood from a ‘lessons learned’ standpoint. The depth of analysis of the World Bank study (in terms of considering different multidisciplinary aspects, at multiple levels), as well as the level of engagement of the different stakeholders in these basins, is encouraging. The WWF study portrays their 14 situations in a clear and consistent manner that is based on conservation, ecosystems, community/local actions and stakeholder engagement. The study by Both ENDS takes a local perspective, looking principally at cases they have been involved with. They all rely principally on local actions, which are almost exclusively developed from the bottom-up, and which have a strong reliance on local solutions that are used to enter into

Table 1. Summary of principal lessons learned and conclusions from the five sources of BSA case histories.

Source	Focus / Issue area	Lessons Learned or Conclusions
Burton (2003)	Basin Organization Analysis (mostly Francophone countries)	<p>Presents eight critical elements that contribute to the success of an integrated river basin management approach, suggesting that the most successful experiences have been derived by combining several of these elements.</p> <ol style="list-style-type: none"> 1. <i>Political Will.</i> At the highest possible level. Clear and tangible (legal framework, institutional arrangements, budgets). Sustained over time, beyond elected terms of politicians. 2. <i>Knowledge.</i> Not science alone, but through the proper use of all available sources of information. Information has to be shared and easily accessible. Integration of information is key to sensible decision-making. Information technologies need to be adapted to managers’ needs; these management tools need to be properly understood to be useful. 3. <i>Sustainable Technologies.</i> Start small to validate the most appropriate technology. Learn from the mistakes of others: technology transfer is essential. Readiness to innovate, while technology dumping may do a lot of damage. 4. <i>Institutional Arrangements.</i> Water is a responsibility shared by a wide range of institutions. Start with existing institutions, but (re)define mandates. Informal arrangements are useful to start with; begin with working groups or task forces to bring people together. This is a people issue; be mindful of personal expectations. 5. <i>Building on Existing Expertise.</i> There exists a wealth of expertise to build upon. This expertise should be put to better use. Capacity development is the key. 6. <i>Community Involvement.</i> Takes time to put it in place; is a long-term investment. Once trust is established, it needs to be nurtured over time. A strong component of any natural resources management project. 7. <i>Economic Prosperity.</i> Difficult to manage without financial support. More than just direct project funding; a whole range of government incentives create a favorable context in which initiatives flourish. Explore new sources of funding; local partnerships can provide a lot of support. 8. <i>Right Timing.</i> All of the above do not have to occur simultaneously, but there exists a successful combination of these elements that requires some of them to be present in the right mix and at the right time.

Source	Focus / Issue area	Lessons Learned or Conclusions	Table 1 continued
GWP ¹	RBOs (14 cases)	All RBOs evolve with time and see their composition and duties adapted from time to time reflecting the real needs of the moment. Successful river basin organizations are supported by: <ol style="list-style-type: none"> 1. An ability to establish trusted technical competencies; 2. A focus on serious recurrent problems such as flooding or drought or supply shortages, and the provision of solutions acceptable to all stakeholders; 3. A broad stakeholder involvement, catering for grassroots participation at a basin-wide level (e.g. through water forums); 4. An ability to generate some form of sustaining revenue; 5. The capacity to collect fees, and attract grants and/or loans; 6. Clear jurisdictional boundaries and appropriate powers. 	
GWP ²	Basin Management Plans (11 cases)	<ol style="list-style-type: none"> 1. Involvement of all relevant stakeholders and the general public is essential for the implementation and success of plans. 2. River basin planning is most successfully applied in circumstances where an appropriate institutional structure (e.g. a river basin organization, or at drainage basin level for lakes) has been established. 3. The long recovery period after stress in lakes means that prevention and planning are much more effective than restoration. 4. Conflict is a common feature for rivers and lakes: upstream–downstream, and conflicts in the same place among different users or over time between uses (e.g. fishing vs. recreation, or biodiversity vs. commercial fishing). 	
GWP ³	Groundwater	The use of administrative tools helped control and reduce the impact of over-exploitation of the aquifer. However, although water use was reduced, many jobs were lost in agriculture and small industries. The two most important lessons learned are: <ol style="list-style-type: none"> 1. Good water management needs to consider the whole hydrological cycle: surface and underground waters cannot be managed separately or independently of the ecosystems on which they depend. 2. Good water management requires sustaining a balance between pumping of groundwater and recharging the aquifer. Aquifer management needs planning to accommodate medium- and long-term use of the resource. 	

1 The GWP cases referenced for river basin organizations (RBOs), available at the GWP website TOOLBOX (<http://www.gwpforum.org/servlet/PSP>), are the following:

- Brazil: River basin committees in Sao Paulo State as instruments of participatory IWRM (#72)
- Bulgaria: Creating a watershed council along Varbitsa River (#142)
- Costa Rica: How an IWRM approach would achieve better water allocation – The Lake Arenal Watershed (#10)
- Guatemala: Towards IWRM in the basin of Lake Atitlán (#9)
- Jordan: From water service provision to planning and management in the Jordan Valley Authority (#161)
- Senegal: Establishing a transboundary organization for IWRM in the Senegal River basin (#45)
- Sri Lanka: Restructuring of Mahaweli Authority to an interbasin management agency (#189)
- Tanzania: Critical analysis of river basin management in the Great Ruaha (#121)
- Thailand: Decentralization and the development of river basin committees case (#186)
- Thailand: Budgetary procedures to provide incentives for river basin committees (#187)
- The Netherlands: Informally co-operating governing bodies design future water system for the Delta Metropolis (#166)
- The Netherlands and Belgium (Flanders): Cross-border co-operation for small-scale river basins (#127)
- Viet Nam's law on water resources and related legislation for implementation of IWRM (#112)
- West Africa: IWRM in the Niger River basin (#46)

2 The GWP cases referenced for basin management plans, available at the GWP website TOOLBOX (<http://www.gwpforum.org/servlet/PSP>), are the following:

- Asia: Water-saving in rice-based ecosystems (#200)
- Central and Eastern Europe: Civil society and the Danube basin planning (#120)
- China: Mountain-river-lake integrated development programme, Jianxi (#118)
- El Salvador, Guatemala and Honduras: The PLAN TRIFINIO for the Upper Lempa: Opportunities and challenges for the shared management of Central American Transboundary Watersheds (#126)
- Estonia and Russia: Managing Transboundary waters in the Lake Peipsi/Chudskoe basin (#16)
- Indonesia: A watershed approach to coastal zone management in Balikpapan Bay (#85)
- Jordan: Amman Zarqa Basin – Using reclaimed water (#79)
- Mexico and Indonesia: Participatory strategies for integrated bay and watershed planning and management (#85)
- Panama: The management of the Panama canal watershed (PCW) (#5)
- The Netherlands: River basin plan for Midden-Holland, the Netherlands (#165)
- The Netherlands: Room for the Rhine (#88)

3 The GWP case referenced for groundwater, available at the GWP website TOOLBOX (<http://www.gwpforum.org/servlet/PSP>), is the one on Spain: Managing water demand in the upper Guadiana basin (#18).

Source	Focus / Issue area	Lessons Learned or Conclusions	Table 1 continued
World Bank (Grey et al., 2003)	Economics of African International Rivers	<ol style="list-style-type: none"> 1. Potential benefits of cooperative water resources management can serve as catalysts for broader regional cooperation, economic integration and development – and even conflict prevention. 2. Riparians will pursue joint action only when they expect to receive greater benefits through cooperation than through unilateral action. 3. Economic analysis can contribute to make the case for cooperation on international rivers, using tools that will help identify and measure the potential incremental benefits of cooperation, determine the distribution of benefits among riparians, and assess the feasibility and fairness of alternative management and investment scenarios. 3. Investment and management schemes can be designed to maximize the aggregate economic benefits of a river system. Where such schemes yield benefit distributions not perceived as equitable among riparians, economic tools could also be used to calculate, design and implement arrangements for redistribution. 5. In these ways, economics can play an important role in enabling the management of international rivers, helping to motivate, design and implement cooperative water resources management. 	
World Bank (Blomquist et al., 2005c)	Eight River Basin: Institutional Aspects	<ol style="list-style-type: none"> 1. Secured active involvement of stakeholders comes from the representation of diverse groups of stakeholders, regular and sustained opportunities for interaction, an ambitious agenda of basin management issues, and direct connection to people's livelihoods and local communities of basin management activities. 2. Factors for successful start-up of river basin organizations include commitment of governmental support to the creation of stakeholder-based or stakeholder-involved organizations. The presence or prospect of valuable infrastructure investments became a point of stakeholder interest. Absence of significant conflicts among basin stakeholders helps. 3. The answer to how to achieve active involvement of stakeholders sustained over time is not simple because of differences in stakeholder involvement noted earlier and the different lengths of time basin management has been undertaken. 4. Stakeholder involvement had substantive linkage to resource management decision-making. Several river basin organizations engaged stakeholders in substantive basin management decisions. More common is the engagement in basin planning, water supply allocation and infrastructure operation areas. Less common is the involvement in setting water charges, collecting fees, flood control, monitoring basin conditions, altering land uses, or infrastructure construction decisions. 5. Stakeholder involvement translates into more effective resource management in the areas of: reduced flooding exposure and better water storage and reservoirs releases management (Brantas, Guadalquivir, Jaguaribe and Murray-Darling); reduced deforestation (Tárcoles); reduced pollution – improved industrial wastewater treatment and reduced use of rivers for waste discharge went hand-in-hand (Fraser); better headwater protection (Alto Tietê); and measurable improvements to wastewater treatment from financial investments of provincial funds for environmental protection and water management (Warta). 6. Resource management improvements were retained in most cases. Principal water resource problems giving rise to establishing basin and sub-basin organizations are addressed and improvements have occurred. With emerging problems and scope of management responsibilities expanded, however, it is too early to tell in some cases whether and how well the arrangements will cope with them. Despite improvements, significant water resource management problems remain. 7. Factors of longevity or demise of decentralized arrangements include, most importantly, consistency of central government support for basin management, stakeholder involvement and water policy reform. Consistency of support may be as important as magnitude. Other factors include financial resources and financial autonomy; top-down versus bottom-up initiation of reform (considered along with prior experience at local level in self-governance and service provision, and consistency of central government support through periods of transition); low levels of cultural conflict among stakeholders; and explicit provisions to recognize and involve sub-basin communities of interest, especially in larger basins and in basins where different water use sectors dominate different areas. 	

Source	Focus / Issue area	Lessons Learned or Conclusions	Table 1 continued
WWF (2003)	Integrated River Basin Management (14 case studies)	<ol style="list-style-type: none"> 1. Long-term investment is needed. 2. River basin management requires an integrated, holistic and strategic approach, based on a clear vision and agreement on the values – natural, social, and economic – to be conserved and the sustainable livelihoods needed by the people of the basin. 3. Biodiversity may have to take a ‘back seat’. 4. It is important to work at different levels simultaneously. 5. Effective partnership building is an essential ingredient of IRBM and enables far more to be accomplished than by working alone. 6. Be ready to seize unexpected opportunities. 7. Sustained efforts are needed to raise public awareness and to gain the support of local communities. 8. River basin conservation must build on a strong informational and science base. 9. River basin management must be established as a political priority. 10. Formal protected area designations may be vital for long-term underpinning of river basin management. 11. The conservation community can catalyze and demonstrate, but effective and sustained implementation of river-basin scale solutions depends on governments, the corporate sector, civil society, communities, and individuals accepting and committing to the principles of IRBM. 	
Both ENDS & Gomuck (2005)	1. Cotahuasi Basin, Arequipa, Peru	<ol style="list-style-type: none"> 1. Feasibility of water management of basin level activities is higher when linked to a bigger objective, such as sustainability. 2. Solving conflicts is easier through platforms established at the lowest level. 3. Practical mechanisms to implement measures are needed. 4. Political will to enforce measures are important. 5. Water management should be linked to other natural resources. 6. A group of water user associations can negotiate the interests of water users in the basin. 	
	2. Se San River Basin, Cambodia	<ol style="list-style-type: none"> 1. A network can create solidarity between different indigenous groups, and can empower communities by providing them a voice in an open and unified manner. 2. Participation of government officials is valuable to galvanize local political support for the advocacy work and to broaden trust in the research findings. 3. Trust comes with sharing power in decision-making processes and bureaucratic governments’ receptiveness to negotiation. 4. An international coalition network has provided strong technical, advisory, analytical and advocacy resources. 5. Local networks can use their international forum to raise community concerns to the international level. 6. Networks grown organically are valuable and effective (bottom up). 7. All actors’ roles in a conflict have to be accounted for to reach a just and equitable outcome. 	
	3. Nan River Basin, Thailand	<ol style="list-style-type: none"> 1. Using existing mechanisms, processes and values is of crucial importance (rather than imposed state agency conditions incompatible with local culturally embedded practices). 2. Villagers’ interest in participation derives from their interest in the outcomes (not from a standardized institutional form of participation). 3. Specific river basin organizations may not be the most strategic point of intervention. Other key groups and networks may play an important role, given the modest resources that are available to become involved in water and river basin issues. 4. Research is significant as much for the process of involvement as for the nature of the results and findings. 5. The inclusive process carried out by a civil society organization attracted interest at community and local government level. 6. Research reports give legitimacy that advocacy and critique does not necessarily afford at the policy level. <ol style="list-style-type: none"> a) Understanding the various ways in which water and river basin management are actively negotiated at a local level gives (i) more thorough insight into key river basin management issues and (ii) a basis to challenge bureaucratic approaches to infrastructure planning and river basin administration currently in place as ‘mainstream’ practice. 	

Source	Focus / Issue area	Lessons Learned or Conclusions	Table 1 continued
	4. Tiquipaya Watershed, Central Valley of Cochabamba, Bolivia	<ol style="list-style-type: none"> 1. Lack of institutional or legal arrangements for water management can lead to conflicts. It is important to encourage people's willingness to get involved in decision-making in water management and help communities and water users to participate effectively. 2. Unstructured discussions lead to violent conflicts. 3. Research and analysis of critical issues (social and economical, land-use planning, implications on technology, water resources development, etc.) is useful in negotiating issues. 4. Beyond information, an intermediary organization can help build consensus and get resources, support for meetings, institutional set-up, etc. This can lead to higher commitment and participation with real dialogue and both legitimacy and power for making decisions, as well as building capacity. 	
	5. Bhima River Basin, India	<ol style="list-style-type: none"> 1. Local stakeholders' participation leads to responsibility and accountability towards the created assets. 2. Basic needs for water, food, health and sanitation were met at a lower cost and time than prior government efforts. 3. Local initiatives choose development options which are socially the least disruptive and which do not cause human displacement. When displacement is needed, the local community internalizes it (adjusting or compensating land and water rights, providing access to other resources like fodder, fishing rights, forest produce, etc.) 4. IRBM requires various techniques that bring about necessary changes. Not all techniques are appropriate for all regions. (For example, because wells cause groundwater tables to drop, stakeholders agreed by consensus not to use wells for irrigation.) 5. Natural disasters highlight the need for a negotiation process and attract participation of officials. 	
	6. Khulna-Jessore Drainage Rehabilitation Project (KJDRP), Bangladesh	<ol style="list-style-type: none"> 1. Local knowledge is important to design programmes as it helps adopt technology appropriate for needs of the people. 2. A negotiation process with community-level stakeholders supported by appropriate institutions makes concerned authorities honour popular demand. 3. Strong institutions with appropriate mandates, local involvement and adequate financial backing need to be in place to carry out water resources management at the local level. 	
	7. Save the Sand Project: An Integrated Catchment Management Initiative, South Africa	<ol style="list-style-type: none"> 1. The Ecosystem Approach offers a useful framework for strategic choices regarding land and water use practices in the catchment. Local people already often think in terms of systems. 2. Negotiation must hold the possibility of real power for those involved – otherwise it stands simply as a token for 'community involvement'. 3. Details of involvement and negotiation (such as who, when and why) must be identified and communicated to make participation meaningful. 4. The intermediary based in the area can change practices of communities and people. 5. A national obligation to adopt IRBM remains nothing more than an intention until it is given meaning at the local level through implementation. An overly ambitious law or act will make no difference in daily practice if active implementation is not sought. 	

dialogue with the administrative entities involved in water management. The GWP cases are mixed in their detail and background.

Overall, what emerges from these studies is an apparently consistent identification of areas of concern. Therefore, it is worthwhile to (i) present the conclusions and recommendations of these studies in a summary format, (ii) identify the common areas of assessment and (iii) focus on important issues that are consistently emerging in conclusions in cases reviewed. A synthesis of this analysis is presented in Table 2.

The results show that there are nine key themes – critical areas of consideration for BSAs – mentioned in most of the reviewed cases:

1. sharing and access to knowledge and understanding good science;
2. support for, and building of, institutions (from local to national scales);
3. stakeholder engagement;
4. the necessity of dispute resolution;
5. the political will;
6. the necessity of capacity development, as a complement to planning and action;
7. the importance of understanding economics and financing;
8. timing, in terms of length and opportunities;
9. the role of partnerships and informal groups.

An additional eight themes appear in three organizations' case history conclusions and recommendations:

1. organizations should be self-financing;
2. done for all water uses and implementation alternatives should be evaluated;
3. a key or focal issue (e.g. crisis, conflict, natural disaster) is commonly a starting point;
4. use of existing methods can facilitate the process;
5. cooperation can be linked to economics;
6. conservation and protected areas are important for biodiversity;
7. intermediaries can play a potentially important role in the process;
8. local (community) engagement is a critical aspect.

Finally, three additional conclusions are highlighted in the studies:

1. drawing from research and studies helps to provide legitimacy and stakeholder access;

2. protection is a more beneficial approach than remediation; and
3. biodiversity may have to take a 'back seat'.

The emergence across these diverse sources of shared key themes is a solid beginning for the further development of potential needs for BSAs organizations in the future. Nonetheless, there are some important elements of the details in the eight World Bank studies that also should provide guidance related to organizational elements and the roles of stakeholders.

3.3.5 Groundwater

The difficulties involved in raising awareness about a precious 'hidden' resource are now largely acknowledged in many water management settings. However, few efforts to overcome these difficulties are being made, in terms of organizations dedicated to the management of aquifers. Stories related to the Guarini, Nubian, Ogallala, Southwest Florida, Northern China Plain and Spanish coastal regions are well known and are a cause for concern. Indeed, some institutions are exploring new management techniques for some historically over-extracted and contaminated subsurface settings. Also, considerable efforts related to transboundary aquifers are being made by ISARM, IAH and other UNESCO groups. A joint FAO, IAEA, UN-DESA and UNESCO (2003) publication on groundwater management similarly targets key problem areas. Most of the concerns come from the pressure of agricultural development – and indiscriminate overexploitation of groundwater in developing countries. Lessons directly related to knowledge sharing and of particular relevance for this work can be found among its conclusions.

Disseminating global lessons: A final key point of leverage for UN-system agencies lies in the global perspective they can bring to groundwater based on actual national data sets. Governments and communities in many parts of the world are trying different approaches to groundwater monitoring, analysis and management. Harvesting and disseminating the lessons from these initiatives could serve as a catalyst for the development of approaches that are effective even in the most difficult locations. As a result, activities that support collecting and disseminating examples of adaptive groundwater management (simply to show what happens) will continue to be an important activity for UN agencies involved in groundwater management. The actual experience of groundwater management, or the lack of it, needs to be charted if real responses are to be effective.

Target studies could include case studies of:

- groundwater management failure;
- specific socio-economic impacts resulting from over abstraction and pollution;
- intense competition among water users (private and public);
- intersectoral competition between irrigated agriculture and urban water supplies;

Table 2. Summary of Common Key Supporting Conclusions and Recommendations

Topic Areas	Burton	GWP 14 RBOs	GWP 11 BMPs	WB Economics	WB 8 Cases	WWF 14 Cases	Both ENDS 7 Cases
1. Sharing, access to knowledge & understanding, good science	Y	Y	Y	Y	Y	Y	Y
2. Support for & building institutions	Y	Y	Y	Y	Y	Y	Local
3. Stakeholder engagement	Y	Y	Y	Y	Y	Y	Y
4. Dispute resolution is a commonly needed process/action	Y	Y	Y	Y	Y	Y	Y
5. Political will	Y	Y		Y	Y	Y	Y
6. Capacity development	Y		Y	Y	Y	Y	Y
7. Economics & financing critical to understand	Y	Y		Y	Y	Y	Local
8. Timing in terms of length & opportunities	Y	Y		Y	Y	Y	
9. Partnerships, informal groups	Y	Y			Y	Y	Y
10. Organizations should be self-financing	Implied	Y			Y		
11. Evaluation should be done for all water uses and implementing alternatives				Y	Y		Y
12. Key or focal issue (Crisis, Conflict, Natural Disaster) commonly a starting point		Y				Y	Y
13. Use of existing methods to facilitate the process	Y					Y	Y
14. Cooperation can be linked to economics				Y	Y		
15. Conservation, protected areas are important						Y	Y
16. Critical aspects of local (Community) engagement	Y					Y	Y
17. Potentially important role of intermediary in the process	Y					Y	Y
18. Use of research & studies to provide legitimacy & stakeholder access	Y						Y
19. Protection is a more beneficial approach than remediation			Y			Y	
20. Biodiversity may have to take a 'back seat'						Y	

- competition between communities located at recharge and discharge areas of aquifer systems;
- competition over transboundary aquifers (exploitation and pollution).

Other fundamental recommendations from this effort involve and address economics, sustainability and water users' associations, both large and small. IAHS is in the process of forming a new working group addressing the roles of partnerships in groundwater management. This could be a valuable asset in terms of consolidating the documentation and lessons being learned from the wide variety of organizations (local to national) which are becoming more engaged in local aquifer management.

3.3.6 Tools for IWRM

The first Expert Group Meeting (July 2005) addressed what tools are potentially available and useful to BSA organizations. Two specific recommendations that came from the EGM were: (1) that guidance should be provided as to which multi-disciplinary tools can be used to assist in the integration and (2) that there should be guidance on which tools are appropriate to use in the different settings. First, it was determined that a list of available tools for IWRM has not been produced (or has not come to our attention). Second, the definition of what constitutes IWRM tools should be clarified.

In the context of this review, 'tools' are products and services that encompass information-, data-, hardware- and software-oriented techniques used in integrated water resources management. Any major basin organization, for example, will rely on flood forecasts, satellite imagery updates and GIS facilities. At a more local scale, less sophisticated mechanisms and communications means are generally used. Finally, guidelines should consider some of the process and community engagement tools that are developed in the scope of the EU WFD.

One challenge that must be addressed is how much effort will be needed to allow basin organizations to start using these tools – in terms of their applicability, efficiency, necessary infrastructure and the required capacity of users. The development of a written manual may or may not be useful. A description of the functionality and benefits of the tools, in terms of characterizing their applicability and the resources needed (e.g. level of sophistication in data, information, equipment and handling), should be an important part of any guidelines. Potentially modifying a Best Available Technology approach could yield guidance in terms of what resources are needed to use the tools and what level of performance and management is needed within organizations for the tools to be of value.

At this stage, however, with respect to tools, it is likely more pertinent to present the IWRM processes implementation pathways they support. That

is, we should be able to demonstrate clearly and rationally how to support the basin stakeholders with existing and already working tools, rather than reinventing them and embarking on tangential techniques. As noted below, awareness of useful tools appears to be largely overestimated and most of the emerging smaller BSAs have little awareness and poor capacity to select or use them. The promotion of existing tools – and in some cases, their improvement – should therefore be addressed, as well as meeting the gaps that are not covered by these tools.

4. Conclusions and recommendations

This section describes the main conclusions that emerged from the SAR and to provides recommendations as a basis for future work. These conclusions and recommendations have also been influenced by the input from the Expert Group Meetings (EGMs) and communications with UNESCO-IHP staff. However, these should not necessarily be considered as the official views of UNESCO-IHP. The main recommendations are that:

1. Case histories should be adequately documented, collected and disseminated.
2. Knowledge of IWRM actions that are taking place should be better coordinated.
3. Tools for IWRM should be documented with respect to the existing and emerging capacity for BSAs, in particular for carrying out multi-disciplinary processes in IWRM.
4. Institutional arrangements to facilitate an IWRM approach at BSA level should be suggested, with clear distinction between institutions and organization.
5. Efforts should be made to achieve a broader recognition that the 'integrated' approach is feasible and beneficial.

1. Case histories should be adequately documented, collected and disseminated.

There is insufficient attention being paid to adequately documenting the work being done by BSA organizations involved with water resources management. There appear to be a limited number of professional journals or associations dealing with basin water management, particularly in developing countries, and their results are not readily available nor found in developing countries outside academic settings.

The IWRA and some other professional water associations and groups do have watershed-related committees, and the IAHS runs a series of conferences on integrated water resources management and maintains an active interest in the subject. However, none of these groups, including INBO, have made it a priority to identify the documentation of the IWRM in the BSA settings.

Recommendations:

- Develop and well publicize an electronic library (clearinghouse) to collect and freely disseminate all available documentation for BSA cases. This would include seeking to obtain copyright releases.
- Develop a simple model for a case history containing the main items for the description of the case and the setting elements. The model should represent the 'BSA in a nutshell', with annexes and electronic links to materials that are emerging and can be supplemented as the case history develops. In the event that UNESCO develops a model, this could eventually be adapted to each IHP region – however, the format of the information should aim to encompass not just the perceived needs of UNESCO, but also those of other agencies such as WMO, FAO and UNEP. Each of these entities has valuable and critical water-related information to provide from their actions in developing countries. This process could also be linked with the World Water Assessment Programme.

2. Knowledge of IWRM actions that are taking place should be better coordinated

Lack of generally used guidelines in the reporting of case studies leads to incommensurability and overlap – and delays progress in the development of IWRM knowledge. There is little current effective coordination between the limited published information and existing associations that are looking at IWRM, nor even those that are involved with water management in BSA settings. Most of this is being done in a relatively *ad hoc* manner. In developing countries, there is little support from donors, national or international agencies to coordinate actions – most of the work is still sector-driven, principally by agricultural bodies. Most organizations do not have real influence to assist coordination on a global scale. The role of GWP and its tool box in this context is limited, as this could have been one of the leading mechanisms to report water actions that are being undertaken in developing countries. As a result, there is no single entity that stands out as a unique leader in coordinating knowledge of IWRM actions. As a result, there are many dispersed efforts.

Recommendations:

- Build and maintain databases of BSAs at the regional level. Many of the BSAs will not be national entities, and local community involvement will increasingly develop.
- Distinguish the scale of the efforts according to basins, sub-basins and aquifers. Those interested in smaller schemes will likely need as much, if not more, help than major basin actions, which are typically followed and funded by international donors and large bodies. Much of the need is at the local level. Therefore, developing local programmes will be a big challenge (they have a different set of requirements than the GEF for example).

3. Tools for IWRM should be well catalogued and documented

The documenting of IWRM tools should focus on existing and emerging capacities for BSAs, in particular for carrying out multidisciplinary processes in IWRM. There are emerging actions that show an increasing interest in the area of BSA organizations' water resources management actions (including, among others, the ESCWA training manual on IWRM; the UNDP CAP-NET programmes and regional actions; the EU WFD emerging actions; the USA Watershed Academy; the 'watershed' associations of Argentina, South Africa, Quebec and Ontario; and local community and sub-basin committees). However, many of the existing and emerging practices and tools are largely being applied in the developed world, and there has been no adaptation for use in their development settings.

The emergence of two new manuals – the joint publication planned by WMO and UNESCO, on *Water Resources Availability and Use*, and the WMO's *Improving the Valuation of Hydrologic Services* – seem directly pertinent to BSA, and the results of these works should be aligned.

However, the scientific and professional communities have not clearly identified the means to develop the tools needed for BSA organizations. No document has been produced to help identify what steps are needed to set one up beyond a charter. Recognizing that another guideline that cannot be used in operational form is of little use, it is recommended that a new approach be implemented as follows:

- A guide on fundamentals for BSA water management organizations and their operations should be developed. This would serve as a 'how-to' guide for new BSA organizations and could also be a valuable resource for those already established. It would include, for example:
 - a. what is needed and how to get up and running as a BSA organization,
 - b. methods to convene and develop a charter for a BSA organization,
 - c. where to look for financing and other in-kind resources to support the actions of the organization,
 - d. research and studies to carry out to demonstrate legitimacy,
 - e. how to collect appropriate legal and technical background information,
 - f. essential management and technical tools needed to carry out and understand water resources in the BSA,

- g. how to coordinate with local and national political systems,
- h. where, when and how to tell the BSA story,
- i. how to engage and work with other industry and government stakeholders.
- A guide on the key principles for the development and operational use of appropriate tools for IWRM should be developed. Key principles would include:
 - a. the need for an appropriate scale to represent management problems. Distinction should be made between comprehensive (identification and understanding of all variables and relationships) and integrated (consideration of key or selected variables) representations.
 - b. Linking social and economic development with integrating the protection of natural ecosystems, building on experience of a systems approach with special focus on feedback relationships between physical and socio-economic subsystems.
 - c. Involvement of all stakeholders. Provide for participation that will verify feedback relationships and assist in development of policy scenarios for analyses. Each policy scenario is a combination of physical (climatic, hydrologic, hydraulic) and socio-economic (operational, budgetary, development, managerial) system variables.
- A key guide for applying interdisciplinary aspects pertinent to BSA organization actions should be developed. It should link the concepts of maximizing social and environmental benefit to water resources development. This needs to be based on application in real-world settings, not theory, although applied research that is pertinent to special settings would be useful and should be included.
- Selective illustration of an operational tool for IWRM should be a key part of the guide. Emphasis should be on pointing out how to cost-effectively obtain and implement, in a practical manner, such a tool.

4. Institutional arrangements: guidelines for the development of institutions for IWRM implementation at BSA level should be developed

Institutional arrangements to facilitate IWRM approaches at BSA level are missing. This review distinguishes between institutions and organizations. ‘Institutions’ are defined as sets of rules, decision-making procedures and programmes that define social practices, assign roles to the participants in these practices, and guide interactions among the occupants of individual roles. ‘Organizations’ are construed as material entities with employees, offices, equipment, budgets and often a legal entity.

Recommendations:

- Provide examples of institutions for IWRM implementation. These examples should distinguish between so-called ‘thin’ and ‘thick’ perspectives. In the thin perspective, institutions are systems of rules, decision-making procedures, and programmes as articulated in formal and explicit statements, including policies, legislation, and regulations. In a thick perspective, all of the elements associated with the thin perspective are recognized, but in addition, attention is given to less tangible and implicit norms and standards, including the implicit ‘rules of the game’, informal understandings and conventions, and expectations consistent with values and culture. A key aspect is that, whereas these intangible norms and standards typically reflect codified rules and procedures, they normally evolve over time in ways not easy to trace back to their formal and tangible foundations. It is this aspect that highlights the difference between rules on paper and rules in use. The selected examples should illustrate how understanding of thin and thick dimensions can be used to create an innovative institutional approach to achieve IWRM.
- Investigate the value of connecting land-use planning and integrated water resources management at BSA level. It has been argued that aquatic and terrestrial systems are closely linked, and therefore should be considered together when framing land-use dynamics, or planning for water management. However, there is a further reason why integrated water management is likely to be more effective if linked to land-use planning or to official plans. Experience has shown that after considerable time and effort have been allocated to IWRM planning, there often is relatively little action. The principal reason is that frequently the IWRM plan has no obvious ‘home’ or legal basis, and therefore has low legitimacy. And, even if it does achieve credibility, there is a challenge in achieving implementation because many of the proposed actions have to be taken on by diverse organizations, whether government agencies, private companies or nongovernmental organizations. Each has to determine how recommendations from the IWRM plan, passed along to it, fit with other responsibilities and priorities. The result is that the IWRM recommendations often have low priority because they are perceived to be someone else’s problem or responsibility. Alternatively, if implemented, they are scheduled to fit into the activities and priorities of each agency, rather than with regard to how they should be sequenced as part of an overall, integrated initiative. This results in low effectiveness and low efficiency. Thus, too often the output of IWRM plans becomes an orphan, and suffers the neglect that can accompany such a situation. In this context, it is increasingly being appreciated that IWRM on the BSA level should be conceived, developed and implemented with explicit connections to other, related initiatives which have

credibility thanks to statutory or other policy or administrative bases. This is not unique to IWRM. The implication is that connecting to statutory-based land-use planning has the potential to improve the effectiveness of IWRM. Where IWRM has been connected to the statutory base of land-use planning and official plans at the local level, progress can be significant.

5. Efforts should be made to achieve a broader recognition that the 'integrated' approach is feasible and beneficial

IWRM is still not well understood by many BSA organizations that are beginning their operation. Several of these are still struggling to obtain either recognition for their existence or legitimacy for their continued development. Nevertheless, examples of the extent to which the approach is working, and how it can be applied, need to be much more broadly explained and publicized. There is as yet no universal recognition that IWRM is not just another top-down approach that is part of international guidance to make more water available more fairly and equitably. It must be shown that IWRM is directly pertinent to, and applicable at, the various levels of different BSA organizations, using methods that are more human and less rigid. To this end, there is an absence of anything other than a scientific approach in much of the process. Donor-sponsored consultants are still developing many of the national IWRM plans currently being created, as countries still lack adequate capacity to develop the plans themselves. Therefore, there is an existing need to better disseminate the available information, in a manner applicable to those situations that have been shown to benefit from an integrated approach to management.

Recommendations:

- Develop an 'IWRM Works' campaign or similar type of awareness-raising programme, that is pertinent to, and should be considered by, those who are indeed committed to carry forth the message and make it work. Such a programme should be related to hot topics and needs at the stakeholder level and be able to be discussed openly by all involved.
- Prepare guidelines for operational implementation of IWRM. There should be special focus on tools for operational implementation and their use.
- Prepare a series of examples to illustrate the implementation of IWRM at BSA level that can be distributed as key and straightforward cases: identifying the steps that were followed and relating how the examples show that it works and which benefits were obtained for the stakeholders. Use one selected example, with a detailed presentation of the process, data collection and analyses required for its implementation. Provide access to the BSA organization actually involved and to representatives who are very familiar with the example used to illustrate the process.
- Establish partnerships to take this message forward prominently and in plain view, so that there can be a united front among like-minded groups. In this way, key organizations can be seen as leading this process, hand-in-hand with effective collaboration that includes national bodies, international governmental organizations, non-governmental organizations and industry components, all of which are committed to IWRM.

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Additional resources

(Posted on the IWRM.org FTP site for the BSA Project)

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Annex 1

IHP-VI Focal Area 2.4 (2001): Methodologies for integrated river basin management

Objectives

- To develop new tools (concepts, modelling approach, decision support systems) that include demand management and resource conservation at a basin scale; and
- To locate water scarcity/water excess and to understand ecological effects of modified flow pattern with different scenarios under climate change or modification by human activities.

Suggested Activities

- Guidelines for hydrologically relevant variables to evaluate the water demand;
- Guidelines for actions in environmental emergency situations;
- Development of specific river basin orientated assessment methodology for a range of physio-geographic and water-use situations and water pollution control and management;
- Use data generated in HELP catchments to study the technical and non-technical aspects of increasing the efficiency with which water is used in both rainfed and irrigated agriculture;
- Identification and quantification of sources of pollution like mines, mine wastes and others;
- Development of specific river-orientated models with an integrative approach considering water resources and water demands;
- Guidelines for new and alternative water supply and water engineering infrastructures based on the recycling of resources;
- Development of decision support systems (DSS) and management information systems (MIS) at the river basin scale, especially in transboundary river basins, including an international conference;
- Impact of urbanization on natural river system and waste water management;
- Improvement of rainfall-runoff analysis through a database of isotopic composition in large rivers;
- 'New generations' of hydroinformatic tools for holistic (integrated) modelling and operational management of water based systems (catchments, hydrographic systems, groundwater aquifers, lakes, coastal waters, two and multiphase systems); and
- Development of links between available (river) reach-based high resolution models for physical patterns and biotic response prediction and river basin management strategies and decision-aiding tools.

Annex 2

Participants of the Expert Group Meetings (11–13 July 2005 and 25–26 June 2007)

Experts

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World Water Assessment Programme side publications, March 2009

During the consultation process for the third edition of the World Water Development Report, a general consensus emerged as to the need to make the forthcoming report more concise, while highlighting major future challenges associated with water availability in terms of quantity and quality.

This series of side publications has been developed to ensure that all issues and debates that might not benefit from sufficient coverage within the report would find space for publication.

The 17 side publications released on the occasion of the World Water Forum in Istanbul in March, 2009, in conjunction with *World Water Development Report 3: Water in a Changing World*, represent the first of what will become an ongoing series of scientific papers, insight reports and dialogue papers that will continue to provide more in-depth or focused information on water-related topics and issues.

Insights

IWRM Implementation in Basins, Sub-Basins and Aquifers: State of the Art Review

by *Keith Kennedy, Slobodan Simonovic, Alberto Tejada-Guibert, Miguel de França Doria and José Luis Martin for UNESCO-IHP*

Institutional Capacity Development in Transboundary Water Management

by *Ruth Vollmer, Reza Ardakanian, Matt Hare, Jan Leentvaar, Charlotte van der Schaaf and Lars Wirkus for UNW-DPC*

Global Trends in Water-Related Disasters: An Insight for Policymakers

by *Yoganath Adikari and Junichi Yoshitani at the Public Works Research Institute, Tsukuba, Japan, for the International Center for Water Hazard and Risk Management (ICHARM), under the auspices of UNESCO.*

Inland Waterborne Transport: Connecting Countries

by *Sobhanlal Bonnerjee, Anne Cann, Harald Koethe, David Lammie, Geerincq Lieven, Jasna Muskatirovic, Benjamin Ndala, Gernot Pauli and Ian White for PIANC/ICIWaRM*

Building a 2nd Generation of New World Water Scenarios

by *Joseph Alcamo and Gilberto Gallopin*

Seeing Traditional Technologies in a New Light: Using Traditional Approaches for Water Management in Drylands

by *Harriet Bigas, Zafar Adeel and Brigitte Schuster (eds), for the United Nations University International Network on Water, Environment and Health (UNU-INWEH)*

Dialogue Series

Water Adaptation in National Adaptation Programmes for Action Freshwater in Climate Adaptation Planning and Climate Adaptation in Freshwater Planning

by *Gunilla Björklund, Håkan Tropp, Joakim Harlin, Alastair Morrison and Andrew Hudson for UNDP*

Integrated Water Resources Management in Action

by *Jan Hassing, Niels Ipsen, Torkil-Jønch Clausen, Henrik Larsen and Palle Lindgaard-Jørgensen for DHI Water Policy and the UNEP-DHI Centre for Water and Environment*

Confronting the Challenges of Climate Variability and Change through an Integrated Strategy for the Sustainable Management of the La Plata River Basin

by *Enrique Bello, Jorge Rucks and Cletus Springer for the Department of Sustainable Development, Organization of American States*

Water and Climate Change: Citizen Mobilization, a Source of Solutions

by *Marie-Joëlle Fluet, International Secretariat for Water; Luc Vescovi, Ouranos, and Amadou Idrissa Bokoye, Environment Canada*

Updating the International Water Events Database

by *Lucia De Stefano, Lynette de Silva, Paris Edwards and Aaron T. Wolf, Program for Water Conflict Management and Transformation, Oregon State University, for UNESCO PCCP*

Water Security and Ecosystems: The Critical Connection

by *Thomas Chiramba and Tim Kasten for UNEP*

Scientific Papers

Climate Changes, Water Security and Possible Remedies for the Middle East

by *Jon Martin Trondalen for UNESCO PCCP*

A Multi-Model Experiment to Assess and Cope with Climate Change Impacts on the Châteauguay Watershed in Southern Quebec

by *Luc Vescovi, Ouranos; Ralf Ludwig, Department of Geography, University of Munich; Jean-François Cyr, Richard Turcotte and Louis-Guillaume Fortin, Centre d'Expertise Hydrique du Québec; Diane Chaumont, Ouranos; Marco Braun and Wolfram Mauser, Department of Geography, University of Munich*

Water and Climate Change in Quebec

by *Luc Vescovi, Ouranos; Pierre Baril, Ministry of Transport, Québec; Claude Desjarlais; André Musy; and René Roy, Hydro-Québec. All authors are members of the Ouranos Consortium*

Investing in Information, Knowledge and Monitoring

by *Jim Winpenny for the WWAP Secretariat*

Water Footprint Analysis (Hydrologic and Economic) of the Guadania River Basin

by *Maite Martínez Aldaya, Twente Water Centre, University of Twente and Manuel Ramon Llamas, Department of Geodynamics, Complutense University of Madrid, Spain*



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