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A Conceptual Model for Implementing Integrated Transboundary Water Resources Management (ITWRM)

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Abstract Implementation of Integrated Water Resources Management (IWRM) in different river basins is challenging mainly because of various kinds of borders, not only between countries, in which case there are Transboundary Waters (TW) to share, but also at a national level, where borders exist between different stakeholder groups, regional administrations, institutions, and scientific disciplines and professionals. An example of the latter is the "border" between scientists and decision makers. Weakening this barrier is the main target of the worldwide UNESCO/HELP programme. In this paper, a conceptual model is formulated in order to facilitate implementation of IWRM in Transboundary Waters (ITWRM). The model is based on interactive consultation with all stakeholders and partners involved in the ITWRM process at the river basin level. The multidisciplinary conceptual model consists of seven steps, the first and main one being (1) Stakeholder Consultation. The remaining six steps, which constantly interact with the first, are: (2) Transboundary Diagnostic Analysis (TDA), (3) Data Collection and Sharing, (4) Common Strategic Action Plan (CSAP), (5) Hydrological and Environmental Assessment, (6) Scenario Analysis, including Climate Change, and (7) Applications.

Key words Transboundary waters; integrated management; conceptual model

Introduction

Different kinds of borders and barriers separate not only countries but, at a national level, science and applications, different groups of professionals, researchers and politicians, different institutions and various regional administrators. A leading example of a barrier in water resources management is the locked paradigm between scientists and decision makers, which creates major difficulties for implementing the concept of Integrated Water Resources Management (IWRM). In order to address this issue, UNESCO initiated, in the frame of its International Hydrological Programme (IHP), the HELP global programme, aiming to reduce the gaps between Hydrology, Environment, Life and Policy (HELP).

When surface waters, like rivers and lakes, or groundwater aquifers cross the borders of different countries, the political barriers between them become the main challenge in applying the IWRM framework. In this case, the term "Transboundary Waters" is used synonymously with "Internationally Shared Waters", and in accordance with the terminology used by UNESCO in its international hydrological initiatives, such as the UNESCO/ISARM (Internationally Shared Aquifer Resources Management) and the UNESCO/PC-CP (Potential Conflict-Cooperation Potential) programmes. It is considered a better choice than other similar expressions such as "international waters", "multinational waters" or "regional waters", and avoids misunderstandings due to political sensitivities over national sovereignty in regions located near borders.

According to previous experience gained by the UNESCO Chair/INWEB (International Network of Water/Environment Centres for the Balkans), there are many important obstacles hindering the effective implementation of the IWRM framework in internationally shared waters management, such as:

- Differences in the use of technical standards and specifications for data collection and information sharing

- Lack of harmonisation in methodological approaches involving conceptual and analytical modelling of hydrological, environmental and socio-economic processes
- Differences in socio-economic and cultural levels between riparian countries
- Lack of trust and mutual interests, conflicting objectives and different priorities between countries, in relation to their history, sovereignty and possible territorial claims, and
- Lack of political will

In the literature (UN WWDR, 2006; 2009; Wolf, *et al*., 1999; GWP, 2000), in previous publications (Ganoulis, *et al.*, 1996; 2000; 2006; 2008), and in a recently published book (Ganoulis, *et al*., 2011), different models of collaborative activities for TWRM have been suggested. The approach used in these models differs, depending on which particular scientific discipline or professional community has developed the model.

For engineers, hydrologists, hydrogeologists or environmental professionals, emphasis is placed on modelling the physical and ecological transboundary hydro-systems in terms of:

a. delineating their natural borders (hydrologic basins for transboundary rivers and lakes, or hydrogeological boundaries for groundwater aquifers),
b. analysing relationships between physical and ecological variables such as precipitation, river flow, pollutant inputs, water quality, biodiversity or groundwater recharge, and
c. suggesting structural or non-structural measures in order to obtain solutions and improve TWRM.

These models, conceptual or mathematical, are more or less accurate subject to data availability and precision, and the various assumptions and simplifications made. They are useful for understanding how the physical and ecological transboundary systems behave under natural and anthropogenic inputs in terms of water quantity and environmental impacts.

For lawyers and social scientists (geographers, economists, sociologists) emphasis is placed on human factors, which can be very complex and difficult to analyse or predict, such as institutional cooperation, stakeholder participation, and negotiation strategies. For lawyers the emphasis is on regulating provisions and duties of riparian countries in terms of access, utilisation, protection, preservation, and management of transboundary waters. The codification of such legal rules is very useful to the international community, even though this process may be somewhat general and unable to cover all specific cases. The main challenge is whether different national administrations will agree to implement international rules at the national level, and at the same time coordinate their activities with riparian countries through bilateral or regional collaborative agreements. This challenge may be faced by raising public and stakeholders' awareness in participatory processes involving national institutions, academic partners, and international organisations.

In the real world, all the above issues and approaches coexist and are inter-related. In order to achieve effective TWRM, these models, whether descriptive or prescriptive, should merge. There are two main strategies for achieving such integration: (a) through effective capacity building and training in TWRM, and (b) by analysing a general framework of conflict resolution, based on how riparian countries may share benefits and risks. Both these strategies are supported by UNESCO's ISARM and PC-CP programmes, and are detailed in Ganoulis, *et al*., 2011.

Transboundary HELP River Basins

The UNESCO/HELP programme established a global network of experimental basins with the aim of exchanging experience on how to apply the IWRM framework by linking hydrology and policy issues.

A certain number of HELP river basins are transboundary, shared (1) between different riparian countries, or (2) between countries having adopted the same legal system, or (3) between states belonging to a unified federal system. Some characteristic examples of transboundary HELP river basins are the following:

- The San Pedro basin, shared between Mexico and USA (two sovereign countries)
- The Mesta/Nestos basin, shared between Bulgaria and Greece (two countries belonging to the European Union and implementing common directives), and
- The Murray-Darling basin in Australia, shared between four federal states and the Australian Capital Territory.

Bi- and multi-lateral agreements on transboundary river, lake, and aquifer water resources management are important tools for enhancing effective cooperation, involving political commitment, and implementing joint water management plans. Depending on the legal status of the riparian countries, developing multilateral regional agreements has different degrees of difficulty. For example, in centralised independent countries, negotiations and legal issues for developing agreements can be performed more easily. In countries belonging to a unified legal system for water management, like the European Union (EU), the situation is facilitated by the application of common water directives (e.g., the EU Water Framework Directive, EU-WFD). In federal states like the USA, Australia, and Canada, developing such agreements may be more difficult as legal responsibility for water is given by constitution to the individual states.

In order to deal with the complexity of real world problems, where no distinction is made between different dependent physical and socio-economic processes, there is a need for the various approaches described above to be integrated. This process of integration could be facilitated in two main ways. First, through education and capacity building, where special training programmes can show how multidisciplinary approaches can be coordinated in order to achieve an integrated view of a problem and effectively solve it in the real world. Second, by taking into account a general framework for risk analysis in conflict resolution, where risks and benefits could be shared between riparian countries and "win-win" solutions to transboundary disputes can be achieved (Ganoulis, 2009). Both these processes are based on specific programmes developed by UNESCO (Ganoulis, *et al.*, 2011).

A collaborative model for TWRM based on the various contributions to Ganoulis, *et al.*, 2011, is illustrated in Fig. 1. This uses the following seven steps and may be adapted to any particular case study of transboundary waters:

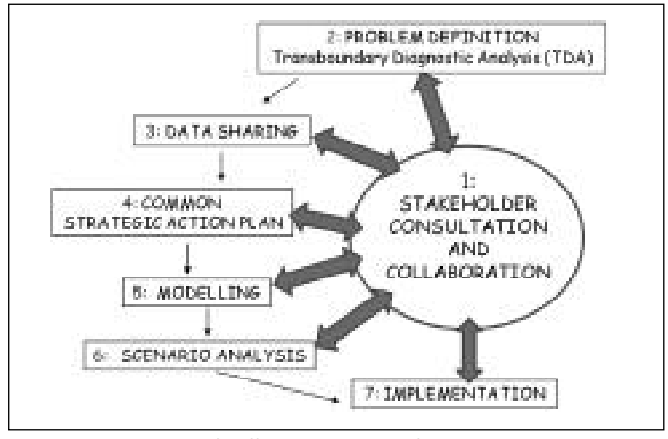

Fig. 1 A conceptual model for effective management of transboundary water resources.

1 *Stakeholder Consultation* and Collaboration, Social Issues, Legal and Institutional Agreements: this step should interact with all the other steps below
2 *Problem Definition*: Transboundary Diagnostic Analysis (TDA)
3 Agree on Data Collection, Common Monitoring and *Data Sharing*
4 Develop a Common Vision and *Common Strategic Action Plan* (CSAP)
5 Physical and Environmental Assessment and *Modelling*
6 *Scenario Analysis* and Decision Support Systems (DSS)
7 Transfer of Models and DSS to Stakeholders, *Applications*

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