

Towards a Regional Strategy for the Management of the Transboundary Aquifer Systems in the Americas

A. Rivera¹, A. Dausman², N. DaFranca³, J. Kettelhut⁴, W. M Alley², R. Chavez-Guillén⁵, M. Espinoza⁶ and O. Tujchneider⁷,

- (1) Geological Survey of Canada, Canada
- (2) U.S. Geological Survey, U.S.A.
- (3) Regional Coordinator ISARM Americas, Brazil
- (4) Water Resources and Urban Environment Secretariat, Brazil
- (5) Comisión Nacional del Agua, México
- (6) Dirección Nacional de Fronteras y Límites del Estado, Chile
- (7) Facultad de Ingeniería y Ciencias Hídricas Universidad Nacional del Litoral, Argentina

ABSTRACT

The Internationally Shared Aquifer Resource Management (ISARM)-Americas initiative has been successful in promoting cooperation in the sharing of data and information on transboundary aquifer systems (TAS) amid 24 countries from Argentina to Canada. Over a period of seven years (2003-2009), the ISARM-Americas initiative, jointly sponsored and coordinated by United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Organization of American States (OAS), succeeded in inventorying 73 TAS in the American hemisphere. The initiative has produced two books; one containing the inventory of the 73 TAS in 2007, and a second one describing the legal and institutional aspects of the 73 TAS, in 2008. A third book is in preparation with a synthesis of the socio-economic, environmental and climatic aspects of the 73 TAS. The ISARM-Americas group is now preparing a regional strategy for the management of the transboundary aquifer systems in the American hemisphere. The regional strategy will be published as a fourth book in 2010 with a synthesis of the socio-economic, environmental and climatic aspects of the 73 TAS. This paper summarizes the current activities towards the preparation of the third book.

Key words: American collaboration, common goals, strategy, Transboundary aquifers, groundwater

1. INTRODUCTION AND OBJECTIVES

The ISARM-Americas initiative has been very successful in promoting cooperation in the sharing of data and information on TAS amid 24 countries from Argentina to Canada. Over a period of seven years (2003-2009), the ISARM-Americas initiative, jointly sponsored and coordinated by UNESCO and OAS, succeeded in inventorying 73 TAS in the American hemisphere (Figure 1). The initiative has produced two books; one containing the inventory of the 73 TAS in 2007 (UNESCO, 2007), and a second one describing the legal and institutional aspects of the 73 TAS in 2008 (UNESCO, 2008). The ISARM-Americas group is now preparing a regional strategy for the management of the TAS in the American hemisphere to be published in the book series in 2010. The Strategy of the American Transboundary Aquifer Systems (SATAS) will consider the provisions contained in the annexed draft articles of the UN resolution. SATAS will take full advantage of the data and information contained in the books published, as well as the successful network of national coordinators from the member National Government Organizations (NGOs) created by the UNESCO-OAS-ISARM–Americas initiative.

The SATAS will consider the various steps that need to be taken to achieve a shared and sustainable management of the transboundary aquifers of the Americas in cooperation with local NGOs. These will include a synopsis of the current management practices of the TAS; the basic scientific and technical knowledge needed for the adequate assessment and management of TAS; as well as the approaches to strategy implementation with practical operational actions. The SATAS promotes collaboration, good neighbourliness, and the adoption of common goals for a sustainable management of aquifers crossing two or more jurisdictions in the American hemisphere. The strategy is designed with strong scientifically-based content aimed at guiding the stakeholders toward informed joint-management decisions, joint resource evaluation, and to help meet the expectations of users of transboundary groundwater resources in terms of water security which is conjunctive use that sustains a reliable supply for all parties without impairing the quantity or quality of the water available to neighbours that overly the TAS.

The main principle adopted by SATAS is the full assessment, maintenance and protection of the groundwater resource to balance economic, environmental and human (social) requirements of the countries sharing the aquifer. The **vision** and the **mission** of ISARM Americas have been adopted by the National Coordinators of the 24 participating countries: VISION: *Improved sustainable management and protection of transboundary groundwater in the Americas*; and the MISSION: *To increase knowledge generation and exchange on transboundary groundwater and strengthen information sharing, communication and cooperation among countries in the Americas* (ISARM, 2009).

In support of the strategy’s vision, ISARM-Americas will pursue five long-term objectives over 10 years. These objectives reflect the results of the working group meetings and the national coordinators workshops. These include the critical importance of knowledge and cooperation as the foundation of long-term groundwater sustainability of shared aquifers crossing two or more jurisdictions in the American hemisphere:

1. Transboundary groundwater resources (supply and use) are understood;
2. Transboundary groundwater management including groundwater availability and sustainability, aquifer vulnerability, and information sharing are ensured;
3. The science and technology knowledge base, information exchange, collaboration/cooperation and communication among Member States sharing transboundary aquifers help foster innovation and development of sustainable groundwater strategies with partners;
4. Common standard rules and protocols related to data, information, parameters and procedures on groundwater management, are developed and their adoption promoted amongst the Member States; and
5. The development and establishment of ad-hoc frameworks related to groundwater management; drawing on international instruments where appropriate are encouraged.

Acuíferos Transfronterizos de las Américas

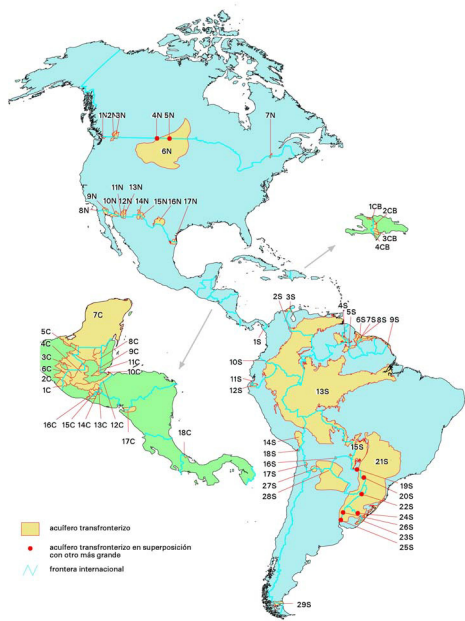


Figure 1: Transboundary Aquifer Systems (TAS) in the Americas (UNESCO, 2007).

2. CURRENT LEVELS OF KNOWLEDGE

A detailed analysis of the 73 TAS of the Americas revealed disparate levels of aquifer knowledge of the 24 countries investigated. The 73 aquifers were classified in four subjective categories with knowledge levels ranging from insufficient (25%), to basic (50%), good (75%) and sufficient (100%) (Figure 2). Results from Figure 2 show:

- Only one TAS contains sufficient data and information to be considered as having adequate knowledge for applying good management practices. The Guaraní transboundary aquifer system, shared by Brazil, Argentina, Uruguay and Paraguay, represents a good example of active participation and strong collaboration amongst the four countries as a result of a large funded project by the Global

Environment Facility (GEF) (Foster et al, 2006).

- The majority of the TAS investigated fall under the “basic” category, with 49 aquifers, of which various levels of data can be found in the countries sharing those aquifers. Five were found to fall within the “good” category. However, there are currently several ongoing international studies.
- Eighteen TAS have insufficient information, as there has been no a regional effort or study to develop a hydrologic budget, thus more collaboration and cooperation between the countries sharing the aquifers are needed.

- The overall results of this investigation are: the need for each country to continue the study of their respective TAS, and to continue developing collaboration with neighbouring countries in order to increase the knowledge, as well as the conjunctive use and management of their shared TAS.

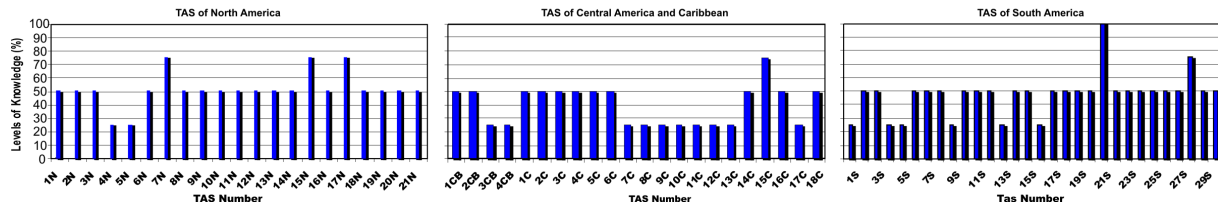


Figure 2: Levels of existing knowledge of the TAS in the Americas.

3. SYNOPSIS OF THE MANAGEMENT OF THE TAS-AMERICAS

The SATAS includes a summary of various aspects involved in the management of the TAS in the region. It presents a synopsis of the institutional, socioeconomic, cultural, and environmental and climatic aspects, as reported in book 2 of UNESCO ISARM-Americas (UNESCO, 2008).

An analysis of the legal and institutional frameworks to the TAS of the Americas was performed, including national legislations and international agreements on groundwater. The rules regarding ownership and jurisdiction on groundwater, groundwater institutional systems, rules regarding groundwater use and protection regulations, and transboundary aquifers were evaluated. Furthermore, regional agreements and treaties (if existing) were included. The results of this investigation show disparate levels of tools for the development and management of transboundary aquifers throughout the American hemisphere.

The review of socioeconomic and cultural issues highlights the potential benefits of shared development and management of transboundary aquifer systems to industrial, urban, and agricultural development, economic growth, poverty reduction, food security, better health conditions, improved environmental protection, and improved livelihoods in most of the 24 countries from the American hemisphere who participated in this survey.

Environmental and climatic aspects were also investigated. The potential effects of climate change on TAS in the Americas included: changing groundwater recharge patterns; increased demand for reliable domestic supply; localised depletion of the groundwater resource; and increased demand for groundwater for agriculture; as well as secondary effects such as impacts on groundwater quality. Furthermore, stresses on the benefits of environmental and climate aspects include: sustainable water abstraction; pollution control; better aquifer management; improved land management; and environmental protection.

The coordination workshops and the integration of data and information for the TAS-Americas occurred over seven years (2003-2009). During those years, a growing interest and capacity of the countries sharing aquifers to work and collaborate together under the UNESCO/OAS ISARM program was observed. As a result of this program, an increasing number of countries are adopting scientific advances in hydrogeology in an effort to develop frameworks for regulations in order to facilitate the development, use, and management of groundwater resources. In turn, this is reflected in the countries' will to face issues related to transboundary aquifers in a coherent and integrated manner.

Many of the challenges surrounding transboundary aquifer management are related to the lack of information. In most instances, data which are vital to good management are fragmented or not available. The lack of information affects the way in which politicians and the public perceive this valuable underground resource; it prevents and limits full comprehension of the importance of groundwater for food security and poverty alleviation in many countries. This is translated into fragmented policies and the absence of strategies for integrated management of groundwater as part of the entire hydrologic budget of transboundary watersheds.

4. BASIC SCIENTIFIC AND TECHNICAL KNOWLEDGE NEEDED FOR THE ADEQUATE ASSESSMENT AND MANAGEMENT OF TAS

This section includes two essential aspects reflecting the assessment and management of TAS in the Americas: one with a description of basic scientific and technical knowledge necessary for the assessment; and a second one with the management aspects. The collective goals for groundwater sustainability in the TAS-Americas are to provide principles and guidelines for the sustainable groundwater management of the TAS.

The main desired principle is to achieve sustainable groundwater development with the full assessment, maintenance and protection of the groundwater resource while balancing economic, environmental and human (social) requirements of the countries sharing the aquifer. This principle could ensure the accomplishments of the five following components:

1. The protection of groundwater quality from contamination;
2. The protection of groundwater supplies from depletion;
3. The protection of ecosystems health;
4. The application of good governance practices through close collaboration and monitoring; and
5. Conflicts resolution.

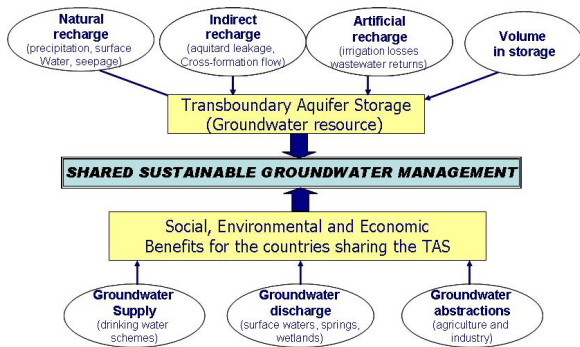
The ISARM-Americas strategy group is attempting to define the basic needs for scientific data to estimate groundwater availability through: the establishment of monitoring networks and databases; conceptual modelling of flow systems; general geology; groundwater levels; hydrography; and estimation of groundwater pumping and their spatial distribution. The benefits of using remote sensing technologies are also being described and recommended in the regional strategy for the TAS of the Americas. Furthermore, monitoring networks and databases for water quality, as well as potential conceptual modelling for quality are described. The application of consistent methods for assessment of aquifer vulnerability estimates, and the qualitative identification of sources of contamination will also be included in the strategy.

Transboundary aquifer assessment includes groundwater availability, aquifer vulnerability, and data needs analysis. As these components are interrelated, they represent a combination of interconnected networks of observations, modelling, and analysis. These components provide a basis for resource appraisal, development, management, and protection in the context of conjunctive use relative to a transboundary setting where multiple objectives and governance can be systematically evaluated in a holistic context. They provide feedback and information on the quantity and quality of groundwater resources, and the use and movement of water in the transboundary aquifer systems relative to the entire hydrologic cycle of the transboundary watershed. The estimation of the hydrologic budget and related analysis of sustainable yield are an integral part of the assessment process (Alley and Leake, 2004). In addition, the assessment of transboundary aquifers requires the assessment of the groundwater and surface-water components as one resource throughout the transboundary watershed.

To achieve the main principle described above, an overall framework was designed following the philosophy described by Hiscock et al (2002) and modified to fit SATAS, shown in Figure 3. In this framework the sustainable groundwater development at global and local levels is not the balancing of available aquifer storage to satisfy a single aim such as meeting water users' demands, but the development, maintenance, and protection of the groundwater resource to balance economic, environmental and human (social) requirements of the countries sharing the aquifer. This framework can be further utilized as a conceptual model to guide the development of a numerical hydrologic flow model of the transboundary aquifer that in turn, can provide a basis for a more systematic analysis of resource management.

Development of an aquifer management plan for each transboundary aquifer depends on specific technical, legal, social, economic and environmental issues, as well as respecting the sovereignty of the countries sharing the aquifer and related international agreements between these countries.

Figure 3: Diagram of elements of conceptual model of sustainable yield within a transboundary aquifer (ISARM, 2009; modified from Hiscock et al., 2002).



The management of aquifers requires activities to evaluate the various aspects that the responsible institutions must consider to support, assist and orient the corresponding management authorities in their decision-making process. Therefore, before a development strategy or management plan can be established, it is necessary to analyze the groundwater use, governmental institutions, socioeconomic and environmental status of the countries, as well as the available data.

5. APPROACHES TO STRATEGY IMPLEMENTATION

Strategy implementation should first take into account results of other successful groundwater management practices around the world, such as the Chalk aquifer in England (Robins et al, 1999). Management of the Chalk aquifer began in the early 1950’s to protect the aquifer from urbanization and saline intrusion. Modeling in combination with monitoring and management has aided in sustaining the aquifer over the years.

The success of implementing the strategy outlined in this document depends on actions by and within the countries in which the transboundary aquifer crosses. It is necessary for the countries that contain the transboundary aquifer to cooperate and share information. For example, data compiled (water use, water quality, or water levels) or scientific studies must be made available for the success of aquifer development, management, and sustainability. It is unlikely that successful development and management of an aquifer can be accomplished without countries willing to cooperate and share available information.

Collection and processing of hydrogeological data, studies and implementation of works for management and protection of aquifers can result in large and sustained costs. Many developing countries have little capacity for public investment; therefore, it is important to establish consensus and compromise between two or more countries on the financing of transboundary aquifer studies and management. A path that has proved feasible to minimize these constraints is through the participation of multilateral development agencies and international donors such as the GEF or the Internationally Shared Aquifer Resources Management - ISARM and OAS. Combined with the technical and financial resources of local NGOs, these sources can help initiate long-term transboundary relations.

Simultaneously, cooperation, collaboration, communication, and social participation within a country are also necessary. Partnerships at different administration levels, such as national or federal, regional, and local levels need to be developed. The design for management may be at a federal level, but it often has to be implemented at a regional or local level for success. Reliable information communicated to the public related to the management (such as conservation measures) must occur if the public is going to participate in the effort at a local level. The success of implementing a strategy strongly depends on capacity building or human resource development. Educating the public on the importance of aquifer management for the future is pertinent for the overall success of transboundary aquifer and management. If people are able to develop a positive attitude towards change, they will likely work together to protect the aquifer.

6. DISCUSSION AND NEXT STEPS

Led and coordinated by UNESCO and OAS, the ISARM-Americas group has gone a long way in creating a network of partnerships with an inventory of 73 TAS in the American hemisphere; in sharing data and information with neighbors; and in cooperating in the preparation and publication of the various

synthesis of knowledge of those TAS. However many challenges remain in the future implementation of the regional strategy for the management of those TAS, as described in this paper.

The challenges are those of combining the scientific and technical recommendations in the SATAS with the numerous legal and institutional instruments of the 24 countries as well as the UN's convention on TAS. The scope of SATAS was designed to establish linkages between science and policies and the existing instruments for the management of TAS. SATAS aims to explain and develop the role of science and the informed-decision approach for the collective understanding, developing, managing, and protecting of the TAS in the Americas. Thus its main message is "a strong scientifically-based strategy could be the backbone for good informed decisions."

The next steps are to complete the full strategy report and define the actions and approaches towards the implementation of the strategy. As such, SATAS will include relevant discussions on the importance of information sharing, communication; cooperation; collaboration; social participation; program (or study) development and related financing; as well as human resources development (capacity building). In defining these, the strategy will take advantage of the results of other successful groundwater management practices in the world (transboundary or not).

Countries participating in the ISARM-Americas initiatives recognize that a single global convention will be difficult to relate to the wide variations in transboundary groundwater conditions and problems encountered by people in countries of the American hemisphere. The key to groundwater management in TAS would lie in the local realities of hydrogeology and the socio-cultural patterns of water uses of the countries sharing the aquifers. However, with the actions taken by ISARM-Americas the group has taken a great leap forward to facilitate systematic development and management of TAS in the Americas.

Finally, it should be noted that international institutions such as UNESCO and OAS, play a very important role, one without which 24 countries could not have come together to agree to share and cooperate on transboundary aquifers. The SATAS country members hope that UNESCO and OAS will continue playing the leadership role they've played in the preparation, completion and implementation of the regional strategy for the management of TAS-Americas.

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