

Sustainable Groundwater Management Concepts & Tools

Briefing Note Series Note 0

Series Overview

2009

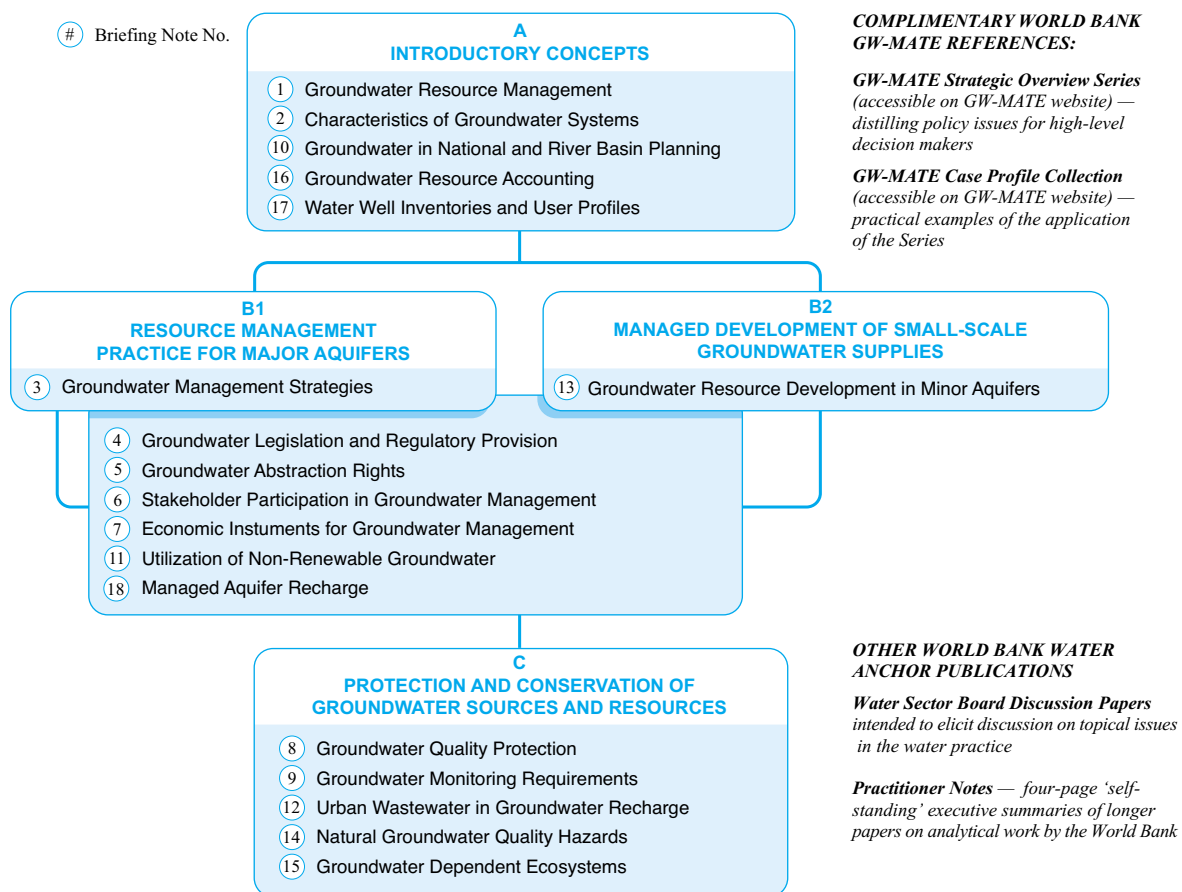
Authors: Stephen Foster, Héctor Garduño, Albert Tuinhof & Catherine Tovey

What is the objective and structure of this Briefing Note Series?

- Groundwater is vital to many nations. Worldwide some 2000 million people, innumerable farmers and many industrial premises depend on it for their water supply. Accelerated development over the past few decades has resulted in great social and economic benefits, by providing low-cost, drought-reliable and (mainly) high-quality water supplies for both the urban and rural population and for irrigation of both staple and high value crops — and further use will be vital for achievement of the ‘UN Millennium Development Goals’. But investment in management and protection of the resource base has been seriously neglected. Whilst groundwater storage is vast (more than 99% of freshwater reserves) its replenishment is finite and mainly limited to relatively shallow aquifers, the quality of which can also be seriously degraded by pollution.
- **The sustainability of groundwater** is closely linked with a range of micro- and macro-policy issues influencing water and land use, and represents one of the major challenges in natural resource management. Practical advances are urgently needed, but there is no simple blueprint for action due to the inherent variability of groundwater systems and related socioeconomic situations. It is, however always feasible to make incremental improvements, and many developing nations need to appreciate their socio-economic dependence on groundwater, and invest in strengthening institutional provisions and building institutional capacity for its improved management before it is too late.
- The GW•MATE Briefing Note Series is being produced progressively, with new titles being added and existing ones revised in the light of project experiences by the World Bank—Groundwater Management Advisory Team. The Series is intended to give a concise introduction to the theory and practice of groundwater resource management and protection (a neglected subject) in a convenient and accessible format. Thus each note aims to answer the ‘most frequently asked questions’ on the topic concerned, especially in the developing country context, and is written in a style that should be intelligible across all professional disciplines working in the water sector. But at the same time, no universal solution can be offered because (as is clearly illustrated in GW•MATE Case Profile Collection) the hydrogeologic setup and socioeconomic situation in each aquifer is unique and calls for a somewhat different management approach. The primary target audience of the Briefing Note Series audience comprises:
 - staff of development banks working on groundwater-related investments
 - water resource and environmental executives or managers with limited experience of groundwater
 - groundwater specialists who have had limited exposure to water resource management.

- The Series considers widely differing levels of aquifer potential and groundwater development (from major aquifers with vast storage reserves providing large-scale water supplies to minor aquifers only capable of yielding small water supplies), and also distinguishes largely consumptive use of groundwater (mainly for agricultural irrigation) from essentially non-consumptive uses (such as urban and most industrial water supply). To achieve this the Series is divided into four separate areas (Figure 1) — and the present Overview provides a guide to its content, to approaches to groundwater resource management practice, and indicates the preferred role for government in the groundwater management process. A GW•MATE Strategic Overview Series is being produced in parallel as a contribution to the broader policy dialogue on groundwater resources.

Figure 1: Overall scope and structure of the Briefing Note Series—Sustainable Groundwater Management



How is the Briefing Note Series contributing to wider capacity building?

- It is noteworthy that during the first 10 years of GW•MATE operation the Briefing Note Series (Figure 1) has become progressively used for the preparation and implementation of groundwater-related projects supported by the World Bank. Most are also available in Spanish and there is demand for Arabic, Chinese, French and Portuguese translations.
 - In addition to the numerous workshops that GW•MATE has held, the Briefing Note Series and selected Case Profiles have been made available to UNDP-CAPNET Africa Groundwater Network, in order to promote the incorporation of groundwater into IWRM in Africa, where groundwater is essential for rural drinking water and livelihoods, urban water-supply at a variety of scales and important groundwater-dependent ecosystems. UNDP-CAPNET and GW•MATE interactively prepared and evaluated these 'Training-the-Trainer Workshops', progressively developing:
 - special modules for topics such as groundwater management and climate change and information and communication for stakeholder participation
 - case studies from the participants, which play a focal role and can contribute to the general regional overview by relating each case to the four socio-economic uses of water outlined in GW•MATE Case Profile 15 'Sub-Saharan Africa – Groundwater Development: a Strategic Overview of Key Issues and Major Needs
 - field trips with stakeholder meetings within workshops
- This approach is probably the broadest and deepest use of GW•MATE materials in training and could be replicated where regional organizations and local governments are interested in taking the lead.

Why are new approaches needed for groundwater resource management practice?

- Sustainable groundwater utilization requires action to be taken at three different administrative levels:
 - macro-economic policy interventions—because groundwater demand is strongly influenced by national subsidies (on water well drilling, electrical energy, diesel fuel, food crops etc.) and they affect the size of existing groundwater-based agriculture and the rate of transition to less water-dependent livelihoods
 - local-level management measures—to create effective organizational arrangements (empowered government agency within the existing legal and institutional framework, user awareness and participation, groundwater abstraction charging, land-use constraints etc.) to regulate, protect and monitor groundwater resources
 - major state/provincial or national adjustments to the legal and institutional framework - but after identifying how to implement preferred management and protection measures, defining the most feasible local organizational arrangements and only then attempting to introduce legal reforms where they can be realistically implemented.

The Briefing Note Series addresses all three levels, but puts greatest emphasis on the second one in the belief that (especially in water-scarce and/or densely-populated regions) sooner or later effective local management arrangements will have to be put in place.

- The approach taken to groundwater management at any moment in time will depend, to a considerable degree, upon information about, and interaction between, the following factors:
 - the size and complexity of groundwater resource
 - the degree of climatic aridity and rate of aquifer recharge and resource renewal
 - water well inventory, scale of groundwater abstraction, and number and profile of groundwater users
 - groundwater resource accounting, with detailed understanding and breakdown of the components of the 'groundwater balance', which is the basis for making management decisions
 - the ecological role of environmental services dependent upon groundwater
 - the susceptibility and vulnerability of the aquifer system to degradation
 - natural groundwater quality concerns (trace element hazards and saline water presence).
- Some key questions that often arise in relation to groundwater management and protection are discussed below :
 - whether management interventions are always necessary—although some low-storage aquifers are self-regulating (since, during extended periods of drought, well yields fall without damaging side effects or extensive third-party interference), abstraction control is usually needed to protect drinking water supplies and environmental flows (and this can be achieved most directly through well-spacing rules or drilling bans)
 - can management actions be taken without adequate aquifer characterization—here a 'parallel-track approach' is strongly advocated, making incremental improvements in management provisions while continuing to advance investigation and monitoring of the aquifer system
 - can resource deficits be met by supply-side measures alone—in reality both managed aquifer recharge and focused demand-management will also always be essential in the longer run (since isolated aquifer recharge measures alone are likely otherwise to stimulate increased groundwater abstraction)
 - should conjunctive use of groundwater and surface water be practiced—where feasible planned conjunctive use will be advantageous, but for agricultural irrigation it is still often an incidental, sub-optimized process because of obstacles posed by existing land tenure and surface water rights.

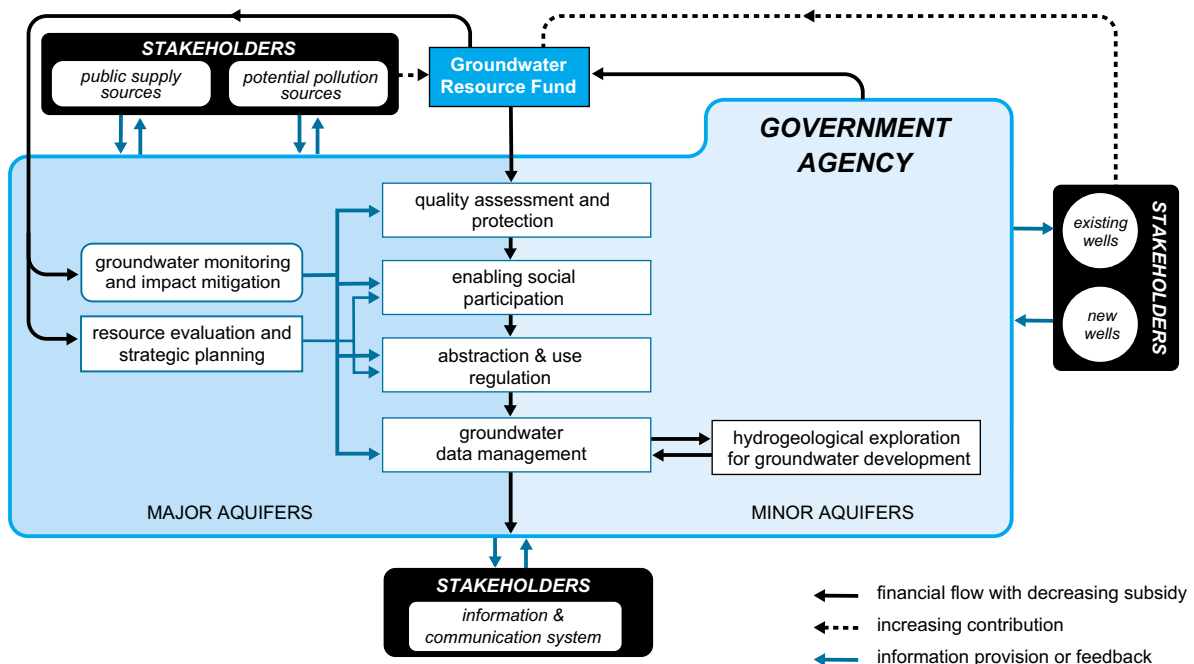
What is the essential role for government in the management process?

- Government has to play the central role of 'guardian' for natural resources like groundwater. Given the absolute necessity of mobilizing stakeholder participation, this role should normally be assumed by the local office of the competent national ministry, an appropriate department of state/provincial government or a river basin agency with executive powers.
- The key functions which need to be performed are summarized in Figure 2—most effort should focus on the large groundwater resources of major aquifer systems, with a simpler level of abstraction administration and quality protection for minor aquifers (for which it may be appropriate to retain some capacity for exploration of poorly understood areas because of their socioeconomic significance in the provision of basic water supplies). The role of government in enabling and nurturing stakeholder participation is important in both major and minor aquifers. At an early stage also, it will be important

for the groundwater resource agency to analyze potential impediments to the management process (inadequate groundwater management boundaries, weak regulatory enforcement, lack of social consensus, poor inter-institutional coordination) and define ways of confronting them. In many settings this will require a significant change in the functionality of the national and/or provincial institutions responsible for groundwater resources.

- An effective Information & Communication System is required to enable stakeholder participation and is the key to transparency (and hence accountability) on groundwater issues, and is thus a critical pillar of any resource governance framework. It should provide not only fundamental technical information on resource status, trends and vulnerabilities, but also a guide to the complex network of public agencies, groundwater users and other stakeholders involved. Appropriate media need to be used to ensure that this information explicitly reaches all concerned and that feedback from stakeholders is facilitated.
- There are strong arguments for the introduction of an effective charging policy for many (but not all) categories of groundwater use, with the funds generated specifically earmarked for direct re-investment in aquifer monitoring and resource administration. This concept is called a ‘groundwater resource fund’ in Figure 2. A ‘stakeholder committee’ could be appointed to agree upon priorities for fund deployment, and government should make clear the benefits to the user.

Figure 2. Schematic functions for a government agency acting as groundwater guardian



- Within its ‘strategic planning’ function (Figure 2) some key issues to be addressed by government, after full consultation with stakeholders, include:
 - defining priority services required from a specific aquifer system (low-cost potable water supplies, improving agricultural irrigation, sustaining ecosystems and environmental features)
 - achieving effective allocation of groundwater between user sectors
 - defining acceptable levels of aquifer and groundwater supply protection
 - reconciling agricultural production goals with groundwater availability and quality protection.

- Because groundwater is a ‘highly decentralized resource’, and one often developed by private initiative, its management and protection will not be effective without proactive social participation. But government will have to make the ‘first move’ by taking the following steps:
 - profiling groundwater users, and thereby understanding the socioeconomic importance of groundwater and assessing the risk of ‘non-action’ both with respect to resource regulation and pollution control
 - prioritizing potential entry points to the management process on a probable cost/potential outcome basis, taking into consideration the need to reconcile ‘bottom-up’ with ‘top-down’ actions
 - selecting ‘pilot areas’ to try out participatory groundwater resource management and quality protection—the boundaries of such pilot areas (and subsequent aquifer management areas) should normally be defined on the basis of groundwater flow systems with specific management needs.

- In summary the practices for groundwater management and protection advocated conform closely with the World Bank Water Resources Sector Strategy 2003 since they represent a ‘pragmatic but principled approach that respects the concepts of efficiency, equity and sustainability but recognizes that management can be intensely political and that reform requires prioritized, sequenced, practical and patient interventions’.

Publication Arrangements

The GW•MATE Briefing Notes Series is published by the World Bank, Washington D.C., USA. It is also available in electronic form on the World Bank water resources website (www.worldbank.org/gwmate) and the Global Water Partnership website (www.gwpforum.org).

The findings, interpretations, and conclusions expressed in this document are entirely those of the authors and should not be attributed in any manner to the World Bank, to its affiliated organizations, or to members of its Board of Executive Directors, or the countries they represent.

Funding Support



GW•MATE (Groundwater Management Advisory Team) is financed by the World Bank's Water Partnership Program (WPP) multi-donor trust fund provided by the British, Danish & Dutch governments and by supplementary support from the UK Department for International Development (DfID).

