

# Sustainable Groundwater Management Concepts & Tools

Briefing Note Series Note 0

## Series Overview

2002-2005

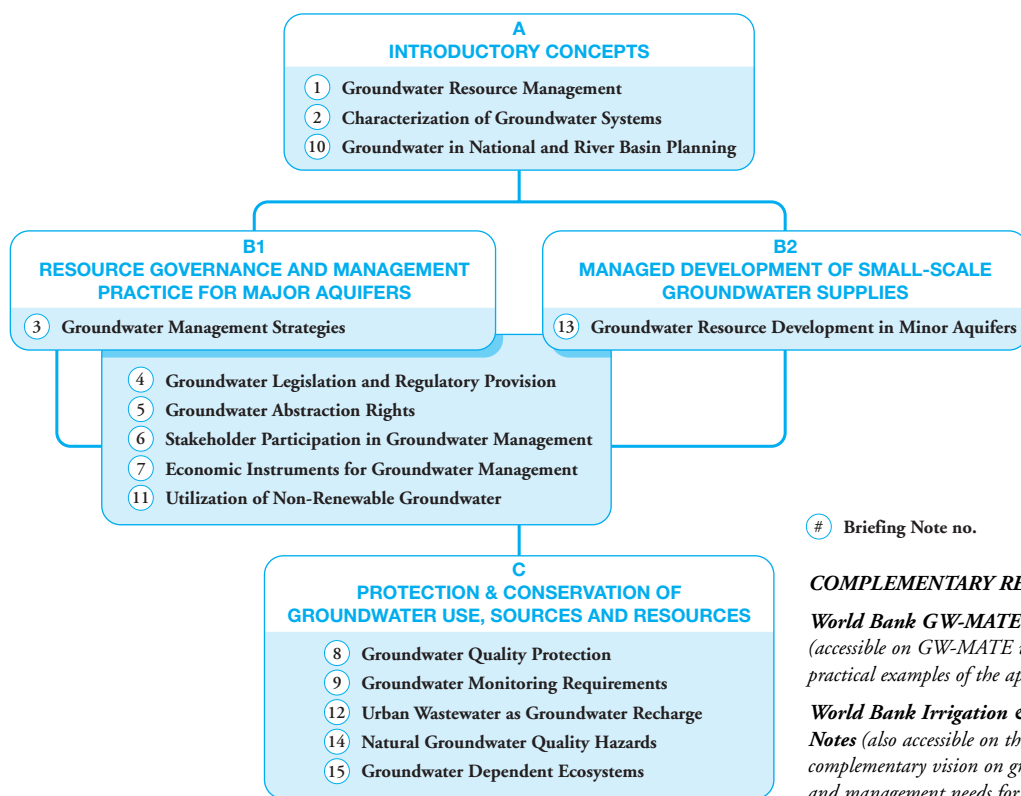
### Editors

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### 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 (potentially high-value) crops. Further use will be vital for achievement of '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 shallower 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; there is no simple blueprint for action, due to the inherent variability of groundwater systems and related socioeconomic situations, but it is always feasible to make incremental improvements. Many developing nations need to appreciate their socio-economic dependency 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 by the World Bank—Groundwater Management Advisory Team, which also acts as a Global Water Partnership Associate Program. 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. The primary target 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). The present overview also provides an initial discussion on approaches to groundwater resource governance and management practice, and indicates the preferred role for government in the groundwater management process.

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



### Why are new approaches needed for groundwater resource governance and management practice?

- Sustainable groundwater utilization will require actions to be taken at two 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) 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 institutional arrangements (empowered government agency, adequate legal framework, user awareness/participation, groundwater abstraction charging, land-use constraints) to regulate, protect and monitor groundwater resources.

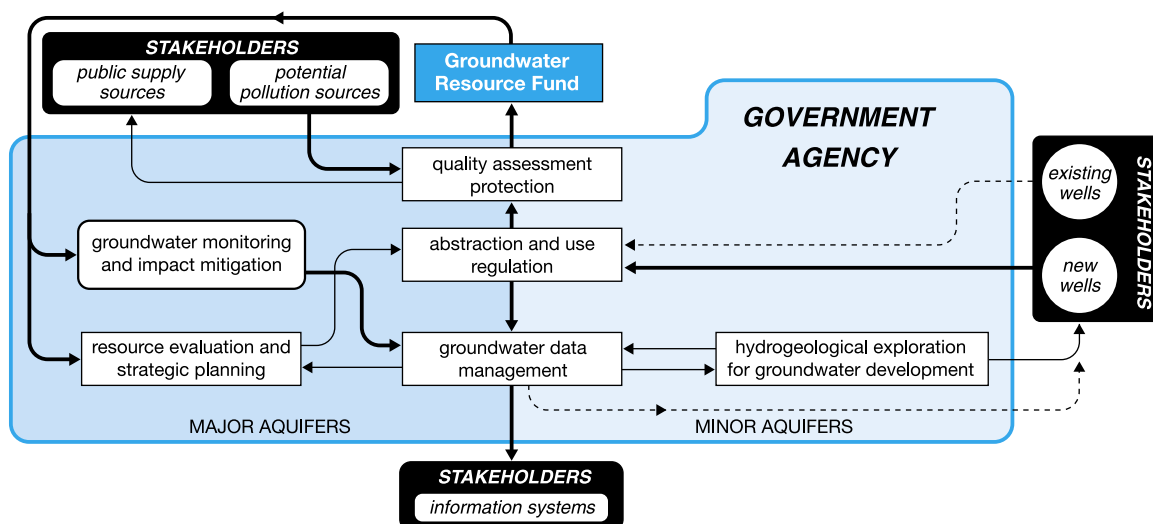
The Briefing Note Series addresses both of these levels, but puts greater emphasis on the latter in the belief that (especially in water-scarce and/or densely-populated regions) sooner or later effective local management arrangements will have to be put in place.
- The approach taken to groundwater management 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 the groundwater resource
  - the degree of climatic aridity and the rate of aquifer recharge and resource renewal
  - the scale of groundwater abstraction and the number and types of groundwater users
  - the ecological role and 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 and issues that often arise in relation to groundwater management and protection are:
  - whether management interventions are always necessary*—although some low-storage aquifers are self-regulating (in 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—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 focused demand-management will also always be essential in the longer run, since aquifer recharge enhancement is 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 regional 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). 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

**Figure 2 Idealized structure and functions for a government agency acting as groundwater guardian**



boundaries, weak regulatory enforcement, lack of social consensus, poor inter-institutional coordination) and define ways of confronting them. In many settings this will require significant changes in the functionality of the national and/or provincial institutions responsible for groundwater resources.

- 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, and a 'stakeholder committee' could be appointed to agree priorities for its deployment.
- Within its 'strategic planning' function (Figure 2) some key issues to be addressed by government, after full consultation with stakeholders, include:
  - defining the priority services required from a specific aquifer system (low-cost potable water supplies), improving agricultural irrigation, sustaining ecosystems and environmental features, etc.)
  - 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 in respect of 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](http://www.worldbank.org/gwmate)) and the Global Water Partnership website ([www.gwpforum.org](http://www.gwpforum.org)).

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