

GROUNDWATER MANAGEMENT & PROTECTION

progress through World Bank operations and beyond during 2000-10

COMPILED BY : Stephen Foster, Catherine Tovey & Gill Tyson



THE WORLD BANK



Global Water
Partnership



WATER
PARTNERSHIP
PROGRAM

GW·MATE

Groundwater
Management
Advisory Team

10th ANNIVERSARY
EXECUTIVE OVERVIEW

ESTABLISHMENT & EVOLUTION

Initial Rationale & Strategy

- The initiative to establish the World Bank-Groundwater Management Advisory Team (**GW•MATE**) was taken in September 2000 – following dialogue at the 2nd World Water Forum (The Hague : March 2000) on the pressing need for a shift of emphasis from ‘uncontrolled waterwell drilling’ to planned groundwater development, management and protection embracing IWRM principles. It comprised an **international multi-disciplinary group of extensively-experienced specialists**, formed into a ‘virtual rapid-response team’ – working on a demand-driven basis and in a catalytic style.

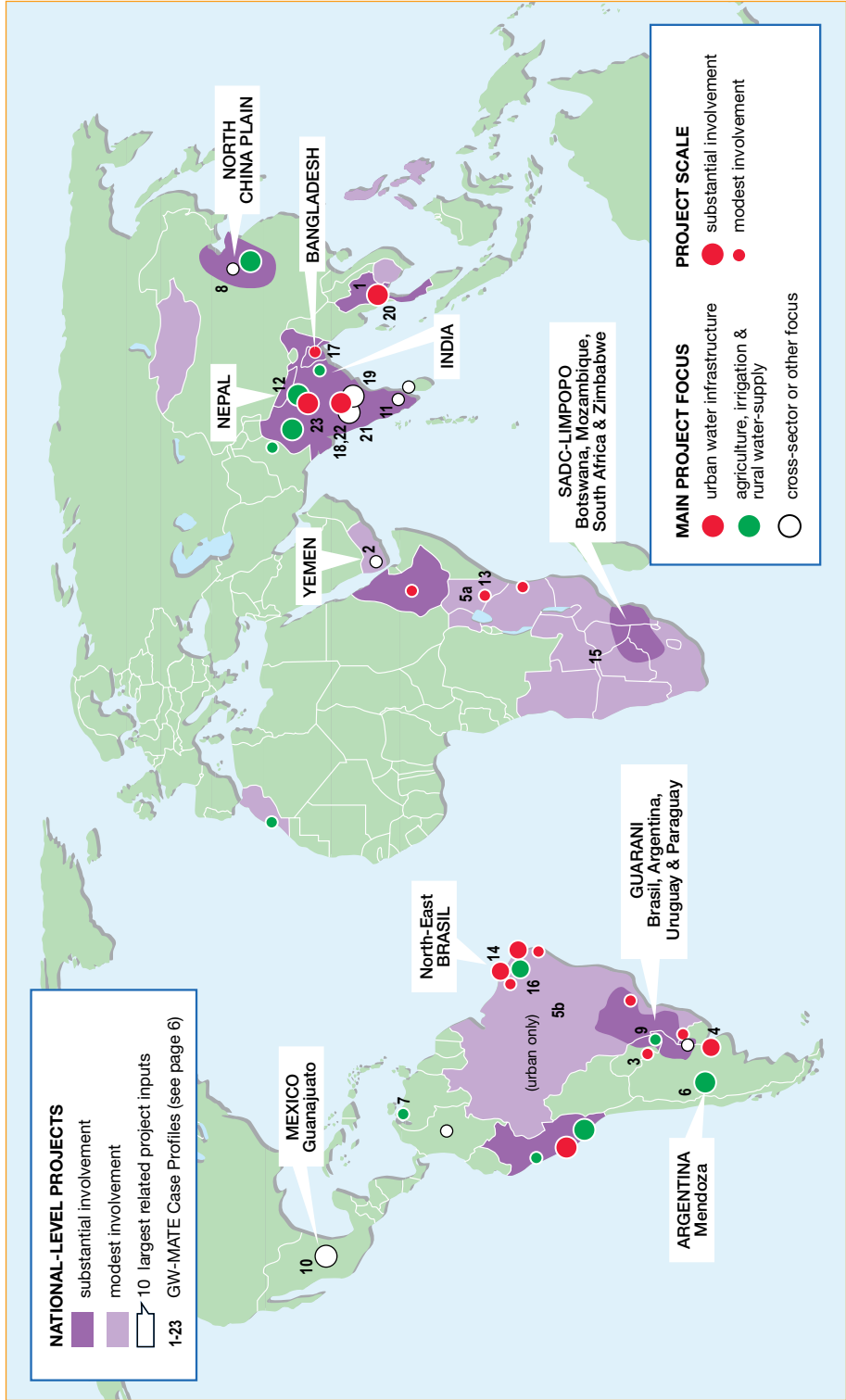
- In the last decades of the 20th Century advances in waterwell technology and hydrogeological knowledge had facilitated a **massive expansion in groundwater use across the developing world** – especially in Asia. Groundwater was of major importance for domestic supply to the growing urban and rural population, for irrigation of both staple and cash crops, and for industrial production. The provision of low-cost, drought-reliable and (mainly) high-quality water supplies was producing enormous social benefits, with many countries developing large groundwater-dependent economies. Further expansion would be instrumental for progress towards the ‘UN Millennium Development Goals’.

- But investment in governance of the resource base was seriously neglected. Groundwater stocks in many aquifers are vast but their replenishment is finite. Indiscriminate resource exploitation was widely leading to serious water-table decline (locally causing aquifer salinization and land subsidence), and was accompanied by pollution of shallow groundwater (due mainly to uncontrolled urbanization and sometimes to natural contaminant mobilization) – all of which were beginning to impact human livelihoods and health. Improving the management and protection of groundwater (**a classic ‘common-pool’ resource**) represented a ‘major environmental challenge’ - since being widely-distributed it is affected by a plethora of local users and polluters, whose behavior in turn is influenced by national policy affecting land and water use. Thus mobilization on improved governance needed to be across sectors and at a wide range of scales.

- The **GW•MATE** strategy was to use the entry point of World Bank projects, together with Global Water Partnership (GWP) regional networks, to ensure groundwater governance received attention in the developing world. More specifically the objectives were :
 - to provide **leadership on groundwater management and protection**, including definition of key government functions
 - to facilitate the **implementation of resource management measures at pilot level**, including mobilization of stakeholders
 - to identify best practices (taking account of hydrogeologic and socioeconomic diversity) and disseminate them so as to build capacity.



GW-MATE Activities in World Bank Projects



Program Development & Major Activities

- Over the following 10 years **GW•MATE** developed very strongly – given the demand for operational support from the World Bank regional divisions, and their national clients, to facilitate and focus investments in groundwater management and protection. This has not only been for water resource projects, but also in urban water-supply and irrigation infrastructure operations – something that would not otherwise have been possible. And with **climate-change issues looming larger** each year of the past decade, there has been a steadily-increasing demand for **GW•MATE** inputs with realization of the **critical role of groundwater storage for adaptation strategies**.
- **Pilot groundwater management projects** of different types have been (and remain) a central component of many projects, with emphasis being put by **GW•MATE** on their implementation. Making progress with groundwater management and protection is, of essence, a long-term activity – and a very positive feature of the **GW•MATE** initiative (further facilitated by the pilot project approach) has been that it has allowed **long-term continuity of support to World Bank clients** well beyond the ‘normal project cycle’ of 3-5 years.
- **GW•MATE** has seized opportunities for productive collaboration with other sub-sectors:
 - Urban & Rural Water Services**
 - pollution protection for public groundwater supply sources
 - significance of private in-situ self-supply from groundwater in urban areas
 - wastewater reuse as a risk and a benefit to groundwater resources
 - strategies for rural water-supply development from minor aquifers
 - management of naturally-occurring groundwater quality problems
 - Agricultural Irrigation & Drainage**
 - realistic groundwater resource accounting in areas of irrigated agriculture
 - promoting ‘real groundwater resource savings’ through irrigation water management
 - improved conjunctive use of groundwater resources in irrigation canal-commands.



- The intensive practical exposure gained through these activities, coupled with the extensive past experience of team members, has provided the basis for :
 - **knowledge product elaboration** – with preparation of three series of website papers ('Sustainable Groundwater Management': Strategic Overview Series, Briefing Note Series & Case Profile Collection), together with elaboration of (or major contributions to) other published books and guides both inside and outside the World Bank
 - **best-practice dissemination** – through delivery of short courses, presenting lectures to professional meetings, participation in collaborative workshops, via the GWP Toolbox and the UNDP-CAPNET Training-the-Trainers Program.

GW•MATE knowledge products have proved highly popular outside the World Bank – and have been adopted by numerous universities as course texts and been translated in part into Spanish, French, Portuguese, Chinese and Arabic.
- Over the 10 year period to September 2010, **GW•MATE** had a total expenditure of US\$ 5.2 million – derived from Dutch (60%), British (30%) and Danish (5%) trust funding, and 5% from other sources. Of this 59% has been expended on supporting World Bank operations, 15% on production of knowledge products, 16% on capacity building and 10% on general coordination. Of that part of the overall total expenditure that can be geographically-attributed, 26% has been deployed in South Asia, 18% in Latin America & Caribbean, 14% in Sub-Saharan Africa and 12% in other regions. However, since inception of the World Bank–Water Partnership Program (WPP) from the above donors in 2009, a special effort has been put into promoting a dialogue and projects on Sub-Saharan Africa issues - with the proportion of recent expenditure in this region reaching 30%.
- From its origins as a World Bank 'project support window', **GW•MATE** has evolved a **global reputation for its professional authority on addressing inter-disciplinary issues of groundwater resource governance, practical management, protection strategy, policy development and resource planning** – this whilst maintaining a high-level of operational support to the World Bank and its clients around the world.



KNOWLEDGE PRODUCTS & OUTREACH

GW•MATE Strategic Overview Series - Sustainable Groundwater Management: Contributions to Policy Promotion*

The GW•MATE Strategic Overview Series comprises a series of in-depth papers synthesizing the wide GW•MATE experience of key aspects of groundwater policy formulation – drawing conclusions relevant at the regional or global level. Detailed case studies which have been drawn upon to reach these conclusions are incorporated as ‘text boxes’. This Series will be of especial interest to all those concerned with incorporating consideration of groundwater into overall water resource governance provisions, urban water infrastructure planning, irrigated agricultural development and water-supply provision in general.

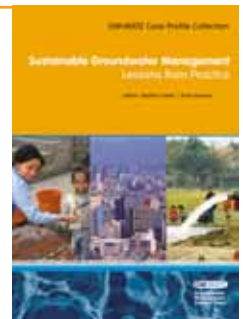
1. GROUNDWATER GOVERNANCE – conceptual framework for assessment of provisions and needs
2. CONJUNCTIVE USE OF GROUNDWATER AND SURFACE WATER – from spontaneous coping strategy to adaptive resource management
3. URBAN GROUNDWATER USE POLICY – balancing the benefits and risks in developing nations
4. SUSTAINABLE GROUNDWATER IRRIGATION – approaches to reconciling demand with resources.
5. APPROPRIATE GROUNDWATER MANAGEMENT FOR SUB-SAHARAN AFRICA – in face of demographic pressure, climate variability and hydrogeologic uncertainty



GW•MATE Case Profile Collection Sustainable Groundwater Management: Lessons from Practice*

The GW•MATE Case Profile Collection is intended to make available the knowledge acquired and lessons learned from experience around the world. The profiles are not intended to be comprehensive descriptions, but rather focus on key management issues that are in the process of being addressed. The collection is complementary to the Briefing Note Series and should be of interest to senior water-sector executives, resource management practitioners and environmental academics looking for concise accounts of international experience related to various facets of groundwater management and protection. The titles available include :

1. THAILAND – Strengthening capacity in groundwater resources management
2. YEMEN – Rationalizing groundwater resource utilization in the Sana’a basin
6. ARGENTINA – Integrated approaches to groundwater resource conservation in the Mendoza aquifers
8. CHINA – Towards sustainable groundwater resource use for irrigated agriculture on the North China Plain
9. BRAZIL, PARAGUAY, URUGUAY & ARGENTINA – The Guarani aquifer initiative for transboundary groundwater management
10. MEXICO – The ‘COTAS’: progress with stakeholder participation in groundwater management in Guanajuato
12. NEPAL – Approach to mitigation of groundwater arsenic contamination including new groundwater legislation
13. KENYA – The role of groundwater in the water supply of Greater Nairobi
16. BRAZIL – Promoting management of an inter-state aquifer under development for irrigated agriculture: the case of the Chapada do Apodi in Northeast Brazil
18. INDIA – Confronting the groundwater management challenge in the Deccan Traps country of Maharashtra
19. INDIA – Addressing groundwater depletion in the drought-prone weathered granitic basement aquifer of Andhra Pradesh
20. THAILAND – Controlling groundwater abstraction and related environmental degradation in Metropolitan Bangkok



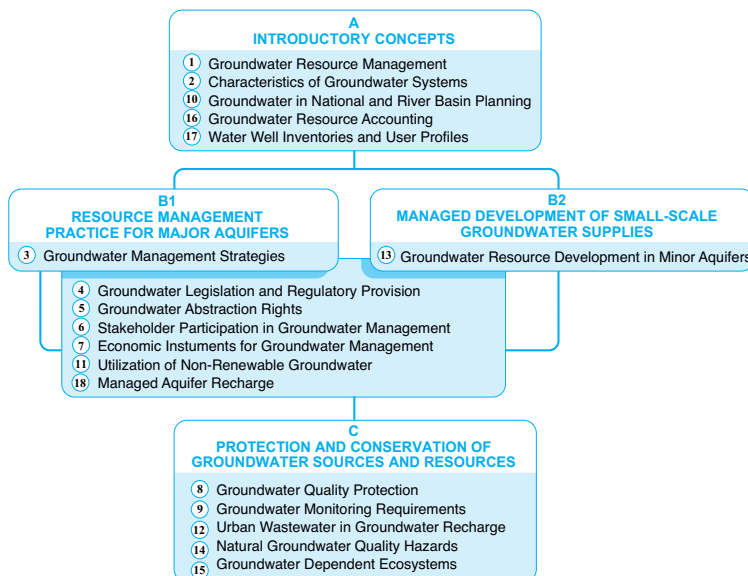
* documents SO-4, SO-5 and CP-17 to be completed and available by December 2010

GW•MATE Briefing Note Series - Sustainable Groundwater Management: Concepts & Tools

The GW•MATE Briefing Note Series provides a concise introduction to the theory and practice of groundwater resource management and protection, and divides into four separate thematic sub areas (see chart below). It is written in a style that should be intelligible across all professional disciplines working in the water sector – and aims to answer the ‘most frequently-asked questions’ on the topic concerned, especially in a developing country context. The Series should also be of general interest to senior executives in water and environmental management.



- 0. SERIES OVERVIEW
- 1. GROUNDWATER RESOURCE MANAGEMENT: an introduction to its scope and practice
- 2. CHARACTERIZATION OF GROUNDWATER SYSTEMS: key concepts and frequent misconceptions
- 3. GROUNDWATER MANAGEMENT STRATEGIES: facets of the integrated approach
- 4. GROUNDWATER LEGISLATION & REGULATORY PROVISION: from customary rules to integrated catchment planning
- 5. GROUNDWATER ABSTRACTION RIGHTS: from theory to practice
- 6. STAKEHOLDER PARTICIPATION IN GROUNDWATER MANAGEMENT: enabling and nurturing engagement
- 7. ECONOMIC INSTRUMENTS FOR GROUNDWATER MANAGEMENT: using incentives to improve sustainability
- 8. GROUNDWATER QUALITY PROTECTION: defining strategy and setting priorities
- 9. GROUNDWATER MONITORING REQUIREMENTS: for managing aquifer response and quality threats
- 10. GROUNDWATER DIMENSIONS OF NATIONAL WATER RESOURCE AND RIVER BASIN PLANNING: promoting an integrated strategy
- 11. UTILIZATION OF NON-RENEWABLE GROUNDWATER: a socially-sustainable approach to resource management
- 12. URBAN WASTEWATER AS GROUNDWATER RECHARGE: evaluating and managing risks and benefits
- 13. GROUNDWATER RESOURCE DEVELOPMENT IN MINOR AQUIFERS: management strategy for village and small town water supply
- 14. NATURAL GROUNDWATER QUALITY HAZARDS: avoiding problems and formulating mitigation strategies
- 15. GROUNDWATER DEPENDENT ECOSYSTEMS: characterization procedures and conservation measures
- 16. GROUNDWATER RESOURCE ACCOUNTING : critical for effective management in a changing world



GW•MATE Major Book Contributions*

- **GROUNDWATER QUALITY PROTECTION** – a guide for utilities, municipal authorities and environment agencies. World Bank Publication (in collaboration with WHO-PAHO) 2002/2007.
- **IAH HYDROGEOLOGY JOURNAL SPECIAL ISSUE 'Groundwater – from Development to Management'** (Volume 12-1) (in collaboration with WB/Editor Karin Kemper) 2004.
- **ARSENIC CONTAMINATION OF GROUNDWATER** : towards a more effective operational response. World Bank Publication (in collaboration with WSP) 2005.
- **NON-RENEWABLE GROUNDWATER RESOURCES** – a guidebook on socially-sustainable use for water policy-makers. UNESCO-IHP VI Publication (in collaboration with WB-GW.MATE) 2006.
- **DEEP WELLS AND PRUDENCE: towards pragmatic action for addressing groundwater overexploitation in India.** World Bank Publication 2010.



* World Bank Technical Papers 390 (1998) & 463 (2000) provided "pre-program baseline reviews" for the inception of **GW•MATE**

GW•MATE Selected Professional Meetings



DATE	ORGANISATION	EVENT	LOCATION
Mar 2003	WWC	3rd World Water Forum Session	Osaka - Japan
Sep 2003	WB-WBI	Professional Training Course	Washington DC - USA
Nov 2003	IWA	Intl Wastewater Conference Keynote	Mexico DF - Mexico
Feb 2004	WB	Water Week Session	Washington DC - USA
Apr 2004	WB-SAR	GW Arsenic Mitigation Seminar	Katmandu - Nepal
Jun 2004	GWP	CP Meeting/Presentation	Kuala Lumpur- Malaysia
Apr 2005	WMO & UNESCO	Groundwater Governance Workshop	Cairo - Egypt
Jul 2005	WB-LAC & OAS	Professional Training Course	Sao Paulo - Brasil
May 2006	IAH	IWRM Regional Conference Keynote	Marrakech - Morocco
Oct 2006	IAH	50th Anniversary Congress Keynote	Beijing - China
Jan 2007	UNU & BMZ	Special Invited Lecture	Bonn - Germany
Feb 2007	WB	Water Week Session	Washington DC - USA
Sep 2007	WB-SAR	GW Management for South Asia Course	Bangkok - Thailand
Nov 2007	WB & GSDA-MH	Training Workshop	Pune - India
Jun 2008	IAHS & IAH	Africa GW & Climate Conf Keynote	Kampala - Uganda
Oct 2008	WHO/UNEP/BMC	IY Sanitation Symposium Keynote	Hannover - Germany
Nov 2008	ABAS	15th Congress Keynote	Natal - Brasil
Feb 2009	IAH	Regional Conference Keynotes	Bangkok - Thailand
Feb 2009	WB	Water Week Session	Washington DC - USA
Jul 2009	IAH	Regional Conference Keynote	Bogota - Colombia
Jul 2009	UNDP-CAPNET	Training-the-Trainers Course	Accra - Ghana
Sep 2009	IAHS & IAH	Joint International Convention Keynote	Hyderabad - India
Nov 2009	UNDP-CAPNET	Training-the-Trainers Course	Dar-es-Salaam - Tanzania
Jan 2010	WB	Sustainable Development Forum	Washington DC - USA
Mar 2010	IAH	Regional Conference IWRD Keynote	Agadir - Morocco
Jun 2010	US-WEF & IAH	Intl GW & Ag Conference Keynote	San Francisco - USA
Sep 2010	SIWI	20th WW Week Keynote & Seminar	Stockholm – Sweden

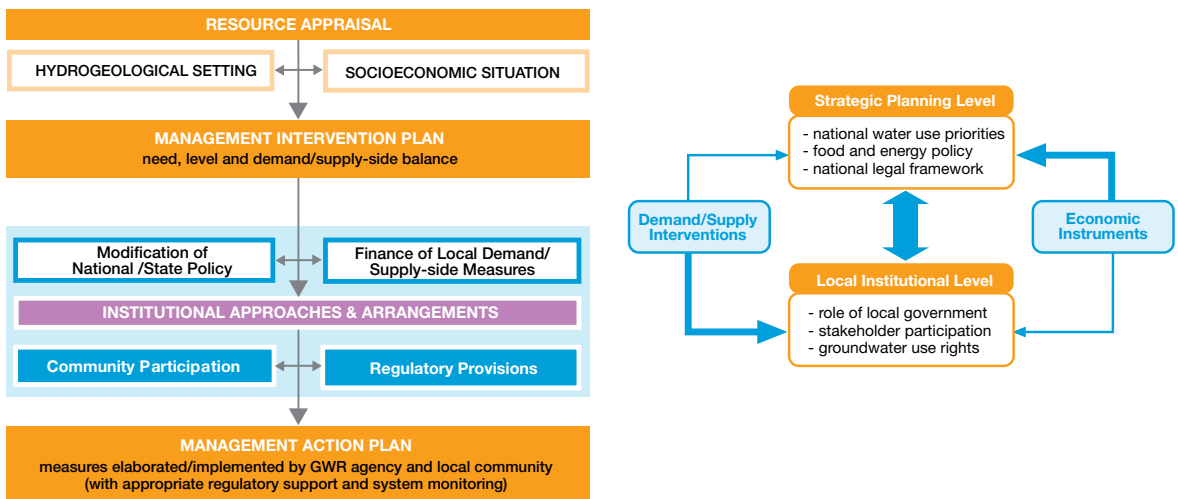
APPROACH & CONTRIBUTION

Pragmatic Framework for Management Action

- The extensive experience of **GW•MATE** in trying to promote improved sustainability of groundwater resource use demonstrates there is **no simple blueprint for action** due to the intrinsic variability of :
 - the hydrogeological setting of the resource
 - the socioeconomic context of its utilization.

- Moreover, this experience suggests that ‘high-level reform’ may not be the best (or a necessary) entry-point for action. Thus a **‘pragmatic framework’ for the definition of ‘groundwater management plans’** has been devised, using local hydrogeological realities and resource use dynamics to identify an appropriate mix of the following :
 - **local-level institutional arrangements** – with an empowered government agency facilitating community awareness, participation and possibly self-regulation
 - **finance/implementation of technical water demand-side and supply-side measures**
 - **macro-policy modifications to constrain groundwater demand**
 - **enhanced resource administration and targeted use regulation.**

Progress will require a balance between ‘bottom-up’ and ‘top-down’ action, with ‘political support’ for prioritized, sequenced, practical and patient interventions.



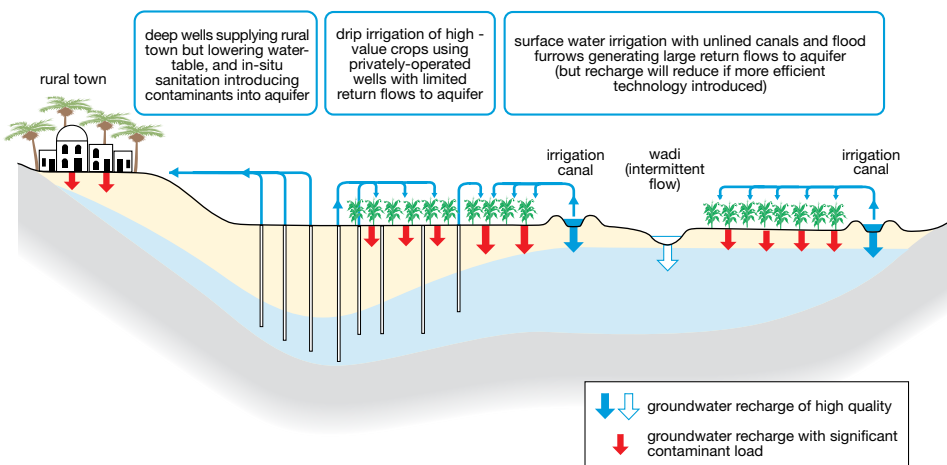
- In promoting advances in groundwater resource management, **GW•MATE** has frequently had to overcome numerous **misconceptions** including :
 - **resource deficits can be met by supply-side measures alone** – when in reality measures to control demand will always be necessary because aquifer recharge enhancement is likely otherwise to stimulate increased groundwater abstraction
 - **reluctance to recognise non-renewable resource exploitation** – which requires proper planning, enhanced management and justifiable economic returns

- **no management action possible without detailed aquifer characterization** – whilst a sound ‘conceptual model’ is important, a ‘parallel-track approach’ is strongly advocated which makes incremental improvements in management whilst continuing to advance groundwater system investigation and monitoring.
- **Groundwater quality protection should follow a comparable strategy** through:
 - **systematic assessment of groundwater pollution hazard** based on mapping of aquifer pollution vulnerability and actual/potential subsurface contaminant loads
 - **definition of a ‘groundwater protection plan’** to reduce this hazard in priority areas through differential land-use management (involving an appropriate mix of local technical measures, stakeholder mobilization and regulatory control) and where necessary modifying national policy on the use of hazardous chemicals.
- Investments to strengthen institutional capacity are critical for improving governance. Groundwater is a ‘highly decentralized resource’ often developed by private initiative, thus its management and protection will not be effective without social (user and polluter) participation. But **government has to play a central role as ‘resource guardian’** (usually via a ‘local-level agency’) – making the first move by :
 - **profiling groundwater users** – as a basis for understanding the socioeconomic importance of the resource and the consequences of ‘non-action’ on its management and protection
 - **selecting ‘pilot areas’ to try out participatory resource management and quality protection** — the boundaries of such pilot areas (and subsequent groundwater management bodies) should be defined on a scientifically-consistent basis.
- In defining the preferred institutional, economic and technical approach to groundwater management and protection, **GW•MATE** considers it necessary to make a distinction between the urban environment and rural areas with major irrigated agriculture.



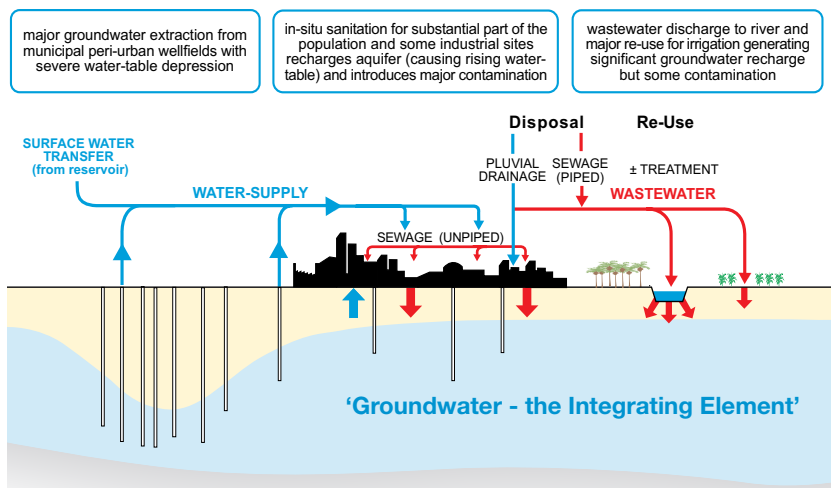
Managing Groundwater Use for Irrigated Agriculture

- Widely in the developing world, the last 20-25 years has witnessed a **massive increase in groundwater resource exploitation for irrigated agriculture** – producing enormous benefits in terms of crop security, farmer incomes, rural livelihoods and food production. But in many countries irrigated agriculture has become the major user and predominant consumer of resources – and **serious questions of resource sustainability (and even irreversible degradation) are arising**.
- The following are some of the key policy issues that **GW•MATE** has had to address when attempting to promote more sustainable use of groundwater in irrigated agriculture :
 - **role of irrigation technology** – investments to improve (so-called) ‘irrigation efficiency’ (whilst highly desirable from other standpoints) do not equate to equivalent ‘groundwater resource savings’ and, without parallel interventions to constrain the area irrigated, the reverse is quite often found to be the case
 - **influence of rural energy subsidies** – electricity subsidies for groundwater pumping are often argued to be the key factor provoking excessive resource exploitation, but on detailed consideration (whilst ‘flat-rate’ tariffs are certainly always perverse) the influence of subsidies may prove less significant, and other macroeconomic interventions (such as waterwell drilling/deepening finance and crop guarantee-prices) may exert more influence on the evolution of groundwater-based agriculture and defer the transition to less ‘water-use intensive’ livelihoods
 - **conjunctive use of groundwater & surface water** – a major opportunity for improving irrigation-water availability/security and expanding agricultural production sustainably (especially on major alluvial plains) but is still largely spontaneous and sub-optimized – a concerted effort needs to be made to tune practice to the dynamics of groundwater/surface water interaction and to confront the socio-economic and institutional impediments (rigid historic surface water-rights, ineffective irrigation canal management and split institutional responsibility).



Urban Groundwater Use Policy

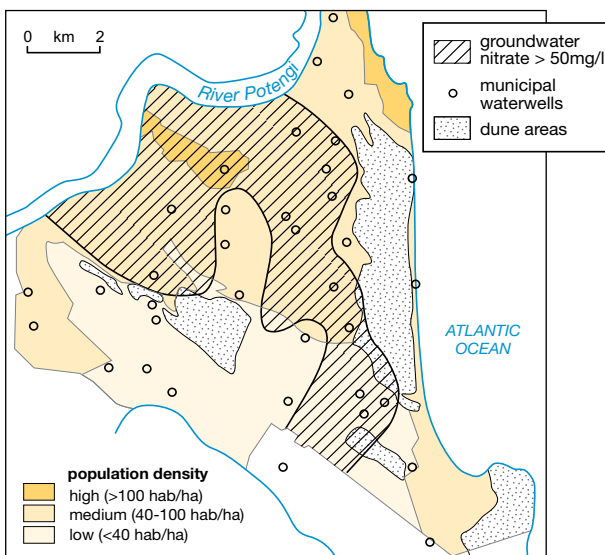
- Groundwater resources are **critical to the economical provision of urban water-supply** in many developing cities and towns worldwide. But climate-change adaptation is putting them under greater stress and rapid uncontrolled urbanization is placing them at increasing risk – managing the nexus with in-situ sanitation being critical in many cases. In a continually-evolving relationship, urbanization processes tend to augment groundwater recharge and degrade groundwater quality, and in turn groundwater system changes can impact urban infrastructure. Without improved policy and planning (based on an ‘integrated vision’), the problems arising turn out to be persistent and costly – **in the urban environment all too often ‘one persons solution becoming another persons problem’!**
- In developing urban groundwater use policy **GW•MATE** considers it pertinent to distinguish between cities and towns where:
 - the municipal water-supply utility or the autonomous company/concessionaire has major dependence on groundwater abstraction
 - private in-situ self-supply from groundwater by residential, commercial and/or industrial users is highly significant
 although in some instances both may be occurring.



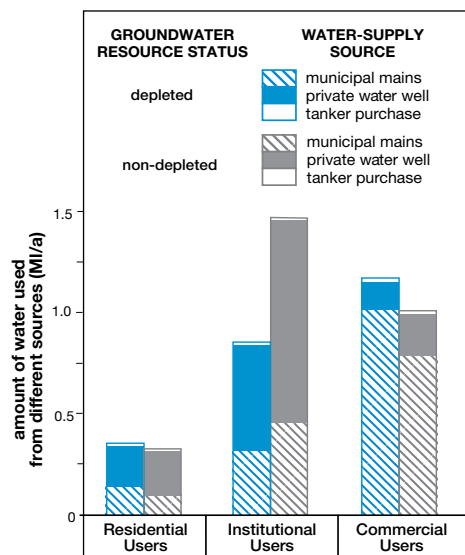
- Quite commonly municipal waterwells have been constrained within the built-up area (or engulfed by rapid urban expansion) without sewered sanitation. In such cases much more effort generally needs to be put into **assessing potential pollution risks and the surveillance of groundwater supply quality** for the range of potential pollutants identified. The **construction of ‘external’ municipal wellfields** (or capture of other water-supply sources) is the rational policy response to loss of (or threat to) urban waterwells. But this will also require much improved coordination and ‘appropriate compensation’ between municipalities within and neighbouring ‘metropolitan districts’, to facilitate the implementation of **equally-necessary protection measures for the associated investment.**

- **Private waterwell drilling by urban residential and other users is usually initiated as a 'coping strategy' at times of inadequate mains water-supply service** – in-situ self-supply from groundwater representing an economical alternative to purchase from water tankers. Very large numbers of waterwells have been (and are being) constructed on this basis – especially in urban areas underlain by shallow aquifers. For the mains water-supply service-level to improve requires higher average domestic water-tariffs – **and private waterwells are then often deployed as a 'cost-reduction strategy'**.
- **GW•MATE** considers it too simplistic to talk in terms of banning residential self-supply from groundwater, except where the risk of negative impacts from aquifer development or epidemic disease transmission are very high. The phenomenon has benefits and risks which need to be carefully balanced and managed.

Natal (South) - Brasil : 2008



Aurangabad - India : 2007



- All too often degradation of groundwater resources in urban areas is not the result of insufficient scientific understanding nor failure to mobilize capital investment – but more due to lack of integrated vision, policy coordination and institutional cooperation. **Groundwater considerations need to be inserted into metropolitan area and municipal infrastructure development plans** through better communication of resource presence and protection needs via land-surface zoning maps and other means.

There follows a tabular summary of some specific project outcomes in which **GW•MATE** has worked with the World Bank's national client organisations to promote improved groundwater resource management and quality protection in a wide range of settings.

GW·MATE Selected National Project Outcomes

LEAD ORGANIZATION(S)

MAIN GROUNDWATER MANAGEMENT OUTCOME(S)

Thailand - Ground-Water Department

provision of 'functional blueprint' and operational structure for transformation of the national groundwater agency from 'resource development to management' and strategic advice on critical phase of successful action to stabilize Bangkok Aquifer

China – Ministry of Water Resources & Guantao County Water Bureau

promotion of county-level groundwater management plan to reduce overdraft of North China Plain Aquifer, featuring concerted effort on 'real water-resource savings' in extensive irrigated staple-crop production -- and through this and other experience contribute to design of National Groundwater Management Center

India – Ministry of Water Resources & Andhra Pradesh, Maharastra, Punjab, Uttar Pradesh States

promotion/support of demand-side management in groundwater use for irrigated agriculture for various excessively exploited aquifers through facilitation/encouragement of community-based self-regulation primarily by crop-water planning (AP & MH) and through mandatory changes in rice-crop cultivation (PJ) – and the pilot facilitation of improved conjunctive use of groundwater and surface water (UP)

Bangladesh - Depts of Public Health & Environment

through World Bank regional program a key contribution to the national groundwater arsenic mitigation strategy and parallel advisory inputs to major water-supply and environmental management projects

Latin America Mercosur & Organization of American States

facilitating design, implementation and assessment of environmental management project for Guarani Aquifer (Brasil/Paraguay/ Uruguay/Argentina) – one of the world's largest groundwater systems and the first GEF-IW-funded project on internationally-shared aquifers – based on degradation and conflict prevention

Argentina – Mendoza State Irrigation Department

technical evaluation/regulatory action to control salinization of Carrizal Aquifer and protect major groundwater-dependent export wine/fruit production, and brokering public-private partnership generating US\$18million investment on evaluation/mitigation of groundwater hydrocarbon pollution risk from major long-standing oil refinery

Brasil – Agencia Nacional de Agua, Ceara & Rio Grande do Norte States

facilitating the first national inter-state dialogue and investigation/management action plan for the shared karstic Apodi Aquifer System (which has been subject to rapid development for commercial production of tropical fruit) and corresponding strengthening of institutional capacity

Peru – Autoridad Nacional de Agua

supporting development of groundwater management capacity in newly-formed national agency (and its local offices) through pilot management projects on two contrasting aquifers intensively used for agricultural irrigation in the Ica District

Morocco - Ministry of Water, Land & Environment

preparing National Groundwater Strategy based on lessons learned with the ABH Souss-Massa in developing/implementing their groundwater management plan (including regulatory provisions, social participation, engineering investments)

Ethiopia - Ministry of Water Resources

formulation of groundwater management framework at national and regional level to address rapidly increasing resource exploitation, including the development of deep groundwater for urban use in the Addis Ababa area

Southern Africa Development Community

extended support for political dialogue to mobilize member governments on national agendas for managed groundwater development, advice on the formation of a regional training/reference centre and collaboration with UNDP-CAPNET on training-the-trainers courses for regional academic centres

CORE TEAM

Stephen Foster	United Kingdom	Program Director
Héctor Garduño	Mexico	Water Resources Institutions & Planning
Albert Tuinhof	Netherlands	Groundwater Development & Management

PROGRAM MANAGEMENT

Catherine Tovey	World Bank	Program Manager
Karen Kemper	World Bank	Past Program Manager
Amal Talbi	World Bank	Deputy Program Manager
Doreen Kirabo	World Bank	Program Co-ordinator
Siet Meijer & Carla Vale	World Bank	Past Program Co-ordinators

OTHER MEMBERS

Ricardo Hirata	Brazil	Groundwater Resource Evaluation & Protection
Frank van Steenberg	Netherlands	Groundwater Resource Management
Marcella Nanni	Italy	Environmental Legislation
Ana Vidal	Uruguay	Water Resources Institutions
Gill Tyson	United Kingdom	Environmental Graphics

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PUBLICATION ARRANGEMENTS

GW-MATE knowledge products are published by the World Bank, Washington DC, USA and available electronically from their water resources website (www.worldbank.org/gwmate) and the GWP website (www.gwpforum.org) or via the GWP Toolbox (www.gwptoolbox.org).

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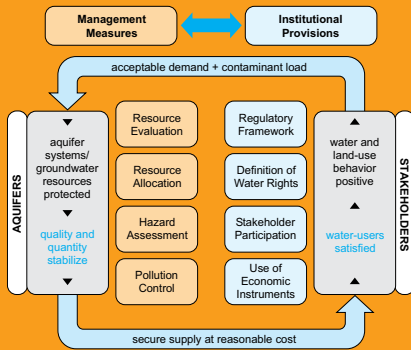
Global Water
Partnership



Bank-Netherlands
Water Partnership Program

DFID

Department for
International
Development



Groundwater Resource Management & Quality Protection

— Promoting a Virtuous Cycle



GW•MATE Contact Details

Dr Catherine Tovey
e-mail: ctovey@worldbank.org

Dr Amal Talbi
e-mail: atalbi@worldbank.org

Dr Stephen Foster
e-mail: GWMATEfoster@aol.com

c/o World Bank
1818 H Street NW
Washington, DC 20433, USA
tel: +1 202 458 7839



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