WATER

P-NOTES

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Groundwater in Rural Development

Facing the Challenges of Supply and Resource Sustainability

Some 200 million people lived on Planet Earth at the start of the modern era. That number rose to 2.5 billion by 1950. At mid-2008, the population is now 7.0 billion and is expected to reach 9.0 billion by 2040. It thus took 1,950 years for the global population to grow ten-fold—but only an additional 58 years to nearly triple. And throughout this period the global availability of water resources has remained more or less constant.

Growing ever more food to feed rising populations will be possible only with increasingly large amounts of water being used for agricultural irrigation, even allowing for further advances in plant genetics. Groundwater—widely developed by private initiative but often stimulated by "soft loan" finance, guaranteed crop prices, and rural energy subsidies—will be a very important source of irrigation water. At the same time groundwater will continue to be the predominant source of household water for the rural population in developing nations.

Agricultural irrigation, the predominant groundwater consumer

As a source of water for irrigation, groundwater offers advantages that surface water sources cannot match—foremost among them dependability. It is naturally drought resilient and can be applied exactly when plants need it. But large-scale use of groundwater for irrigation is a relatively recent phenomenon, introduced only after the development of powerful and low-cost well-drilling rigs and pumps, and after rural electrification was extended to supply the energy needed to drive the new equipment. Even more recent, and still far from universal, is careful attention to the rates of replenishment of the aquifers that provide the groundwater being pumped. The sustainability of groundwater abstraction now hangs over great swathes of the world's agriculture like the Sword of Damocles.

Individual well owners and widely scattered cooperatives have managed to provide affordable, good-quality groundwater for irrigating crops across vast areas of relatively arid and drought-prone land in Asia, and to lesser extent in Latin America and Africa. And with ever-more powerful technology at their disposal, their ability to do so has been magnified to such an extent that individual decisions can affect their neighbors in unforeseen ways.

The enormous demand for groundwater requires us to find a balance between the immediate benefits of groundwater use for irrigation and ensuring the sustainability of the resource base for tomorrow's use. The imperative of achieving that balance must be posed at the outset of every investment plan related to groundwater use in agriculture.

Excerpted from *Groundwater in Rural Development: Facing the Challenges of Supply and Resource Sustainability* by Stephen Foster, John Chilton, Marcus Moench, Franklin Cardy, and Manuel Schiffler (World Bank Technical Paper 463, March 2000)—a GW-MATE publication.
Visit *www.worldbank.org/gwmate/* for more information. The publication is available in PDF format from www.worldbank.org/water.

GW·MATE

India: the trap set by subsidized electricity

India offers a clear demonstration of the major socio-economic advances produced by intensive pumping of groundwater to irrigate crops, but also of its negative impact and grave concerns about sustainability.

Through the use of groundwater from the 1980s onwards, many rural areas of India have flourished, with major increases in crop production that have contributed greatly to improving national food security. More than 50 percent of India's irrigated agriculture depends on groundwater, and crop yields are generally 30–50 percent higher in groundwater-irrigated areas. Concomitantly, about 85 percent of the drinking water needs of rural areas are also met from groundwater.

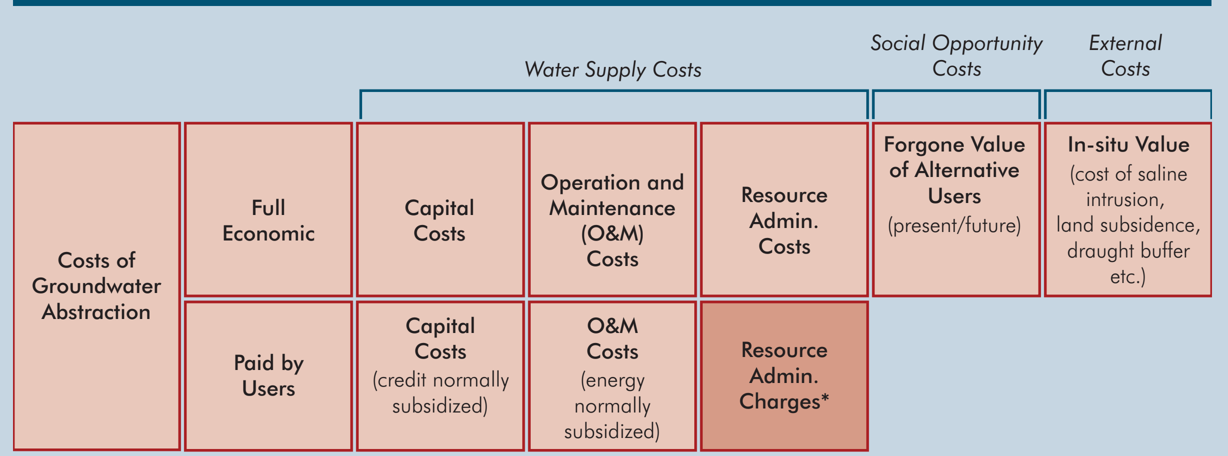
But this example of sound groundwater use is accompanied by a well-intentioned policy that has gone sour. The large rural community of groundwater-based farmers in peninsular India (who do not enjoy the benefits of farming within the reach of major surface-water irrigation canals) lobbied for and achieved concessions from federal and state governments for rural electrification and then highly subsidized (flat-rate) electricity tariffs for groundwater pumping.

The country's governments failed at the outset to assess the risk of groundwater overexploitation and of associated reductions in water tables. Thus the full economic cost of groundwater abstraction and of the electrical energy required to power it at ever-decreasing efficiency (as a result of the falling water table) was not considered. Typically, only a portion of the full cost of groundwater abstraction is being paid by the users (figure 1), leaving today's taxpayers and tomorrow's generation to foot the rest of the bill. Subsidizing electrical power for groundwater pumping certainly achieved the policy goal of raising crop yields, especially for relatively well-off farmers who could afford to drill deeper in pursuit of the falling water-table. But it also caused thousands of village wells to dry up, with the poorest members of the rural community, who depended on those wells for household water, suffering most.

Until relatively recently, virtually all Indian government organizations concerned with groundwater had been established, and were sustained, to promote resource *exploitation* rather than to ensure resource *management*. India is still struggling for a way out of that dilemma.

More troubling is that the Indian pattern has repeated itself elsewhere. That many have fallen into this trap is surprising, considering that simple procedures for estimating groundwater resource balances have been available since the 1970s and could have been used to guide investment decisions affecting irrigated agriculture.

Figure 1. Assessing the costs of groundwater abstraction



Note: Only a relative (and not absolute) scale of economic costs is implied in this figure.
* frequently not levied or do not cover real costs

Toward sustainability: conserving while consuming

Around the world, people are discovering the truth of Benjamin Franklin's dictum: "You don't value water till the well runs dry." Only in the most arid of countries is water generally recognized for the precious resource it is—and even there inefficient agricultural use of groundwater can be widespread.

Hydrogeologists from China to Nigeria and from India to Mexico are realizing that recognizing the problem and acting to correct it do not necessarily go hand in hand. Inaction, it seems, is generally a consequence of conflicting stakeholder claims, wrong-headed political decisions, and powerful interest groups. Unless developing-world governments (and the international institutions that support them) can mobilize the principal stakeholders, from large agricultural producers to small subsistence farmers

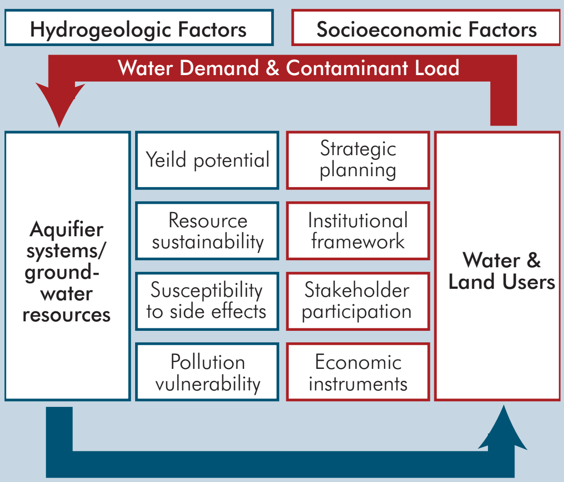
Figure 2. Stakeholders in rural groundwater development for agricultural irrigation

Note: The horizontal time scale shown in the figure may be from 1 to 5 decades.
* other branches of government will normally be concerned with groundwater resource management

(figure 2), groundwater use will not be put back on a sustainable path, and sinking water tables will eventually turn crop lands into dust bowls.

Clearly, what is needed most, but understood least, is competent groundwater resource management. But what kind of management and on what scale? Well, the participatory type of resource management needed in areas where irrigated agriculture demands large volumes of groundwater is in fact a social process, one more familiar to politicians than to engineers. The keys to that process are balance and respect—respect for technical expertise, balanced by respect for the views of those directly affected by decisions. Those who have a say in groundwater use are many. Water-user associations, village councils, and national parliaments are as essential to effective groundwater management as national planning ministries and regional regulatory bodies.

Figure 3. A conceptual framework for the management and protection of groundwater resources



What is needed is an integrated approach to planning groundwater supply that marries stakeholder participation with technical expertise, together with a broad vision of present and future welfare. That approach implies community involvement in design, implementation, maintenance, and financing of projects, as well as reconciliation of communities' wishes with their willingness to pay for water at a rate that reflects full operating and capital costs. In most cases, subsidies are appropriate only for the poorest of the community.

The key hydrogeological and socioeconomic elements that determine the effect of water- and land-use activities on groundwater are indicated schematically in figure 3. Projects undertaken at the local level should be designed at an appropriate technical level (no more complex than necessary) but make maximum use of national services and supplies.

Because water is a scarce good, decisions on its allocation are bound to be contentious. For that reason, groundwater management will succeed only in a robust institutional framework, one characterized by impartial expert research, careful coalition building, transparent and participatory decision making, systematic monitoring of implementation, and political accountability for failure as well as success.

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