International Association of Hydrogeologists

Strategic Overview Series

POVERTY REDUCTION & GROUNDWATER

KEY MESSAGES

- groundwater development is closely linked with poverty reduction in developing countries
- this results from groundwater generally being the lowest cost and most reliable source of potable water-supply
- good project design, procurement for and supervision of waterwell construction are essential to take best advantage of groundwater resources
- waterwells are particularly critical for poverty reduction in rural areas, greatly reducing the amount of time spent by women on water collection
- small-scale irrigation is also highly significant in lifting people out of poverty and is best based on waterwells that allow user control on the timing of water applications
- advances in manual drilling techniques have radically reduced the cost of waterwell construction in some hydrogeological settings and thus contributed to poverty reduction

What are the key linkages between poverty reduction and groundwater ?

The main objective of this overview is to draw the attention of a broader audience in the water and development sectors to the critical importance of groundwater for poverty reduction in developing countries. This is because groundwater :

- development costs are low as a result of widespread distribution at relatively shallow depths
- usually is of good natural quality needing minimal treatment which reduces health hazards
- seasonal reliability is relatively high as a result of the large storage of most aquifer systems
- allows user control, making it especially suitable in rural environments for small-scale irrigation.

Waterwell construction costs currently fall mainly in the range US$10,000–20,000, and considerably higher (up to US$50,000) where deep boreholes (of 200 – 300m) are required, and thus private waterwell ownership is likely to remain the preserve of wealthier members of society. However, waterwell costs shared by communities is common-place, and compared to surface-water sources (which often

RAPID MECHANICAL DRILLING OF A NEW VILLAGE WATERWELL

This Series is designed both to inform professionals in other sectors of key interactions with groundwater resources and hydrogeological science, and to guide IAH members in their outreach to related sectors.

YOUNG PEOPLE CARRYING WATER IN UGANDA

require costly treatment), most funding agencies find groundwater development costs very much lower, and related investment is also capable of being staged.

This has made groundwater the preferred source of community organisations, irrigation associations, developmental NGOs, and even of some urban water utilities. Thus, looked at overall, the presence of groundwater of adequate quality can deliver much cheaper and more reliable water-supplies than surface-water sources, and makes the task of providing a convenient minimal service for poorer communities easier to achieve.

How do the characteristics of groundwater resources favour water-supply development in rural areas ?

For dispersed village communities groundwater is the preferred source, since it can be developed stepwise at low capital cost and offers high reliability in drought. Waterwells have become the predominant source of improved village water-supplies across low-income countries, and in some regions there are simply no all-the-year-round alternatives of suitable quality. They are thus considered as fully meeting the criteria of the UN-Sustainable Development Goals (SDGs).

The presence of village waterwells, that have been appropriately sited, properly constructed and adequately maintained, can greatly reduce the time spent daily by women on domestic water collection, and in this critical way make an important contribution to poverty reduction. When part of the task of domestic water collection also falls upon children, it can reduce the time they have available for important schooling.

In some parts of India the cost of drilling a 50m-depth village borehole plus installing a hand-pump for a population of 200 is currently as little as US$ 5,000. And even allowing for maintenance and amortization costs of 12% pa the resulting cost of water-supply per person is very low. Moreover, the volumes of water needed to meet the demands of rural villages are very small in relation to most groundwater recharge rates, and can be readily met by low-cost small-diameter boreholes or dugwells.

PUMP INSTALLATION IN BURKINA FASO

UPGRO PROGRAMME FOR SUB-SAHARAN AFRICA (UK Government Funded)
(www.upgro.org)

The UPGro (Unlocking the Potential of Groundwater for the Poor) Programme was a 7-year research effort comprising 5 large inter-disciplinary applied research projects in a total of 12 countries, with some 125 researchers directly engaged. Some memorable quotes from programme contributors include :

- *Most of those (villagers) interviewed felt that life had changed for the better after waterwell and hand-pump installation. In particular less sickness and better health, and less time spent and tiredness, were experienced by village women. However, children became more engaged in water collection because the new water sources were closer to villages.*
- *There was strong empirical evidence linking improvements in groundwater access to the well-being of rural agricultural communities, with improved reliability and quality of drinking water-supply and water availability for small-scale irrigation.*
- *Hundreds of millions of people in low-income urban settlements rely on collection from waterwells for drinking and other domestic purposes, but efforts to enhance the management of these water sources receive little attention.*

Water abstraction can be performed by using low-cost hand-pumps or small motorized pumps (of 0.2-1.0 l/sec, capacity). Such yields are available from most rock types using sound expertise for well design. However, larger supplies (1-5 l/sec) for pumping to water-supply distribution tanks and piped networks, will often prove a more serious challenge and require additional specialist expertise.

Sound waterwell sitings, design, construction, pump selection and system maintenance are essential to ensure both source and resource sustainability. The most common service delivery model for rural communities in low-income countries is community management, in which communities carry the responsibility for managing and maintaining the water-supply. The choice between drilled boreholes and dugwells will depend on the local hydrogeology and on available equipment. A dugwell of 10-15m depth and 5-6m diameter fitted with a centrifugal pump currently costs about US$ 1,500 in India and, provided correctly sited, is an alternative preferred by some villagers because maintenance is easier and there may be sufficient water production to allow some irrigation.

For all installations systematic sanitary inspection is advisable to identify potentially serious groundwater pollution hazards (related to in-situ sanitation, livestock stables and village drainage). Some groundwaters may also contain hazardous natural levels of fluoride or arsenic or soluble iron, and specialist expertise will be needed to diagnose and minimize such problems, and in some instances removal maybe the only realistic option. In the case of aggressive groundwater quality (low pH and high salinity) the use of submersible pump components that do not corrode is desirable, but can present either technical complications or financial impediments.

Small-scale irrigation offers more secure crop yields and profitable agricultural production, and is also best based on groundwater. Waterwells allow close control of irrigation applications by their owners or operators. Thus groundwater irrigation is a critical activity in the struggle for poverty alleviation, offering a better food supply to families and the possibility of selling crops as a source of revenue.

How does groundwater development in the urban environment favour poverty reduction ?

In many urban areas the existence of usable aquifers offers the possibility of developing

SOUNDLY COMPLETED VILLAGE HAND-PUMP WATERWELL

low-cost high-reliability groundwater supplies in piped networks. These should enable water utilities to provide a reliable basic supply to urban dwellers at a subsidized (social) tariff. Any reluctance of water utilities in this regard is usually related to lack of knowledge of their key staff on groundwater development, resulting in a predisposition to large surface-water sources with complex treatment needs.

However, there are some concerns that the current boom in urban self-supply based on private waterwells will primarily benefit only the more wealthy households, (who can afford the capital cost of individual wells) and that this phenomenon may also prove counter-productive in the longer run because of its potentially serious impact on water-utility revenues and investments. But, it is without doubt that in many urban areas of low-income countries, with at best intermittent piped water-supply, households would face serious water-supply problems without ongoing investments in self-supply despite the related urban pollution hazards.

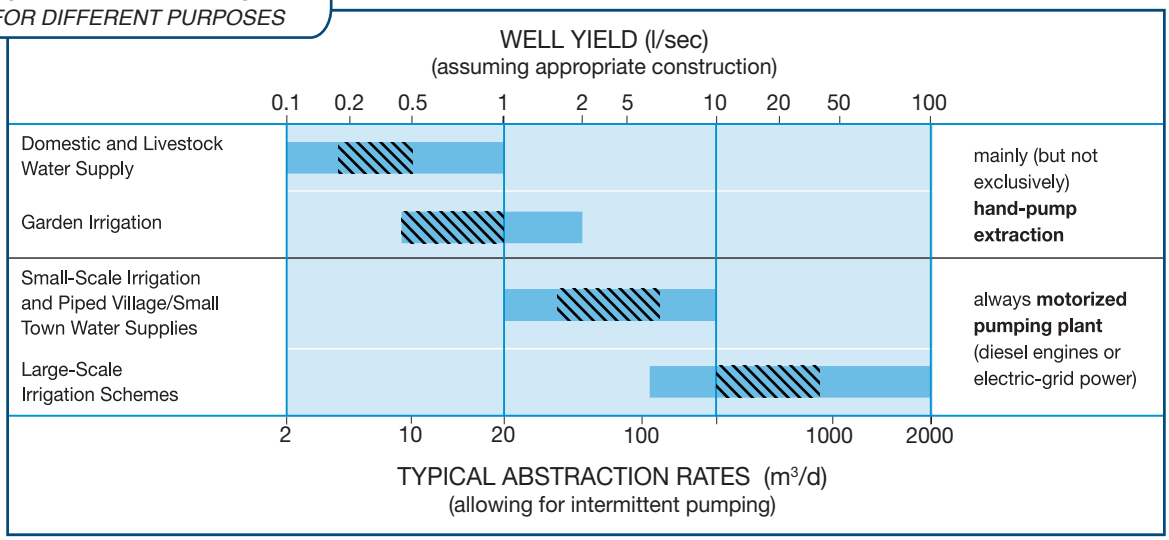
Waterwells are also widely the water source for the development of peri-urban horticulture, which will make a contribution to improving food availability for poorer families.

How have manual drilling techniques impacted groundwater development for the poor?

The deployment of manual drilling techniques, where geology is suitable, has radically lowered the cost of borehole construction compared with the use of mechanized drilling techniques, bringing the ownership of waterwells and self-supply from groundwater within the reach of some poorer urban dwellers.

Moreover, the high portability of manual drilling equipment has enabled the provision of safe

RANGE OF WATERWELL YIELDS AND USE FOR DIFFERENT PURPOSES



MANUAL LOW-COST DRILLING OF HAND PUMP WATERWELL

groundwater sources to the more remote of rural areas, including riverine communities who cannot be reached with mechanized drilling rigs.

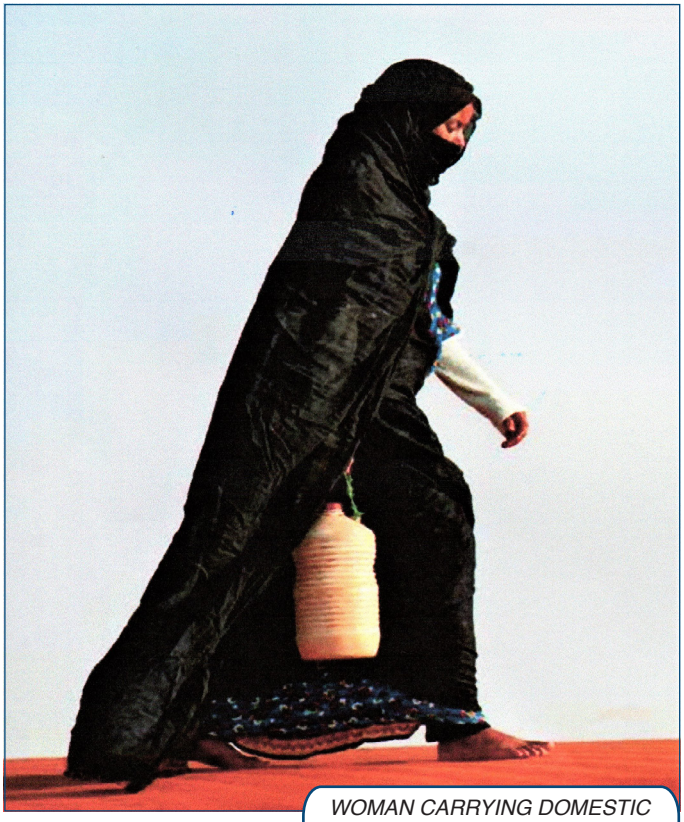
Why do groundwater supplies require proactive management and protection to fulfill their role in poverty reduction ?

Inadequate water quality is directly responsible for mortality or morbidity of its consumers. To deliver their full potential for poverty reduction, groundwater supplies need to be proactively managed to protect the resource from serious pollution, and also mitigate progressive resource depletion and waterwell yield failure. Moreover, a significant number of waterwell users in some countries have suffered chronic exposure to geogenically-contaminated groundwater (in the form of excessive arsenic or fluoride), whose presence should have been detected earlier.

Community education on the need to manage and protect waterwell sources is vital, since without this action the quality of groundwater supply may be compromised and risk not fulfilling the potential contribution to poverty reduction and climate-change adaptation. Without concerted action on understanding, managing and protecting the resource, groundwater will become of questionable sustainability and risk not fulfilling its potential contribution to poverty reduction and climate-change adaptation.

The task of managing and protecting groundwater for potable water-supply use normally falls upon local regulatory agencies, but they will need the proactive support and engagement of water utilities to be effective in this regard. Civil society also has an important role to play, since securely protected waterwells mean a healthier and more active population.

The groundwater pollution hazard to waterwells in shallow aquifers can often be significant. However, in most situations prevailing constraints on human and financial resources do not allow for regular monitoring of large numbers of highly-dispersed waterwells. Further, the quality of groundwater supplies depends primarily on good waterwell siting and construction, including sound emplacement of sanitary seals and surface plinths. In certain specific cases where serious natural groundwater quality hazards or pre-existing groundwater pollution has been identified, water quality surveying will be required with labelling of waterwells according to whether their supplies are potable or hazardous for drinking and cooking.



WOMAN CARRYING DOMESTIC WATER-SUPPLY

International Association of Hydrogeologists

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POVERTY REDUCTION & GROUNDWATER

SCHOOL CHILDREN CARRYING DOMESTIC WATER-SUPPLY

PRIORITY ACTIONS

- waterwells need to appropriately sited, properly constructed and adequately maintained if they are to be a sustainable water-supply source for poorer members of society
- groundwater resources urgently require improved evaluation, management and protection for the purposes of human water-supply
- surface-water sources of doubtful quality and associated health hazard need to be identified and replaced by waterwells wherever feasible
- efforts need to be focussed upon identifying and controlling potential sources of serious groundwater pollution and recognising the presence of geogenic contamination (especially by arsenic or fluoride), and where necessary communicating the risks to waterwell users
- while prevailing human and financial constraints do not allow for regular groundwater monitoring, some waterwell quality surveying is essential to confirm or negate supply potability

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