Rapid assessment of groundwater opportunities for displaced and refugee populations

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Refugee camps may be more like cities than rural areas in terms of their demand for volumes of drinking water. When conducting a rapid assessment of groundwater, designers should consider how much is needed and how it will be delivered. An integrated approach is required to take into account the needs of pre-existing local populations as well as future operation and maintenance.

In emergencies involving the displacement of populations – either within or outside their national borders – groundwater may be an attractive, or the only, water source option for the medium to long term. However, groundwater is a hidden and often misunderstood resource, and methodologies for its rapid assessment in emergencies are underdeveloped.

Demand

The Sphere standards[1] (Sphere, 2004) require, among other things, the supply of a minimum quantity of 15 litres of safe water per person per day. The minimum living space per person in an emergency settlement is specified as 45m^2. For a large population of refugees or internally displaced persons (IDPs) in a densely populated camp, the second of these figures implies a population density of up to about 22,000 persons per km^2. When combined with the first figure, the implication is a water consumption figure of more than 330m^3 per day per km^2 of land area, or about 120mm (as a depth equivalent) per year.

It is instructive to compare the last of these figures with the consumption of water in rural areas of developing countries. Mean national population densities vary, but in Latin America they reach to about 50 persons per km^2, in some countries of Africa they reach to about 150 persons per km^2, and in India the mean national population density is about 350 persons per km^2. Even with consumption rates of 20–30 litres per person per day (values which are rarely achieved if water has to be carried), these figures translate to demand of only 0.5, 1.4 and 3mm per year.

Comparing these figures with annual rainfall and, more importantly in the present context, groundwater recharge rates, shows that 'normal' rural consumption rates are very small (even in semi-arid regions, groundwater recharge may average 5–10mm per year), but consumption rates in densely populated camps can be very high. In this regard, large, densely populated camps are more like cities than rural populations. The issue of sustainable groundwater withdrawal is raised again later in this paper.

Dense populations in large IDP and refugee camps require numerous water points. The Sphere standards require water points to be established within 500m walking distance of the users. Furthermore, on the assumption of water points functioning eight hours per day, Sphere gives guideline figures for the number of users per outlet, varying from 250 persons for a shared tap, to 400 for an open hand-dug well, to 500 per handpump. Combining these guidelines, 45–90 water points per km^2 (taps, wells or boreholes, the latter with or without handpumps) may be required.

It is clear from the above that the water demands of large, densely populated camps require an assessment, not only of short-term source yield, but also of long-term renewable water resources – whether supply is to be from surface water or groundwater. Many refugee and IDP camps become long-term settlements, and so this long view is necessary.

Assessing potential

Assessing the potential for groundwater development in emergencies requires attention to at least the following five issues:

- present and future groundwater quality,
- well or borehole design,
- environmental sustainability: renewable groundwater resources,
- functional sustainability: operation and maintenance post-construction,
- management of construction programmes.

Groundwater quality

Normal water-quality assessments of physical, chemical and microbiological aspects which would apply in any rural or urban water supply programme need to be supplemented with one additional consideration. Given the high population densities in camps, and the sometimes conflicting water demands (for example between domestic and livestock watering), some assessment needs to be made of the likely deterioration over time of groundwater quality beneath and around such settlements.

In particular, one would expect some aspects of water chemistry associated with human or animal faecal pollution, such as chloride and nitrate, to worsen. Pathogen load, as shown by indicator bacteria, would also be expected to increase over time.

Well design

A general assessment of geology and hydrogeology (identifying lithology, aquifers and aquifer types, aquifer properties, depths to groundwater and so on) can be carried out from maps, reports and databases held within the country involved, or overseas. There is often a surprisingly useful knowledge base in the geological surveys and professional societies of former colonial powers – although much of this is only accessible in hard copy, not electronic form. In addition a number of initiatives are now under way to place national groundwater information in the public domain through the internet.

However, general assessments alone are not sufficient to lead to specific well or borehole designs, which are necessary for budgeting, contractual, and logistical decision-making. Numerous well or borehole design decisions need to be made. The main matters to be decided are:

- design discharge per groundwater abstraction point,
- probable well or borehole total depth,
- dug well or drilled borehole construction diameter,
- casing, screen or other lining type, lengths and diameters,
- screen or lining perforation type and size,
- annular backfill or envelope type (gravel pack, formation stabilizer, geotextile, sanitary seal/grout),
- headworks detail.

This is not the place to describe the detail of well and borehole design practice[2], the key point here being that the study of reports, maps and groundwater databases should be done with the specific purpose of developing expected designs of groundwater abstraction points, which match water demands with local hydrogeology. A rapid desk-based assessment of groundwater opportunities should result in well or borehole designs, detailed specifications and projected numbers of groundwater abstraction points.

Environmental sustainability

The development of rural groundwater supplies in non-emergency situations rarely takes account of environmental sustainability in general, or renewable groundwater resources in particular. The figures given earlier show that this neglect may often be justified. If rural groundwater abstractions amount to only 0.5–3.0mm per year, out of annual rainfall which may range from a few hundred to the low thousands of mm per year, and corresponding groundwater recharge amounts to a few tens to several hundreds of mm per year, then the impact of such groundwater development is probably insignificant.

On the contrary, though, groundwater demands in the order of 120mm per year (see above) are highly likely to have impacts, not only on local water tables (threatening long-term sustainability of abstractions), but also on surrounding natural groundwater discharge features such as springs, swamps and wetlands, and stream baseflow. These in turn may affect other domestic water users as well as fishing communities, pastoralists and livestock owners, and sedentary farmers. Environmental sustainability can thus have a direct impact on functional sustainability, as well as possibly exacerbating competition or conflict over scarce resources.

It is therefore essential that a sound assessment is made of the likely environmental impacts of groundwater abstraction prior to commencing significant development. I suggest here that 'significant' in this context may mean any development which intends to abstract more than about 5mm of groundwater per year.

Functional sustainability

There is ample evidence now, both from long-term development programmes[3] and from emergency responses, that unless issues of long-term functional sustainability are thought about from the beginning, this neglect is likely to lead to later failure. Properly designed and constructed groundwater abstraction points can be expected to have a design life of 20–30 years, so this must be the planning horizon for operation, maintenance and periodic (every 5–10 years) pump replacement.

Even in a short-term emergency (one in which the return and resettlement of displaced populations take place a few months after the initial cause of displacement), it is likely that constructed groundwater abstraction points will be used by local populations, and over the long term.

Two fundamental aspects require attention:

- who will manage the water supply system, both in the short term and in the long term (including any handover issues)? and
- where will the money come from to manage and maintain the water supply, both in the short term and in the long term?

There needs to be hard-headed realism about both these aspects, not wishful thinking. Both have implications for design. For example, motorized groundwater abstraction systems which are reliant on diesel fuel and supplies of spare parts may be appropriate in the short-term while international agencies are present with funding and logistical support, but they may not be sustainable after handover to local authorities or water user communities. Such issues pose real practical challenges for the linkage between relief, rehabilitation and development.

The issue of ownership and long-term responsibility for maintenance has its roots in the quality of relationships and collaboration established between implementing agencies (commonly international humanitarian organizations such as the UN agencies and INGOs) on the one hand, and local communities and local government on the other. It also depends on humanitarian agencies taking a long-term planning horizon, as well as recognizing the difficulties local authorities have in making their voice heard at the time of the emergency itself.

Water points built for refugee camps may need to be managed by local populations after the emergency is over.

Management of construction programmes

If the groundwater option is to be pursued in an emergency, choices need to be made about who carries out construction (international or local humanitarian agencies or private contractors) and who assures the quality of the end-product. It is the second of these which is commonly the weak point in implementation. Drilling and well construction supervision is often inadequate in terms of amount, and carried out by inadequately experienced and trained individuals. Young engineers and geologists (either national or international) who are often assigned the task of supervision, have rarely seen a drilling rig before their first assignment of this type, and they are even less likely to have received any specific training for the task.

Construction supervision requires the responsible person to observe, measure and record relevant points such as total depth, amount and positioning of casing and screen, annular backfill quantities and depths, and test pumping data; as well as to decide and agree, through constructive dialogue with the driller, on appropriate actions when (not if) unexpected situations arise. This is a challenging role, especially for a raw graduate working with an experienced driller.

Beyond the emergency

If and when internally displaced persons or refugees return home, decisions need to be taken about the groundwater abstraction points constructed for emergency use. Will they be integrated into the water supply coverage to the local population, or decommissioned? The answer to this question depends largely on location of the water points relative to demands, and on source designs, with their operation, maintenance, and replacement cost implications. If some groundwater abstraction points effectively become redundant, they should be properly decommissioned, both to protect groundwater resources, and to ensure that local coverage statistics reflect realities. All of this re-emphasizes the importance of thinking about the end from the beginning.

Ways forward

In order to establish more professional practice in this area in future, action in the following areas is needed:

- the development of a widely accepted procedure for groundwater assessment in emergencies;
- training and resourcing of individuals and institutions responsible for construction supervision;
- more effective collaboration between international humanitarian agencies, local government and local NGOs.

About the author
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