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WATER, SANITATION AND HYGIENE: CHALLENGES OF THE MILLENNIUM

# GIS and modelling in the management of rural water supply

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UNTIL THE 1970'S THE rural population of Bangladesh relied on surface water and traditional dug wells for their domestic water supply. Use of these unsafe sources led to large-scale outbreaks of cholera and diarrhoeal disease, particularly amongst young children. The GoB, UNICEF and others identified groundwater as a safe alternative and commenced a massive programme of installing hand tubewells (HTW). Later this was also taken up by the private sector. Estimates of the present number of HTW's in use range between 3 and 10 million. The success of the switch to 'safe' sources of water supply led to dramatic reductions in both morbidity and mortality attributed to diarrhoeal diseases. As recently as 1998, UNICEF concluded that more 97% of the rural population had access to safe drinking water.

## Challenges for the Millennium

Major challenges for rural water supply that have become apparent in the past decade include:

- Growth of demand due to both the increase in rural population and a likely increase in per-capita consumption. Population growth may not be the critical factor for rural water supply, since demographic forecasts indicate that the major growth in population will be in urban centres. However, even in urban areas, water supply practice will, in part, be similar to that in the rural areas.
- Groundwater quality in Bangladesh, and in particular arsenic contamination, has come to the forefront of world attention in recent years. The occurrence of arsenic in drinking water and its associated health implications is the greatest challenge for the millennium.
- Other, though less serious, water quality problems exist. Manganese is found at levels of health concern over large areas, while lower levels of manganese plus the even more common high levels of iron are objectionable to users, and illustrate the increasing demand for better quality supplies. Salinity in the coastal belt and potential future contamination of groundwater from agricultural and industrial sources are challenges that cannot be ignored.
- Contamination of surface water from industry and municipal waste become another challenge when this is considered as an alternative source for drinking water.
- Groundwater abstraction for irrigation has led to significant seasonal declines in the groundwater table during the dry season. This decline has already led to the standard No 6 HTW (a suction-mode pump) becoming inoperable for 2 – 3 months a year in many parts of the Northwest, Southwest and North-central regions. There is thus a need for a large-scale shift to the use of force-mode pumps such as the Tara (plus mini-Tara and Super Tara) or even motorised deep tubewells. The seasonal decline in the water table will become worse as the demand for groundwater irrigation continues to grow. A re-assessment of the impact of groundwater abstraction on HTW, undertaken during the NWMPP, has indicated that the impact is regionally and sometimes also locally variable
- Social and gender issues play a vital role in rural water supply. Solutions may be technically sound but socially unacceptable. Much effort will be required to build awareness and ensure the effective participation of the local population.

## Management of Rural Water Supply

The technical options for safe drinking water supplies in rural areas are limited to groundwater and surface water. Options such as bottled water are only affordable to the rich. For groundwater, there are choices. Deep groundwater may not contain arsenic and should be free of faecal pollution and thus constitutes a safe source without treatment, although the drilling cost is, of course, higher. Around 25-30% of shallow groundwater sources are contaminated by arsenic and must be treated before it is suitable for human consumption. Choices are thus controlled by cost, which needs to be born by the water users. On the other hand, about 70% of shallow groundwater sources are **not** contaminated by arsenic. Communities and households can implement these supplies with their own financial and technical resources. The protection of this precious resource and the monitoring of presently uncontaminated supplies should be key areas of policy.

It is easy to propose switching back to surface water in areas where the groundwater is contaminated by arsenic. Surface waters always require treatment, and over large areas may be in inadequate supply and/or highly polluted in the late dry season. Furthermore, the availability of surface water may become further reduced by the inevitable expansion of groundwater irrigation. The problems of operation and maintenance of treatment plants is a global phenomenon, and hence risks avoiding arsenicosis only at the risk of the increased incidence of diarrhoeal disease. On the other, rainwater harvesting has potential where rainfall relatively uniform and reliable.

The National Policy for Safe Water Supply and Sanitation aims to shift the responsibility for the development and the management of water supply and sanitation through local bodies, private sector partnerships, NGOs, CBOs and women's groups (including WATSAN committees). The role of the government in rural water supply is thus changing from implementing to enabling and monitoring. This new role will involve new responsibilities:

- Facilitating local government and CBO's to implement water supplies
- Water quality surveillance
- Conflict resolution, which relates to:
  - priority of resources for drinking water and thus the problems of reduced water availability due to falling groundwater tables and reduction in base flow in rivers;
  - water quality protection from pollution (through land use planning and zoning), pollution prevention and clean-up;
  - economic measures, such as taxation and subsidy;
- Emergency remediation (safe water as a right?).

The new role of the government warrants the need for improved information management and strategic planning capability. Significant efforts have been made in management of information through the establishment of the National Water Resources Database (NWRD) under NWMPP. In itself this has been a great achievement, but is not sufficient for rural water supply management. A more focussed approach is required to allow the concerned government agency (DPHE) to fulfil its responsibilities. It is the opinion of the author that this system comprises the following elements:

- A Geographical Information System (GIS) that includes all components required for strategic planning for rural water supply. The GIS should include all information on groundwater and surface water, both quantitative and qualitative. All information that describes the spatial and temporal variations in the resource should be included in the GIS. This includes monitoring data on groundwater levels, river flows and water quality. The other important information to be incorporated is largely non-technical and includes information on social and gender issues and water supply organisations.
- Resource assessment and planning tools that integrate groundwater and surface water, and are capable of assessing both quantitative and qualitative responses. Resource models are essential to assess resource availability and vulnerability at both regional and local scales and to assess impacts of both climatic conditions and human activities. Water quality models are needed to assess both long and short-term changes in water quality, be it movement of arsenic in groundwater, saline intrusion in the coastal belt or the impact of industrial pollution on surface and groundwaters.
- Tools that allow quantitative prediction of water demand and responses. Such tools should also be able to assess human response to new methods of rural water supply.

Although the capability to undertake the development of GIS and resource assessment and planning tools is available in Bangladesh, one first needs to address a number of important issues:

- How easy will it be to access the NWRD? What type of institutional and communications link can be established and what are the cost implications? Is the NWRD truly a national resource?
- Does DPHE have the capability to undertake rural water supply management with the tools described above? This requires thinking seriously about the role DPHE will play in the future and its internal structure and staffing profile. A new range of skills is required.
- Who will be responsible for monitoring? Information is collected by other organisations, and problems with data integrity or late delivery to the NWRD would inevitably affect the management process.
- Within DPHE, who will access the GIS and be capable to operate the resource assessment models? What will be the links to the local and regional water supply and sanitation bodies?
- And last, but not least, how will the GIS be used and for what purpose? One must seriously consider the use of the GIS and resource assessment tools for planning, monitoring and implementation. One may consider the involvement of local organisations involved with the specialist applications of GIS and resource modelling, such as EGIS and SWMC

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