Policy priorities for **the boom in urban private wells**

Rapid urban population growth has led to a boom in private well construction to access groundwater supplies. Evidence from four Indian cities highlights the need for coherent public policy to harmonise private and public investment in urban water supply. By **Mohammad Faiz Alam** and **Stephen Foster**.

The Agrasen ki Baoli step well, a designated monument, in Delhi

© Manu_Bahuguna / iStock

Globally, the urban population is growing at an unprecedented rate. Meanwhile, the coverage and reliability of utility water supplies in developing cities remains widely inadequate. Consequently, people turn to other ways of meeting their water needs. The result is that private self-supply, using in-situ wells (taken here to include all types of borehole, borewell, tubewell and dugwell), is booming, especially in the cities of South Asia, tropical Africa and Brazil. Yet such off-grid supply remains poorly documented and inadequately evaluated in public policy terms.

The need to define public policy

Preliminary studies of the extent of urban groundwater use from private wells have been carried out for Fortaleza and Recife in Brazil and Lucknow in India (by the World Bank GW-MATe Program; Foster 2010) and for Bangalore in India, Lusaka in Zambia, and Accra in Ghana (Grönwall *et al* 2010; Grönwall 2016). More recently, the situation in selected tropical African cities was summarised (Foster *et al* 2018). These studies provide considerable evidence of increasing dependence on private wells in response to rapid urban population growth and escalating water demand, facilitated by the generally modest capital cost of constructing wells.

There is an urgent need to take stock of urban private

Mohammad Faiz Alam, of the International Water Association Groundwater Management Specialist Group, is at the International Water Management Institute, Delhi Office, India. **Stephen Foster**, Chair of the International Water Association Groundwater Management Specialist Group and Past President of the International Association of Hydrogeologists, is at University College London, UK

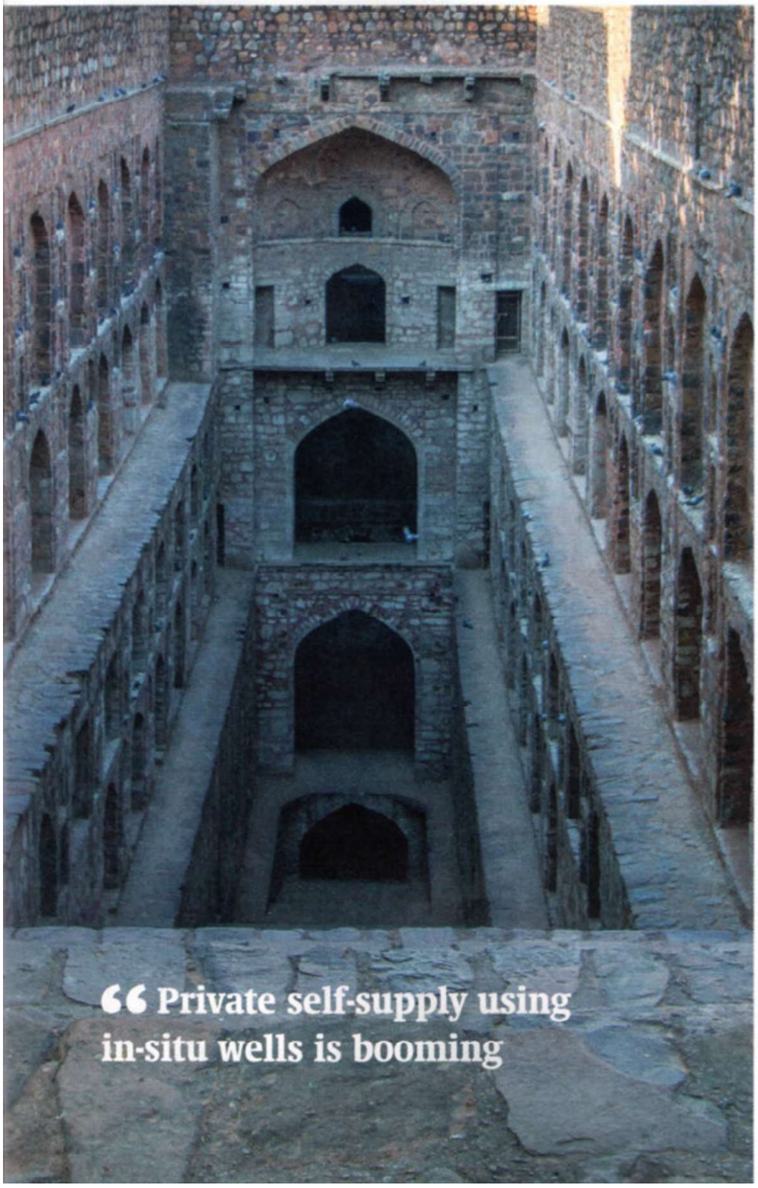
well use and better understand the dynamics of overall investment in water supply provision and its associated socio-economic implications. Public policy needs to be formulated to reconcile the widely differing perspectives of private users and public utilities. A key question is whether 'off grid' solutions to water supply provision have an increasing role to play despite their potential health risks and apparent lack of economy of scale.

Among higher income groups, ownership of a private well is widely seen as enhancing personal supply security in the face of an unreliable public supply. Properties with wells (or favourably located for access to groundwater) attract a higher market value. There is also a widespread perception that groundwater is of excellent quality and private wells are, therefore, reasonably safe. While there is some truth in this, an adequately performing water utility could offer a more secure supply of assured quality. On the other hand, the technological and financial inefficiencies of many urban water utilities in the developing world mean there is a question as to whether this can be done at comparable cost.

From a water utility perspective, unregulated private access to groundwater in urban areas often means large numbers of affluent residents opt to obtain most of their water from in-situ self-supply. This could free up utility water production to meet the needs of low-income neighbourhoods, but substantially reduces utility revenue collection and makes it more difficult to mobilise investment in new infrastructure and maintain highly subsidised social tariffs. In addition, if mains sewerage is (or is planned to be) provided, private self-supply wells will generate additional sewer flows, for which a way has to be found to collect charges.

The scale of private self-supply, and how this can compare with water utility supply provision, is highlighted by assessment of four Indian cities – Aurangabad, Indore, Delhi and

“There is an urgent need to take stock of urban private well use



The Agrasen ki Baoli is one of the wells in Delhi that has now been sealed

© JulieanneBirch / iStock

“Private self-supply using in-situ wells is booming

Delhi, Federal Capital

Delhi is home to more than 17 million people and its water supply is managed by Delhi Jal Board (DJB), an autonomous public organisation. The DJB water supply network covers 82% of households and supplies 4720 Ml/d. The DJB obtains its supply mainly from surface water sources, with only 360 Ml/d being groundwater, abstracted from more than 420 wells.

The DJB faces a supply gap of about 480 Ml/d, with distribution losses as high as 40%. With its supply reliability only about three hours/day, private well construction has soared, although this is not reflected in official statistics. Independent estimates from the Central Ground Water Board indicate that private domestic and commercial groundwater abstraction in Delhi is about 680 Ml/d. The 2011 census shows that 280,000 households report tubewells / borewells as their main source of drinking water, and almost 180,000 households reported handpump wells as their main source. Overall, almost 6% of households depend on groundwater, with the associated private capital investment on borewells/tubewells estimated at $230 million ($70/household) and private operational costs at $2.5-4.0 million/year. This high private capital and operational cost for groundwater use contrasts with the DJB's poor financial situation, with a cost recovery ratio of only 42%.

There has been a recent drive to seal illegal wells to mitigate urban groundwater depletion. However, given the poor reliability of the public supply, private in-situ groundwater abstraction is expected to continue. Consequently, there is a need for a more nuanced approach to mapping private groundwater supply so that the public utility supply can be better integrated with this reality.

Chennai (see boxes). This assessment reveals the urgent need for public policy formulation on what is a critical future issue for many developing cities.

Evaluating the self-supply phenomenon

These case studies, supported by the earlier evaluations, show that private self-supply from groundwater in developing cities varies somewhat with urban evolution and hydrogeologic setting, but is often a major component of total urban water supply, and one that is not frequently recognised in official reports.

Initial private investment in well construction is usually triggered by highly inadequate utility water services, as a coping strategy for water supply security by multi-residential and individual properties, commercial premises and industrial enterprises. A further conclusion is that the unit cost of private groundwater supplies is often lower than that of the municipal water supply operational cost and so the 'unsubsidised tariff'. As a result, private well use continues as a cost reduction strategy even when public supply has improved.

These conclusions must be considered in the wider context of urban groundwater. It is important that resources are used efficiently and sustainably in developing cities, as they can play a key role in climate change adaptation. In this context, it will be important to manage the large groundwater storage of most aquifers as a strategic reserve to be used with surface sources to improve supply security. To achieve this, monitoring, assessment, management and protection of groundwater must be improved, applied research programmes commissioned to increase the understanding of key hydrogeologic processes, and political and public awareness of the critical role of groundwater greatly improved. This means it will be very important to undertake detailed economic and technical evaluations of private self-supply, looking at how it can be better harmonised with utility water and sanitation services and investments.

Self-supply can help to relieve pressure on urban water utility resources, particularly for non-sensitive uses (such as irrigating gardens, parks and sports fields, laundry, cleaning and cooling systems). It can also help to guard against urban water table rebound and related drainage problems, should utility abstraction reduce radically. But if many affluent residents opt for self-supply, there are many complex knock-on financial effects that must also be evaluated.

The results of such evaluations are, therefore, urgently needed to inform public opinion and policy decisions on planning future urban water services. Governments need to explore ways in which water utility operations can be expanded to include monitoring and management of self-supply from groundwater (including use metrics, sewer discharges, quality hazards and suitability for use) and working more closely with water resource regulators on groundwater evaluation and quality monitoring. It is recognised that, to make these activities possible, the current governance provisions and mandates of some utilities will need to be revised.

An emerging policy question is whether the risks of private residential self-supply might justify an attempt to ban urban well drilling. The potability of groundwater from private wells in urban areas is often open to question, as shallow wells may be easily polluted by sanitary latrines and fuel oils stored nearby. If an assessment identifies serious

Aurangabad, Maharashtra State

Aurangabad has grown rapidly in recent years, to a population of about 1.2 million. In 1998, public water supply became the responsibility of the Aurangabad Municipal Corporation (AMC), which takes 150 Ml/d from a reservoir 45km away and at a 180m lower elevation. This supplements local groundwater sources that provide a maximum of 15 Ml/d. However, electrical power shortages for the required high-lift pumping often result in a very poor service level (widely less than one in 24 hours). Consequently, most residential properties and commercial premises have drilled borewells.

The area has limited resources and the water table post-monsoon is about 5m below ground level, falling to more than 10m below ground level in the dry season. Well capital costs are very low (generally less than $400). An expenditure review revealed that private groundwater costs $0.15-0.25/m^3, compared with tankered water at $1.30-1.35/m^3. When available, the highly subsidised municipal piped supply is $0.03/m^3, although AMC incurs operational costs of $0.16/m^3 for production. As most borewells fail during the dry season (April to June), the decision to construct wells is not primarily related to resource availability. It is a coping strategy to reduce the period when users have to purchase expensive tankered water. As a result, about 60% of the total supply (0.32-35 Ml/year) is met from wells, 35% by the AMC, and only 5% from tankers.

Chennai, where overabstraction means there is a risk of saline intrusion

© bigapple / iStock

hazard from groundwater pollution or over-exploitation, the managing entity could consider registering all commercial and industrial users, together with residential use for apartment blocks and other multi-occupancy housing. It could also charge – directly by metering or indirectly by estimated sewer discharge – for abstraction to constrain use, and to issue advice on water quality or health warnings to private well operators. If severe pollution occurs, it could also declare sources unsuitable for potable and sensitive uses.

Historically, urban private well bans have been introduced as part of efforts to control specific waterborne diseases or the effects of aquifer depletion from excessive abstraction. But they are difficult to police and sustain, unless an abundant public supply is available at an attractive cost. Moreover, in many hydrogeologic settings, intensive private well use – in the absence of large water utility abstraction – does not cause overexploitation as water mains leakage and in-situ sanitation seepage often provide abundant aquifer replenishment in urban areas. ●

Indore, Madhya Pradesh State

Indore, one of India's fastest-growing cities, has a population of about 1.9 million and almost 0.5 million households. The Indore Municipal Corporation (IMC) faces major challenges in trying to meet escalating water demand and has currently only achieved 46% water mains coverage, with a supply reliability of about 1 hour/day on average. The IMC water supply amounts to about 320 Ml/d, of which 42-60 Ml/d (15-20%) is from groundwater. Private groundwater use (residential, industrial and commercial) is estimated at 100 Ml/d. Little is known about groundwater quality, or any risks to human health for private residential well users, and a survey of groundwater quality issues must be an urgent priority for the city.

It is estimated that 35-40% of all households rely on private wells as their main drinking-water source. There are an estimated 150,000 residential wells producing about 90 Ml/d, with a notable capital investment of $87 million (or $190/household). The unit cost of private groundwater supplies is calculated at $0.04/m^3 compared with the supply cost incurred by the water utility of $0.23/m^3.

The estimated operational cost of private wells is $1.4-2.0 million/year, which represents 36% of the annual utility water supply revenue, demonstrating the magnitude of private investment in securing an urban water supply.

References

Foster S, Hirata R, Misra S & Garduño H 2010. *Urban groundwater use policy – balancing the benefits and risks in developing nations*. GW-MATe Strategic Overview Series 3. World Bank (www.un-igrac.org).

Foster S, Bousquet A & Furey S 2018. *Urban groundwater use in Tropical Africa – a key factor in enhancing water security?* Water Policy 20: 982-994.

Grönwall J, Mulenga M & McGranahan G 2010. *Groundwater, self-supply and poor urban dwellers – a review with case studies of Bangalore and Lusaka*. IIED Human Settlements-Water & Sanitation Paper 26.

Grönwall J 2016. *Self-supply and accountability: to govern or not to govern groundwater for the (peri-)urban poor in Accra, Ghana*. Environmental Earth Science 75: 1163–1173.

Case study data sources for Aurangabad (A), Indore (I), Delhi (D) and Chennai (C): World Bank GW-Mate Case Profile 2008 (A), Indian Census 2011 (A, I, D), Central Groundwater Board of India 2018 (A, I, D), Ministry of Housing & Urban Affairs Service Level Benchmarking 2009 (I, D), IMC Budget Estimate and Service Level Improvement Plan 2016-17 (I), Delhi Jal Board Budgetary Transactions 2016-17 (D), Guntoju, Alam & Sikka, www.downtoearth.org.in 2019 (C).

Chennai, Tamil Nadu State

Chennai Metropolitan Area is the fourth-largest urban conglomerate in India, and its 8.6 million population is currently facing an acute water crisis. Chennai's four main reservoirs/lakes have almost dried up as a result of persistent drought, and combined surface water storage stood at only 0.1% of total storage in June 2019. During the worst days of the crisis, the water utility was only able to supply about 525 Ml/d of the total demand of 830 Ml/d. Much of the city became totally dependent on groundwater, which is abstracted extensively within and outside the city limits.

Within the city, there are about 420,000 private wells. But, because of long-term overexploitation and limited recharge during recent poor monsoons, the water table has fallen, causing wells to dry up, and groundwater quality to deteriorate, with the risk of seawater intrusion. As a result, more than 5,000 tankers of 9,000-litre capacity have been doing five to six trips daily to supply groundwater from the surrounding rural areas for the water utility and private operators, at a total rate of 200-300 Ml/d. However, groundwater overexploitation has led to conflicts and tensions at the urban-rural interface.