



# Reducing the costs of borehole drilling in Africa: insights from Ethiopia

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**Borehole drilling is particularly expensive in Africa. Technical solutions to reduce costs include reducing borehole diameter and inserting a PVC rather than steel casing, but institutional factors such as the development of the private sector for drilling may add to the costs.**

**B**orehole drilling costs in Africa are perceived to be very high, and indeed this is generally true in absolute terms. While a hard-rock borehole in India might be constructed for around US\$1,000, the corresponding borehole (similar depth, same purpose – community handpump supply) in many African countries would cost 10 times as much, or more. Given the heavy dependence of much of rural Africa on groundwater, and the projected future needs for borehole drilling to meet the Millennium Development Goals (one million boreholes – see Baumann and Carter, this issue), even small cost savings could be very significant.

Against this background the World Bank's Water and Sanitation Program (WSP) recently commissioned a country case study under RWSN's Cost-Effective Boreholes flagship.<sup>1</sup> The purpose of the study was to identify strategies for cost saving, based on a sound understanding of the drilling sector in Ethiopia. The study was carried out by a team of five Ethiopian consultants (with backgrounds in hydrogeology, economics, institutions, water engineering and drilling) under the leadership of Richard Carter (Cranfield University, UK).

## Country background

Ethiopia's natural and physical environment is characterized by diversity. Altitudes range from 125m below sea level in the Danakil depression (Afar Region) to over 4600m above sea level

in the Simien Mountains of Amhara Region. Mean annual rainfall varies from less than 100mm in the Ogaden (Somali Region) to over 2500mm in the Gambella highlands. Around 70 per cent of the population live in the 1500–2400m altitude range. The geology is extremely heterogeneous, including intrusive and extrusive volcanic rocks, extensive sedimentary formations and alluvial deposits. Infrastructure, especially all-weather road access, is poor.

Strong state control affects any development activity in Ethiopia. Telecommunications, including internet, email and mobile telephone, are under state monopoly. Importation is subject to rules such as those requiring the use of national carriers. Registration and licensing of groundwater professionals and drilling companies are demanding (although not yet fully enforced), and the numbers of personnel required are more reminiscent of public sector operations than more streamlined and modern ways of working in the private sector. Insecurity is an issue in some parts of the country, notably northern Tigray and Afar, and Somali Regions. Finally, drilling activity in Ethiopia takes place not only in the usual rural contexts (domestic and agricultural) and urban contexts (domestic and industrial), but also in emergencies (triggered especially by regular and frequent droughts) and in the government's ambitious resettlement programme, through which more than two million people are currently being moved from

vulnerable and drought-prone areas to more favourable living conditions.

## Understanding the context

A mix of state and private or civil society players operate in Ethiopia's drilling sector, and financial commitments in the run-up to 2015 are significantly increasing, with rapid expansion in private-sector activity from home and abroad – in short, a very dynamic situation.

As elsewhere, federal government's role has evolved from that of service provider to setting sector policy and strategies, channelling funding and providing guidance to the regions, and regulating the private sector and other



Private sector drilling companies have only recently emerged in Ethiopia



Large distances between drilling sites add to costs

providers of goods and services. The Regional Water Resources Bureaux (RWBs) in turn are the major purchasers of contracted-out services, such as borehole drilling, using donor and nationally generated funds. Where Ethiopia differs from many other African countries is in the supply side of the equation. Box 1 summarizes some of the main features of the drilling sector, with a focus on the main groups of players.

## Technical and contractual solutions

Much work on borehole cost reduction in Africa has centred around what are now well-known technical and contractual solutions. It is clear that by reducing borehole diameters or depths, by using plastic instead of steel casings, and by packaging drilling contracts to reduce mobilization costs, costs can be reduced in certain circumstances.<sup>2</sup> Table 1 sets out some of the options for reducing the four main cost components of a borehole.

## Seeing the bigger picture

The performance or 'health' of the drilling sector in a particular country depends on many factors, which may influence what can be done in technical or contractual terms to reduce borehole construction costs. For example:

- In Ethiopia, although drilling success rates are high (70-80 per cent, particularly good given the extremely

### Box 1. Ethiopia's drilling sector players

*The state enterprises*, which are still the preferred service providers for the RWBs, especially in emergency and resettlement programmes, have evolved over the last 30 years from the public authorities of the post-imperial/early Derg period. The oldest dates back to about 1975. Six of Ethiopia's regions (Tigray, Amhara, Oromia, SNNPRR, Somali and Afar) have enterprises which are engaged in water-well drilling, while some of these same regions, and two others (Benishangul-Gumuz, Gambella) have drilling capacity within their Water Resource Bureaux. The state enterprises are expected to operate in a financially viable manner, without state subsidy, and to compete with the private sector. They differ from the true private sector, however, in three important respects: (a) they are governed by boards, often comprising mainly government personnel; (b) they are usually the contractor of preference for (regional or federal) government; and (c) they are subject to civil service rules concerning matters such as employment and procurement.

*Large donors*, including the World Bank, the African Development Bank, the European Union, and the Netherlands Government, have either recently started or are about to commence significant water sector investment programmes. A large part of the capital investment brought in through these programmes will inevitably be spent on groundwater development. Although the amounts of money and the timings involved remain uncertain at the present time, it seems likely that annual water sector expenditure may soon more than double from the US\$68m (fiscal year 2001-2) estimated by WSP (2004).

*The private sector*. This is a relatively recent phenomenon in Ethiopia. The oldest company started business in Ethiopia in 1991, and thus only has 14 years' experience. In recent years the indigenous private sector has experienced competition from foreign firms, especially from China and India. These seem able to operate at significantly lower costs than the indigenous private sector (although it is not clear to what extent this is achieved at the expense of construction quality, staff conditions, or competitive practices). In total around 25-30 private drilling companies now operate in Ethiopia.

*Non-governmental organizations and faith-based organizations*. A few of these have their own drilling equipment. Other NGOs sub-contract drilling to state enterprises or private companies, but use their own in-house or consultant expertise for surveys, design and supervision.

heterogeneous geology), there is often great uncertainty prior to drilling as to how deep the groundwater is. Consequently heavyweight equipment tends to be mobilized, in case of need to drill deeper than predicted, so adding to overall construction costs.

- The procedures for importation of equipment and spare parts may be very cumbersome for indigenous contractors, so extending down-times and hence drilling costs. Even if a minor spare part is required for rig or compressor, it may take weeks or even months to obtain this.



Drilling draws a crowd in Kadogly, Sudan

Table 1. Technical and contractual approaches to reducing borehole costs

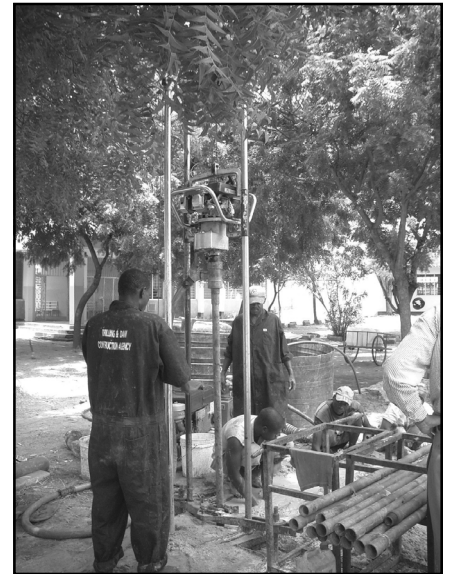
Cost component	Possible areas of saving	Comments
Mobilization	<ul style="list-style-type: none"> <li>• Packaging (letting contracts of multiple wells in similar geology to one contractor) and clustering (close proximity of wells in package).</li> <li>• Use of lightweight equipment needing fewer support vehicles.</li> </ul>	Since nothing can be done to reduce distances involved, the only strategies can be to aim for economy of scale, or use smaller, lighter equipment.
Drilling	<ul style="list-style-type: none"> <li>• Use of lightweight equipment where possible (with lower depreciation costs).</li> <li>• Adoption of well designs involving shallower depths and smaller diameters (so reducing energy costs and costs of drill fluids).</li> <li>• Enhanced efficiency of 'conventional' drilling operations.</li> </ul>	<p>The first two (which are inter-linked) are only possible where groundwater occurs at shallow depths, and where low well discharges are acceptable, enabling the use of small diameter pumps.</p> <p>Improved drilling speeds and efficiency of use of equipment are possible through best management practices, including incentives for drill crew.</p>
Casing	<ul style="list-style-type: none"> <li>• Use of plastic (rather than steel) casing and screen, where possible.</li> <li>• Adoption of well designs involving shallower depths and smaller diameters (so reducing length and diameter of casings and screens, and smaller annular volumes for gravel packs).</li> <li>• Enhanced efficiency of installation.</li> </ul>	<p>Not possible in situations where high yields are needed, or groundwater is deep. uPVC casings are not generally used in wells deeper than about 100m.</p> <p>Efficiency savings reduce installation times.</p>
Development and test pumping	<ul style="list-style-type: none"> <li>• Shorter test pumping periods for low-yielding wells.</li> </ul>	<p>Short-cuts should not be taken with development, since these would adversely affect long-term performance.</p> <p>There is an argument for carrying out less-demanding yield/draw-down tests for handpump wells, but these should not be omitted altogether.</p>

- The number and expertise of available professional and technical personnel (hydrogeologists, geophysicists, drillers, mechanics) may be limited. In Ethiopia for instance there is now only one institution that provides practical drilling training, but this is only for public sector trainees. The private sector has to rely on attracting staff from the public sector with better remuneration packages and conditions of service.
- The procedures for tendering and for winning contracts vary from country to country in terms of their clarity,

transparency, fairness and degree of interference by politicians or others with vested interests. A healthy contracted-out drilling sector is one in which the procedures involved are clear, predictable, fair and free from interference.

## Conclusions

The technical and contractual means by which drilling costs can be reduced are well known. They include drilling at smaller diameters, to shallower depths than has been common, and using plastic casing and screen rather than steel. They involve the use of small rigs



Smaller drilling rigs are cheaper to mobilize

which are less costly in terms of capital and depreciation, and cheaper to mobilize. If contracts are packaged and clustered, economies of scale can be achieved.

However, while these solutions are appropriate in areas of predictable geology, and where small-scale point water sources are required, their application is more difficult in countries with very diverse geology, less predictable hydrogeology, and, frequently, considerable depths to water. Ethiopia falls into this category.

Finally, technical and contractual solutions can only be applied within a conducive operating environment. If public sector institutions and private companies are willing to adapt; if governance issues are properly addressed; and if investments are made in supporting knowledge-based products (including geological databases), training, and research and development; then it is more likely that such solutions will be adopted and applied with intelligence and purpose.

## References

- 1 RWSN/WSP (2006) 'Cost-effective boreholes country case study, Ethiopia', RWSN.
- 2 Ball, Peter (2004) 'Solutions for reducing borehole costs in rural Africa', WSP Field Note.

## About the author

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