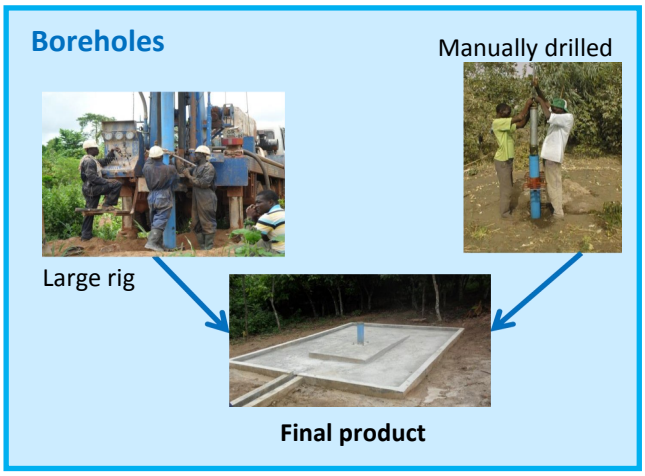


MANUAL DRILLING LEARNING SERIES

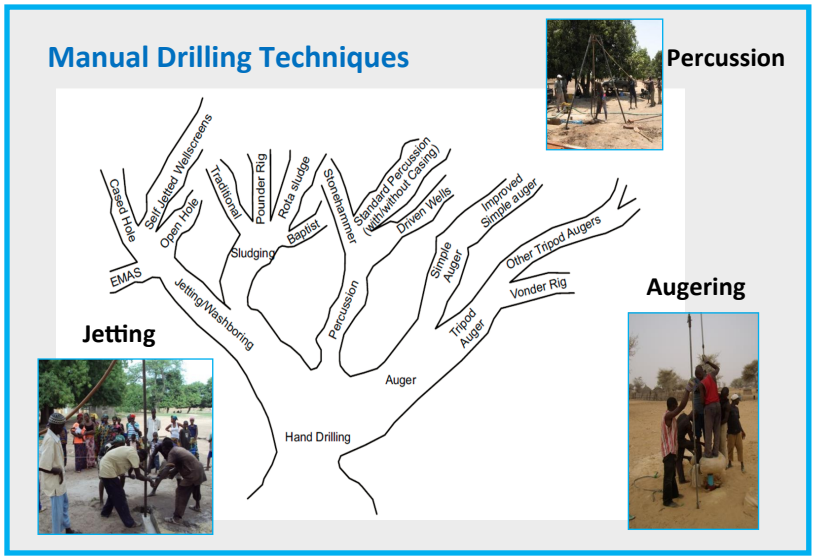
Learning Note 1: Introduction to Manual Drilling Technologies and their Potential to Improve Rural Water Supplies (11 February 2014)

What is Manual Drilling?

Manual drilling has a considerable history and is extremely widespread in parts of India, Bangladesh, Nepal, Nigeria and Niger. In contrast there are a number of African countries (including Guinea, Liberia, Mauritania, Malawi, Sierra Leone and Zambia) where manual drilling technologies have been more recently introduced. In such cases, the manual drilling is operating at a very small scale, with technologies still being tested and piloted. Chad and Senegal are examples of countries where technology uptake is currently at a tipping point, from a few thousand to tens of thousands of wells; in other words transitioning from piloting to large scale.



During the webinar, manual drilling techniques were defined and limitations and opportunities for manual drilling. In general boreholes can provide better quality water without additional treatment, compared to surface water and open hand dug wells. Boreholes can be drilled from the surface, using a variety of techniques ranging from truck-mounted rig to hand operated tools. People often associate hand drilled or manually drilled boreholes with a large diameter open well, but a borehole is actually less than 200mm in diameter and is drilled from the surface. There are numerous manual drilling techniques available, all of which use, or combine augering, percussion and jetting or washboring. Details of these techniques can be downloaded from the UNICEF Manual Drilling toolkit (www.unicef.org/wash/index_49090.html) and are summarised in the webinar presentation which is available on the UNICEF intranet page (http://uni.cf/1jH8dor).



All drilling techniques need to be able to:

- Penetrate the formation to be drilled
- Remove the loose material from the hole
- Support the hole to prevent collapse during or immediately after drilling

Manual drilling can do all three, but only works where the formation is not too hard and the depth to the aquifer (water bearing formation) is relatively shallow. Generally, the depth drilled with manual drilling does not exceed 50m but, in Nigeria for example there are places where manual drilling has reached 120m.

Favourable conditions for manual drilling are usually found in low lying areas of loose unconsolidated sediments or of highly weathered crystalline rocks with adequate precipitation. In Sierra Leone, the coastal plains and alluvial sediments and inland valley swamps are particularly suitable for manual drilling. Within the weathered crystalline rocks, suitable areas can also be located.

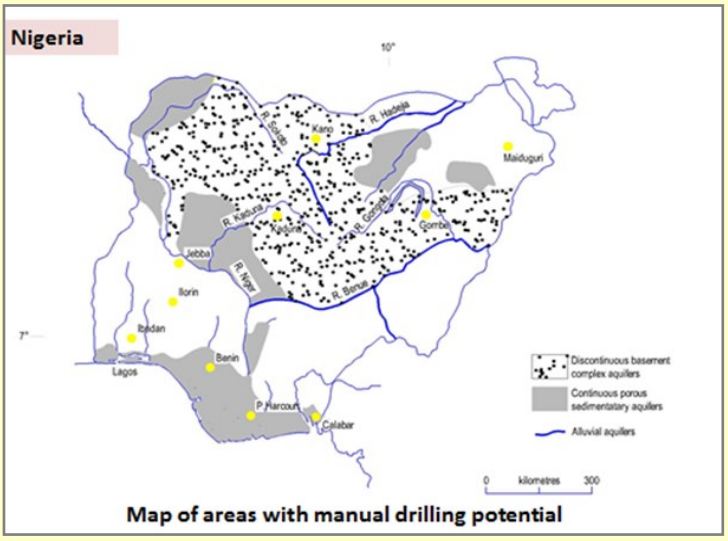
Case Study

Manual Drilling Case Study 1: Nigeria

Tubewells have been constructed manually for irrigation in the alluvial flatlands of Nigeria since the early 1980s. From irrigation, the practice has been extended to water supply. Nigeria is underlain by approximately 50% sedimentary and 50% crystalline rocks.

The areas of proven shallow aquifers suitable for manual drilling in Nigeria are:

- The alluvial deposits along the flood plains of the major rivers
- Discontinuous weathered crystalline rock aquifers
- Continuous sedimentary aquifers



Map of areas with manual drilling potential

The alluvial deposits are usually developed for irrigation, but some communities have also developed these for water supply. In these areas there are concerns about contamination by fertilisers and surface water incursion.

There are zones in of deep weathering on the basement complex which can be reached by manual drilling. In the northern states of Bauch, Kano, Kaduna and Zamfara states manual drilling is being successfully carried out. The continuous porous sedimentary aquifers include the shallow coastal plains sand aquifers that run from the west to the east of the country, underlying the cities of Lagos, Benin, Port Harcourt and Calabar as well as Edo State. In fact, in these areas most of the drilling is undertake manually and could be extended further into rural areas. However, there are concerns about over abstraction in densely populated urban coastal towns.

Case Study

Manual Drilling Case Study 2: Sudan

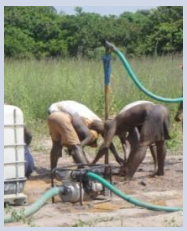
Sudan also comprises 50% sedimentary and 50% crystalline rocks. About 2% of the land area of the country is covered by alluvial deposits. These occur along the floodplains of the Nile River and its tributaries as well as the Wadis of Gash, Nyala and Azum. The deposits are in hydraulic continuity with the river channels and are recharged annually by river flows and precipitation. The thickness of the material ranges from 10 to 60m with water levels ranging from 2 to 20m. As in Nigeria, the weathered crystalline rocks of Sudan also have the potential for rural water supply by manual drilling.

The examples show that shallow aquifers in unconsolidated sediments and highly weathered crystalline rock with adequate recharge are suitable for manual drilling. Terrains with similar hydrogeological conditions on the continent are likely to provide an opportunity for rural water supply through manual drilling.

Why is Manual Drilling a critical component of UNICEF's WASH agenda?

A manually drilled well is an important complementary technology that can improve drinking water access in regions with suitable geology and hydrogeology. In Africa, manually drilled wells can cost 4 to 10 times less than machine drilled wells.

In 2010 UNICEF, in partnership with EnterpriseWorks/Vita and Practica Foundation launched a toolkit that sets out a step by step methodology for the promotion of a local professional manual drilling sector.

35-meter Deep Well in Senegal		
Manual Drilling	**Small Rig**	**Large Rig**
		
$2,238	**$3,168**	**$9,014**

It is worth considering manual drilling due to:

- The relatively low investment costs for businesses to enter the market
- The fact that all tools and supplies can be carried to locations that are inaccessible for a vehicle
- Local manual drilling businesses create local employment
- Drilling costs are lower than for machine drilled wells.

Manual drilling should be considered as the first alternative when drilling conditions are favourable, followed by small rigs and finally larger machines.

Given the potential of manual drilling to improve drinking water supplies, together with the growing interest in the technology, there is need to monitor progress, share experiences and enable stakeholders to learn about good policies and practices. The first Manual Drilling webinar has kicked off this process. The second webinar of the 18th February will enable the sharing of experiences of manual drilling at scale from India, Senegal, Nigeria and Bolivia.

Questions raised during the Webinar:

How can I know if Manual Drilling is suitable in my region?

The first step would be to obtain a topographical map of the country and identify the low lying areas and floodplains of the major rivers. From a geological map, look for the sediments in the coastal areas and for the soft formations, loose formations, sands and gravels not the hard rock. There may be need for the help of a geologist or hydrogeologist to help. Some mapping of potential for manual drilling has been undertaken for Chad by UNICEF (http://www.unicef.org/wash/index_54332.html).

How can we ensure the quality of manually drilled wells?

Training and regulation of drilling businesses is vital. Drillers should understand basic hydrogeology as well as how to design and construct a quality borehole. They also recommend that the government undertakes some form of certification; which is also important for the regulation of machine drilling. During the webinar there was some discussion with respect to the level of professionalism of the estimated 200 manual drilling enterprises in Nigeria. Experience has shown that the quality of manually drilled wells, when carried out professionally, is comparable with that of machine drilled wells.

In the case of village water supplies in Senegal and Ghana, work has been going on to develop manual drilling standards that meet similar criteria to those of conventionally drilled wells, particularly with respect to development, gravel packing and sanitary seal. It was pointed out that manual drilling standards vary, depending on whether there is a higher emphasis on construction quality or price. In Chad the government has set relatively high standards whereas in Tanzania the relatively lower standards allow for cheaper materials.

Overcoming biases against manual drilling is a major challenge and Jon Naugle pointed out the need to prove that the quality of the final water supply does not depend on how the borehole is made. In other words a 40 meter well fitted whether machine or manually drilled is basically the same final product provided that the same casing and gravel pack are used and the same development are carried out.

There was considerable exchange regarding the cost of manual drilling and this was shared directly between the webinar participants. Arjen van der Wal pointed out that it is very difficult to compare prices from one country to another, and that price needs to be considered alongside construction quality, including the casing, development and completion of the borehole. It was also pointed out that that the sustainability of the water supply depends on recharge, whether through rainfall of from river flow.

Did you miss the webinar?

You can watch the webinar on: http://vimeo.com/86508528.

A summary as well of all presentations and scripts (English and French) is available on: http://www.rural-water-supply.net/en/resources/details/565

Additional Resources

Other webinars

Jose Gesti Canto (2014) *Introduction to Manual Drilling and its Potential to Improve Drinking Water Supplies/Introduction sur les technologies de forage manuel et leur potentiel pour améliorer l'approvisionnement en eau potable en milieu rural*, Presentation at the 1st UNICEF -RWSN Webinar on Manual Drilling, 11th Feb 2014, Available on: http://www.rural-water-supply.net/en/resources/details/565

Arjen van der Wal and Jon Naugle (2014) *Introduction: Manual Drilling an Option for Rural Water Supply/le Forage Manuel, une option pour l'approvisionnement en eau potable en milieu rural,* Presentation at the 1st UNICEF -RWSN Webinar on Manual Drilling, 11th Feb 2014, Available on: http://www.rural-water-supply.net/en/resources/details/565

Dotun Adekile (2014) *Suitable areas for manual drilling in Africa/Zones appropriées pour le forage manuel en Afrique*, Presentation at the 1st UNICEF -RWSN Webinar on Manual Drilling, 11th Feb 2014, Available on: http://www.rural-water-supply.net/en/resources/details/565

Manual Drilling Technologies (RWSN): http://www.rural-water-supply.net/en/implementation/manual-drilling

Hand Drilling Directory (RWSN): http://www.rural-water-supply.net/en/resources/details/156

Professionalising Manual Drilling (UNICEF): http://www.unicef.org/wash/index_54332.html

Training videos (various): http://www.rural-water-supply.net/en/training-research

RWSN Publications: http://www.rural-water-supply.net/en/resources-top/sort/year-desc/filter/2_32_9
and http://vimeo.com/84021165