Technology Fact Sheet: Borehole drilling

Introduction

Access to a reliable and sustainable water source is the foundation for a successful irrigation project. Water can be sourced from surface reservoirs such as rivers, lagoons, and dams, or from groundwater sources such as wells and boreholes. When a borehole is drilled, different types of geological formations (soil layers) can be encountered. A range of different drilling techniques have been developed to drill through these diverse formations. In Mozambique, the success rate of drilling varies between 60-70%[1]. Drilling in the south of Mozambique is available using mechanized and manual drilling techniques. The design most frequently used in Mozambique for rural groundwater projects is presented in figure 1.

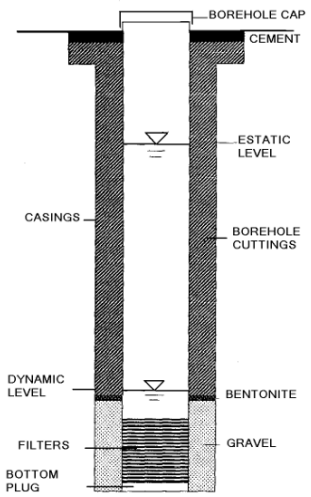

Figure 1 - Standard borehole configuration (DNA 1998)

(source: criteria for the construction of boreholes, second edition, DGRH, 1998)

The following aspects are part of the configuration:

- PVC casing with 4" internal and 4.5" external diameter until the base
- Bottom plug (non-specified material)
- Borehole of at least 6", with annular space of 2"
- Openings of 2 mm for filters
- Gravel
- Bentonite (Gravel seal)
- Filling
- Sanitary seal

Figure 1. Standard borehole configuration in Mozambique (DNA, 1998)

Technology characteristics

Mechanized drilling relies on the use of motors, gears and fuel to power through rock and tough soils. There are two techniques that can be combined: rotary (soft layer), which uses a rotating drill bit. And percussion (hard layer), which makes use of hammering. Both methods use the circulation of fluid to remove the cuttings and to prevent the borehole from collapsing.

The incorporation of a robust motor ensures enough torque to facilitate the drill's ability to go through resistant soil layers and reach deeper aquifers. Drilling equipment is often imported from South Africa, India, the USA and Thailand.

Figure 2. Manual drilling team using the jetting technique.

[1] A borehole is considered positive for irrigation purposes when the flow rate exceeds XX liter/min. Assessment of the national drilling sector capacity for rural water supply in Mozambique, WE-consult 2006.

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Manual drilling is a practical and affordable solution for wells less than 40 m deep in alluvial soils and soft-weathered rocks. These can be divided into four main techniques, which can be combined: Hand Auger, Manual Percussion, and Manual rotary.

The primary differences between mechanized and manual drilling are the drilling depth, hardness of soils, and the accessibility, skills, and equipment required for the execution of the activities; see table below. Both methods contribute to ensuring a sustainable and reliable water supply for successful irrigation projects in Mozambique.

Table 1. Advantages and disadvantages of drilling techniques

Drilling technique	Advantages	Disadvantages	Average drilling depth[2] (m)
Mechanized drilling	• Possibility to reach deeper aquifers • Professionalized sector (more than manual) • The final well is of higher quality compared to manually drilled wells	• More expensive than manual drilling • Not accessible for complicated landscapes or during emergency response • Drilling equipment needs to be imported • Higher skilled personnel required	40-150
Manual drilling	• Equipment can be easily transported to remote or difficult to access areas (by boat, horses) • Equipment can be produced and repaired on-site • Provides local employment for small enterprises • Cost savings: 4-10 cheaper than mechanized drilling	• Relies on human energy to construct the borehole. • If the water level is too deep, it cannot access it. • Difficult to go through resistant soil layers	10-40

Potential co-benefits of borehole drilling for irrigation

Environmental	Borehole drilling initiatives in Mozambique offer substantial environmental co-benefits. By providing reliable access to clean and safe water sources and contributing to the conservation of local ecosystems. Reduced reliance on surface water decreases the risk of contamination and supports the preservation of biodiversity. Additionally, sustainable management of groundwater resources ensures the long-term health of the environment, promoting resilience in the face of climate variability.
Social	Access to reliable water sources for irrigation enhances food security, providing communities with a stable and diversified source of income through agriculture. Additionally, this initiative empowers local farmers, especially women, by reducing the physical demands of manual water collection.
Economic	Increased agricultural productivity, made possible by reliable and accessible water sources, leads to higher crop yields and improved income for farmers. Contributing to local economic improvement. The shift from rain-fer agriculture to irrigated farming

[2] Highly dependent on the soil layers where it is being drilled.

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	mitigates the impact of climate variability on crop-yields, ensuring a more stable income for communities.

Applicability and potential to Pangalata association

Water availability in the surroundings of the Pangalata association fields is not a problem as its location is privileged on the bank of the Incomati River. However, the riverbank faces erosion each year, forcing the water to recede during the dry season. There is a real risk of sudden high-water levels during the rainy season due to a dam in South Africa (upstream) that gets opened with only one hour's notice. As information does not reach the community quickly, the risk of losing any infrastructure installed in the bank instalment is high. Through the first field recognition, it has been determined that chances for drilling a borehole are high, and it is the preferred option of the community as it will allow for the pump to be located in their agricultural plots, increasing the security of the assets. Therefore, potential is assessed as medium-high.

Sources:

- We Consult, 2006. Assessment of the national drilling sector capacity for rural water supply in Mozambique.
- Practica foundation, 2006. Understanding groundwater and wells in manual drilling. Instruction handbook for manual drilling teams on hydro-geology for well drilling, well installation and well development.

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