Water supply

Deciding which type of water supply technology will suit a community depends on their needs and the water sources available in the area. Drinking water supplies must use uncontaminated sources, as treatment chemicals and equipment are too expensive for benefiting communities.

WaterAid/Caroline Penn

Falling rainwater is some of the cleanest naturally occurring water available and where it falls regularly there is scope to collect it, before evaporation takes place and before it becomes contaminated. This is called **rainwater harvesting**. Water is generally collected from pre-cleaned roofs, where it runs via guttering in to a storage tank.

However, using a clean surface water or groundwater source is often more preferable as the quantity and quality are generally more reliable.

Uncontaminated **surface water supplies** include small upland rivers, streams or springs. In some areas springs can be tapped, protected and used directly at their source. Spring protection to prevent contamination includes fencing the surrounding area to prevent animals entering, a concrete retaining wall and outlet pipe to keep the area clean while buckets are filled and a drainage area below to prevent pools of stagnant water collecting.

In hilly areas, water can be piped down to communities from higher water sources through **gravity-fed schemes**. The spring or small unpolluted stream is tapped, dammed and protected at its source before being piped down to storage tanks in villages. Distribution pipes then feed protected tapstands allowing people to draw water close to their homes.

This method avoids the potential mechanical problems of pumps, but still needs careful maintenance to keep the water clean. The initial costs for these schemes are high due to long pipelines and storage tanks, but the running costs are very low. Conversely, the level of service is high.

However, far more people worldwide rely on **groundwater** for their drinking water. Groundwater is usually safe to drink because permeable layers of earth act as fine filters removing bacteria and other impurities as water seeps through.

Hand-dug wells are the most common method of abstracting groundwater in the developing world. However traditional hand-dug wells often dry out as they are too shallow and also become polluted as the sides are not lined and the top is uncovered. Without proper drainage, pools of water can form around the wells and these can act as breeding grounds for disease-carrying insects like mosquitoes.

WaterAid technology uses the traditional hand-dug methods, with additional features to prevent these problems. Hand-dug wells are usually 1.2m in diameter to allow sufficient digging space. Depths vary, from shallow wells at 5m to deep wells over 20m, but all are deep enough to ensure the water table can still be reached during the dry season.

Hand-dug wells are also lined to prevent pollution and make them more stable - particularly those built in the dry season which are liable to collapse in the wet season. Linings are usually made by either pouring concrete into steel moulds or using pre-cast concrete rings. At the level of the water table, linings have porous walls and precast rings are left unjointed to allow water to ingress into the well.

Once dug, the wall of the well is raised with a concrete upstand and cover slab to prevent polluted surface water seeping back in. Drainage channels are also formed to stop the build up of wastewater.

Rather than digging new wells, some programmes rehabilitate traditional hand-dug wells. Traditional wells are dug deeper and wider, lined, then sealed and protected to prevent contamination.

Tubewells and boreholes

In areas with lower water tables, where water needs to be collected from a greater depth or where ground conditions permit hand drilling or augering to be carried out WaterAid uses other technologies including tubewells or boreholes.

Tubewells are small diameter holes drilled by hand-powered methods of augering and sludging. Although hand-dug wells can retain more water, tubewells can be built quickly and cheaply, require less maintenance, can reach greater depths and are safer to construct. However, they are reliant on drilling tools which may not be readily available.

Where there are harder rocks and the water table is very low, engine-driven augers and rock drills are necessary to cut through the earth to depths of 100m or more. These wells, called **boreholes**, are only used when absolutely necessary as finding water takes time, money and effort through hydrological surveys and they are also expensive to construct and run.

Even at great depths, handpumps can be used to draw water from tubewells or boreholes with narrow diameters. However, where there is a higher demand for water and only deeper sources are available, wide tubewells or boreholes are used and the water then has to be pumped to the surface using diesel or electric engines. The water is then usually stored in large tanks before being piped to tapstands in surrounding villages. The diesel or electric pumps needed are expensive to maintain.

Pumps or buckets?

Where hand-dug wells are built communities have to choose whether to use a **handpump** or a dedicated **bucket and windlass**. Deciding between them depends on the well's yield, the ability of the community to pay for maintenance and the type of tools and spare parts available at an affordable cost.

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WaterAid/Abir Abdullah

Where they are appropriate and affordable handpumps are preferable as they are sealed around the well and so prevent contamination.

However, where handpump spares are very hard to come by or are too expensive communities can choose a bucket and windlass instead. Although easy to operate and repair, using a bucket and windlass does not allow the well to be sealed as it must be opened to collect water, which can allow pollution. However providing the well is covered when it isn't in use, and there is a dedicated bucket and windlass to ensure minimum human contact, then contamination is minimised.

Sanitation

Hygienic lavatories are just as important as clean water to improve health and WaterAid uses various technologies to ensure communities gain access to safe sanitation. Given sensitive guidelines and a little technical help, families can build latrines for themselves at very low cost.

The most common type of latrine is the **dry pit latrine**. The main criteria are that the pit should be at least three metres deep and completely above the water table. The squat slab covering the pit should be strong and easy to clean, with a keyhole shaped drop hole and foot pads. It should be precast away from the pit and then placed over it. A shelter built of local materials can then provide privacy.

Ventilated improved pit (VIP) latrines also have vent pipes to take smells and insects away. Insects, attracted to the source of light in the vent pipe, are trapped at the top by a fly screen.

Where people use water to clean themselves after they have visited the latrine, **pour-flush latrines** are favoured instead. In these the latrine pan is placed a few metres away from the pit and a pipe with a u-bend connects the two. The u-bend stops flies and smells escaping from the pit.

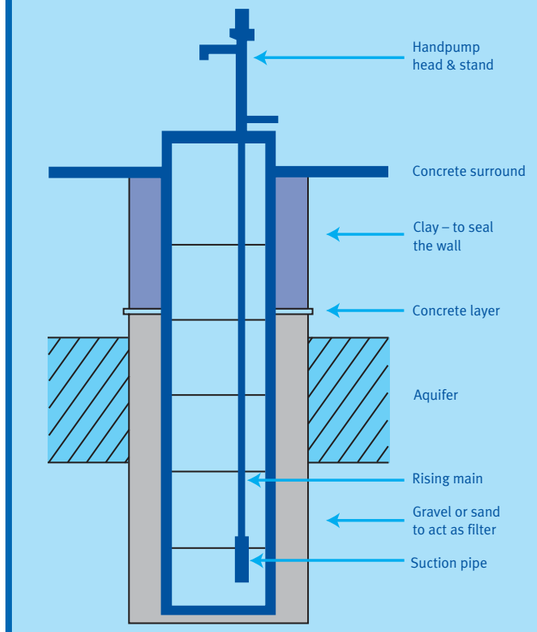
WaterAid is also currently developing **ecological sanitation** technologies which benefit local agriculture by creating a safe, renewable source of fertile compost from human waste.

Urban solutions

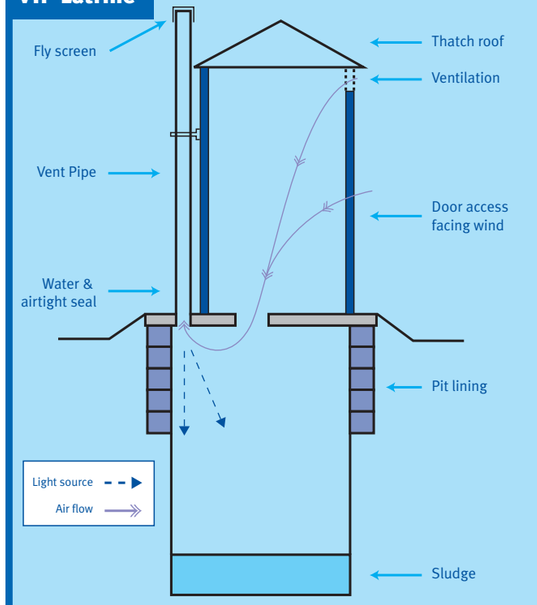
Because of the higher population densities in urban areas different technologies are often needed. While tubewells can be used to provide water, where possible a preferable solution is to negotiate with the local government or water suppliers to connect slum communities to the city's piped supplies and then provide communal tapstands managed by the beneficiaries.

Pit latrines can fill too quickly and the large numbers needed can eventually pollute underground water supplies. In some cases septic tanks are used but where possible, WaterAid is helping community groups build sewerage systems that can be linked to the city's systems and treatment works. WaterAid also helps these groups to build and manage communal toilet and washing facilities.

Cross-section of a hand-dug well and handpump



VIP Latrine



The faecal oral route

All of the technologies that WaterAid uses are designed to provide a barrier to diseases carried in faecal matter. These can enter people's mouths via a number of routes including water, soil, flies and fingers. This is called the faecal oral route. When used in conjunction with hygiene education WaterAid technologies block this route and so reduce the likelihood of diseases being transmitted.