

WHERE SHALL WE DIG, AND HOW DEEP?

In any landscape containing people, there also exists water, to which they have access. Without water, people cannot live. Therefore, if people are living there, there is also water.

In rural Africa, where 85% of the total population of a country may typically be living by subsistence farming¹, the same rule is true – there are existing sources of water. They are almost always highly polluted and serve the human population, their domestic animals, but also the wild animals of the area. Without water nothing lives. These sources of water are always shallow, because the people have not had access to mechanical means of exploiting water sources deep below the surface. These shallow sources, ponds, seeps and springs provide water for the people. However, with increases in population, traditional sources may be under more pressure.



The photo shows a typical water hole in East Africa. This one was a spring with an overflow some of the time. Logs are placed to allow the people access as water levels fall seasonally. Whatever was on the feet of the user was also walked into the water, which is the source of 80% of tropical diseases.

In desert areas where the population is sparse, and water is highly valued, very deep hand dug wells have been made. They take a long time, and require specialists for construction and maintenance. Wells as deep as 70 metres are made. They are uncommon, and not typical of the more populated areas, where generally water is more easily obtained, but has a lesser value.

In order to improve the quality of water supply to the human population it is necessary to provide hygienic alternatives to traditional sources. This will, in most cases, eliminate the water-borne diseases, which plague much of the developing world, particularly Africa. The new wells² will derive water from the same origin as the old ones; this is the annual rainfall. It is only necessary to duplicate in a

hygienic manner the traditional sources. The same water will be tapped, but using a new well which has been constructed so that the source cannot be polluted by the users, but also that it cannot be over-exploited.

With a traditional pond, as the dry season progresses, the level falls, and the users have to walk further into the hole. As the available water reduces, the people are forced to use less. A new well and hand pump can lead to over exploitation because the reducing levels in an enclosed well are not visible to the users. They are unable to deduce from the feel of the handle that the level is lower day to day. The real indication is when the pump starts to draw air, rather than water at the height of the morning demand. This regulates demand, because it takes longer to fill a bucket.

One of the major advantages of drilling, as opposed to digging the new wells is the ability to drill deeper than is normally possible in hand-dug wells. On hitting the water table, hand digging is normally stopped. Digging below water in open wells is difficult, and limited to about an arm's length. Drilling overcomes this difficulty, but it is not always profitable to drill too deep.³ It may also be argued that an open well, protected by a concrete curb, while not being just as hygienic as a closed and pumped well, nevertheless provides an improved supply, and protection from certain important debilitating diseases. Open wells have the advantage that they are almost maintenance free in the absence of a mechanical pump.

The volume of water that can be extracted from a well depends on the rainfall pattern for the area, and on the geology. Recoverable water is frequently taken to be about 6% of the rainfall. So in an area receiving 1,000 mm of rain a year, the recoverable amount per hectare would be 6% of 10,000 cubic metres – say 600 cubic metres a year, or 1644 litres per day. One hectare is the area of a circle of diameter 113 metres. The recoverable rainfall on this area would provide for the requirements of only 82 people, at 20 litres per head per day in this rainfall pattern.

If the geology of the area is average, and the depth of water-absorbing earth overlying the hard rock native to the area is great enough, it may be possible to drill deeper, and create an enlarged circle of influence for the well. If the overburden is shallow, the best that can be expected, is often only a diameter of some 200 metres. 6% of this rainfall is enough for a population of about 250 people – sustained each year by new groundwater, supplied by the rainfall of 1,000 mm. Variations in rainfall and depth of water-absorbing overburden will influence the amount of water that can reasonably be expected of a well.

This is another reason why it is important to have enough wells distributed over the landscape to match the settlement pattern of the population. The number of wells needs to be in agreement with the likely yield, given the rainfall regime, and the geology.

¹ See also:

http://en.wikipedia.org/wiki/Subsistence_farming

² In this essay, the word “well” also means bore hole, hand or mechanically drilled well.

³ See below about the unforeseen consequences of drilling too deep.

Drilling deeper, particularly into hard rock, may not produce any more water than a shallow well built entirely within the overburden. It is also possible in tropical geology that water which has lain against bedrock for a long time, and which is not subject to refreshment by annual rainfall, may contain harmful minerals, which would damage the health of people drinking it; Fluoride and Arsenic fall into this category.

Ideally, the depth to dig or drill should be not much more than the existing water sources, with the proviso that sufficient cover should be provided to ensure hygienic conditions in the new well. 10 metres cover would be an ideal minimum, when possible, for a well intended to be closed and pumped.

Drilling deeper than necessary has some consequences that may be unforeseen. Obtaining water from a hand pump is easier than getting it from an open source – apart from the perceived notion that it is of better quality. There will thus be the inevitable temptation for people to obtain most of their water, for all purposes, from the pump. If the new well has been made over-deep, it is likely that adjacent 'traditional' water sources will dry up as the groundwater is drawn into the hygienic well by the action of pumping, and as the general water level is depressed. The result will be an even greater reliance on the new well and pump. It may not be just the nearest well that dries. Experience shows that it is possible to over-drill one new well to such an extent that the entire village becomes reliant on the single pump. As many as 10 other shallow wells having dried, simply because the single hand pump was drawing from 5 metres (16 ft) greater depth than was possible with the traditional hand dug wells. It would have been better if all wells had all been duplicated, by having a new well and pump. A political calculation was made at the time that more votes per dollar were likely to result from placing a single new well in each village of up to 5000 people.

Over-pumping from a well that has been drilled too deep, may cause springs to dry up, with consequences for both wild and domestic animals of the area, and also anyone down-stream using the water for irrigation.

Incidentally, to properly serve 5000 people in a sustainable manner using hand pumps and wells requires a minimum of 20 good quality pumps. There is more on this subject in our essay at [http://www.consallen.com/One well is no use.pdf](http://www.consallen.com/One%20well%20is%20no%20use.pdf)

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<http://www.consallen.com>

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