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What is sand-abstraction?

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- The availability of water in dry areas
- The system of sand-abstraction

The availability of water in dry areas

Water is a resource that is unevenly distributed throughout the world and is often subject to excessive and disproportionate use. Over time, many areas have developed a water deficit where demand exceeds the possibility of supply. For everyone to live a normal and healthy life, however, there must be an adequate supply of water. Ideally, this should include water for livestock and irrigation. Water for irrigation allows for the small-scale farming of vegetables or protein crops as a supplement to staple foods.

In arid and semi-arid areas (sometimes referred to collectively as dryland areas) the rainfall is often unreliable, typically comprising storms that are intense but of short duration. Often in these dryland areas there is not enough rainfall to ensure that crops can be grown reliably. The period of time between adequate rainfalls can be so long that crops become water-stressed and wilt or die. Where rainfall is low, the rivers may not flow throughout the year. Depending on the geographical location and the rainfall season, river flow may vary from a few weeks or months to just a few hours in a year, or over several years.

Despite limited rainfall in dryland areas, water is generally available in aquifers underground. Depending on the geology, the nature of the rocks

Water is often considered to be both a renewable and an infinite resource – it is neither!

and soil, as well the climate of the area, water may occur at depths from just a few centimetres to several hundred metres. In many arid regions groundwater aquifers have a limited potential or are deep and difficult to access. Deep water aquifers are generally slow to drain and so collect high concentrations of mineral salts from the rock to the extent that the water becomes unpalatable and sometimes unusable. During years of drought in particular, aquifers may be severely depleted and unable to sustain the local community. Water in an aquifer is usually abstracted through boreholes and wells.

Although water can be stored in dams in dryland areas, ideally a dam should have a deep basin so that the water does not have a large surface area exposed for evaporation. In areas where the average ambient temperature is high, water loss is likely to be severe from the open surface water of a dam. Flat areas do not make good dam sites as the water depth in the dam is likely to be limited and the water liable to dry up. In arid areas that are prone to erosion the useful life of a dam may be significantly reduced by excessive deposits of silt within the dam basin.

Small amounts of water can be stored in water harvesting tanks but their effectiveness is often limited, particularly in regions with short and erratic rainfall seasons or where the seasons are long, hot and dry. In these conditions, supplies can deplete quickly and not be frequently replenished.

Within arid areas water is naturally retained in the sediment of sand river channels although in a dry riverbed this is not always apparent. The water in a sand river is clean and not subject to the same amount of evaporation as an open surface dam. Sand river water supplies can be used to augment the supply of water from underground aquifers and dams, especially in remote rural areas where it is imperative that local communities are able to operate independently and maintain their own water supplies. Sand dams and sub-surface dams function like sand rivers as they retain water in the sediment and reduce evaporation.

The system of sand-abstraction

In dryland conditions soils are easily eroded and with occasional but heavy downpours, large quantities of coarse material are washed into the waterways. In situations where sediment builds up, these become the sand rivers and 'wadis'[1] so common in arid areas. These rivers often contain

[1] A Wadi is a dry riverbed in an arid zone that contains water only during times of heavy rain. As flow is often the result of an intense localized storm a wadi typically has no source or outlet.

Abstraction
The process of drawing water from an aquifer

Sand-abstraction
The process of drawing water from sand rivers

Photograph 1.1. A resident of Huwana village draws clean water for household use from an open sand-well on the Manzamnyama River, Matabeleland South, Zimbabwe

large volumes of unconsolidated sediment that retains water in the pore spaces. In a large river system the supply of water in the sediment can last all year round. Such water retained within sand riverbeds has been used by arid-land dwellers for centuries and is an established and accepted practice.

New and imaginative initiatives to abstract this water require identification and development. Sustainable water abstraction systems that are acceptable and manageable by rural communities are required to augment existing water supplies.

Sand-abstraction can provide a source of water in arid and semi-arid areas. In many situations sand river aquifers constitute a viable water resource with significant potential.

Traditional systems make water available through temporary sand wells that are dug in the riverbeds and are regularly deepened as the water-level drops. A shallow film of water is exposed that can be scooped out with a small dish. To increase the depth of water within the well to some 50mm, an open-ended 20 or 100 litre drum is dug into the water-bearing sand (Photograph 1.2). This method of abstraction is low-cost, practical, easily constructed and completely sustainable which makes it popular with poor communities.

Photograph 1.2. A traditional open sand well

These traditional wells are vulnerable however, and only last a season. The sides of the wells are un-shored and unstable so the sand falls slowly down into the bottom and requires cleaning out every time it is used. Often the wells are fenced with brushwood to prevent animals from entering the pit as they increase the movement of sand into the well and foul the water. Brushwood fences, however, are themselves a problem (Photograph 1.3). When the river next flows, the wells fill with brushwood and silt which complicates re-excavation of the well in the following seasons. Over time, trapped brushwood may collect silt and other debris in the river channel creating false islands which further reduces the well site area and may widen or clog the river and cause flooding.

The present technology of sand-abstraction is the result of a progression from the traditional open sand well to the installation of sub-surface abstraction equipment that will effectively separate water from sand. Each system uses a screen to control the movement of sediment so that water becomes free of suspended particles and is accessible for abstraction. Depending on the system, once the water is free of sediment it can be drawn to the surface by anything from a bucket to a mechanically-powered pump. Screens for sand-abstraction come in the form of well-points, infiltration galleries or part of a caisson or well shaft. A particular advantage of a sand-abstraction system is that the water is not open to contamination but is naturally filtered and cleaned.

Photograph 1.3. Brushwood fencing surrounding a traditional sand well

The common use of the term 'sand-abstraction' is unfortunate as it does little to explain or promote the method of water abstraction. A more appropriate term would be 'water-from-sand-abstraction' as the method is that of drawing water from saturated river sediment and not the removal of sediment from sand rivers as the common term might imply.

Freshwater in rivers and lakes together with soil moisture and groundwater accounts for less than 1% of the total volume of the world's water resource.

Chapter summary

Sand-abstraction is a useful water resource that is available to vulnerable communities in harsh dryland areas. It has been used for centuries by remote rural communities and has become an acceptable source of water that many people understand and are able to manage to great advantage. As a means of providing a source of safe water, however, it is a methodology that has not been developed by the water supply industry, nor become a solution adopted by national water supply authorities or development agencies. Sand-abstraction can be a useful, alternative source of water in dryland areas that can be managed and operated independently by low-income communities. It has the potential to augment supplies provided by established water supply systems.

There is a need to further appreciate the potential of sand-abstraction and to understand how to access water in this way. The starting point for this is to understand sand rivers and their potential for storing water, and to understand the system of sand-abstraction.