SAND DAMS: THE WORLD'S MOST COST-EFFECTIVE METHOD OF CONSERVING RAINWATER

Excellent | Pioneers of Sand Dams

Image by Polly Braden

PIONEERING SAND DAMS

People and animals have been using water from sand rivers since time immemorial.

Natural undulations in sub-surface bedrock form underground dams that hold clean, filtered water. Sand dam technology is founded on this natural method of water conservation. By building a barrier across seasonal sand rivers, enormous sub-surface reservoirs can be created in areas of water stress.

When I first encountered sand dams in 1985, I thought they were special; now I know they are nothing short of miraculous. I have seen water pouring out of a pipe from a sand dam at a rate of ten million litres a year – maybe not that astonishing until you realise that there had been no rain in the area for nine months.

Sand dams are the most cost-effective method of rainwater harvesting known. They have the potential to provide communities living in dryland areas with a clean local water supply for life, even during periods of drought.

We know how much this is needed, especially in dryland areas of the world – where 80% of the world's poorest people live. We also know that access to water in these areas is likely to worsen: Climate change is already altering rain patterns, creating more droughts, more floods and shorter, more intense rains.

I am always wary of 'technology-led' solutions. The under-developed world is littered with rusting tractors and broken water pumps. Yet, sand dams are a technology. Their success lies in the method of implementation. We have supported communities in Kenya to build almost 400 sand dams in the last ten years – contributing to the 1,500 that have been built in Kenya since the late 1970's.

Sand dams work because they enable communities to address their key priority of water in a way that enables true community ownership and sustainability. Building them is hard work and no one in their right mind would work that hard to build something that wasn't useful. More than anyone else, farmers know what works best for them.

However, sand dams are still little understood, particularly with regards to making them succeed or applying them to contexts outside of Kenya. This is what we seek to change. Excellent Development's vision is that sand dams will take their rightful place alongside other water solutions, to become part of a range of options for conserving water that is widely understood and considered by development agencies in different contexts.

We must listen carefully to the beneficiaries of our work, but how can people ask for a solution they don't know exists? As the pioneer of cars, Henry Ford, was attributed to have said: "If I'd asked people what they wanted, they would have said faster horses".

Sand dams are a key solution to water conservation in drylands. I hope you will become a pioneer too, as I believe the movement is growing – as is the imperative.

Sand dams have the potential to transform millions of lives. With your help they will.

Thank you

Simon Maddrell
Executive Director

THE PROBLEM

There are 900 million people in the world who do not have access to an improved water source. Of these, 84% live in rural areas. This disparity between rural and urban access to water is typical of developing nations. In all countries it is the poorest who suffer the most.

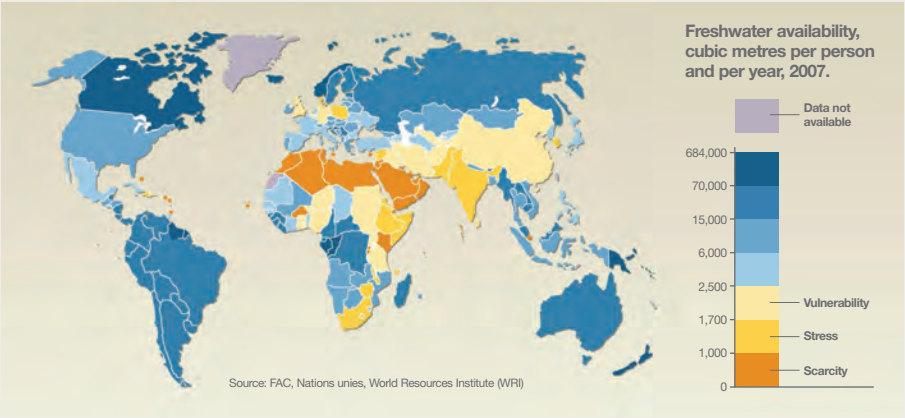
For poor, rural communities across the world, the lack of access to reliable, clean, local water adversely affects health, nutrition, food security, education and well-being. It is the reason why 4,100 children under the age of five die every day from diarrhoeal diseases; why women and children devote hours each day to providing household water; and why smallholder farmers are limited to lives of subsistence.

In dryland environments, highly variable and unpredictable patterns of rainfall make these problems even more critical.

Drylands cover approximately 40% of the world's land area and support 80% of the world's poorest people, mostly in the rural areas of Africa and Asia. Approximately 10% of drylands display symptoms of land degradation: Water scarcity, sparse vegetation, soil-erosion and nutrient depletion; further diminishing the ability of ecosystems to absorb and store rainwater.

900 million people do not have access to an improved water source

Climate change is already exacerbating these problems through the increased unpredictability and extreme variations of rainfall frequency and intensity, temperature and drought. It is estimated that, by 2030, water scarcity will displace up to 700 million people and leave half of the world's population in conditions of high water stress.

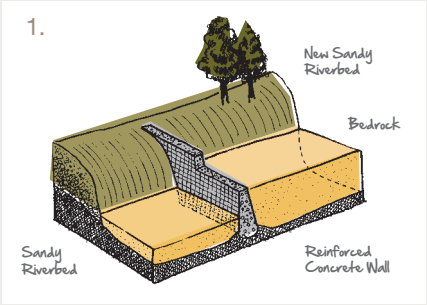


A DRYLANDS SOLUTION: WHAT ARE SAND DAMS?

Sand dams are the most cost-effective method of water conservation in dryland environments. They provide an improved, local and reliable source of water for communities living in remote, rural areas.

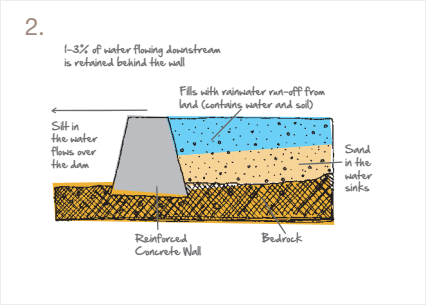
Simply by capturing rain-water, sand dams transform drylands into places where people, plants and animals can thrive. They are one of the most effective and sustainable, yet currently under-utilised, technologies for water conservation in the world.

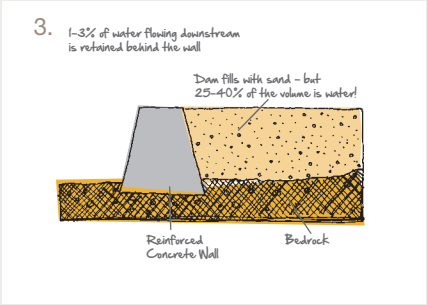
Sand dams are most effective where there is a high level of sediment in the river water. A high sediment yield from river water is characteristic of drylands; hence sand dams work best where the need is greatest.



A sand dam is a reinforced concrete wall built during the dry season across a seasonal sandy river.

An ancient idea for a sustainable future





During the rainy season, a seasonal river forms and carries soil (made up of silt and sand) downstream. The heavy sand accumulates behind the dam, while the light silt washes over the dam wall.

Within one to four rainy seasons, the dam fills with sand. But, up to 40% of the volume of this sand is actually composed of water. A mature sand dam can store up to 20 million litres of water. This replenishes after each rainfall but, even without regular rain, can support over 1000 people with a year round local source of water.

Even without regular rain, sand dams can support over 1,000 people with a year round local source of water

There are three options for water abstraction from sand dams: Traditional scoop holes, or an infiltration gallery leading either to a pipe or tap through the dam wall, or to a sealed shallow well with a hand pump.

WHY USE SAND DAMS?

Sustainable, rural development in drylands is primarily inhibited by a lack of local access to water. In addition, environmental degradation, disease and a dependence on rain-fed agriculture cause water, food and economic insecurity. The solution begins with the conservation of water and soil.

Many semi-arid countries receive as much annual rainfall as those in more temperate climates. The problem then is not in the amount of rainfall, but in the distribution of it over time. Kenya, for example, receives all of its annual rain within two short, but intense, rainy seasons. The challenge is how best to conserve this water where it falls for sustained year-round use.

It is generally recognised that water management in drylands should focus on water conservation.

Sand dams are the most cost-effective method of water conservation

However, many technological solutions continue to be implemented that serve only to abstract water from the aquifer, without consideration of how to replenish it. Over time, such approaches only diminish the long-term sustainability of ecosystems and water supplies. Worse still, they often require an imposition of complex and unsustainable management processes to regulate water use and maintain mechanical parts.

So, in time, what was intended as a solution becomes itself part of the problem. It is estimated that more than 40% of hand pumps in sub-Saharan Africa simply do not work.

Image by Polly Braden

Sand dams are a technology with a difference. They are a method of water conservation that re-charges the aquifer. In doing so, they actually increase the amount of water that is available for abstraction; empowering communities to utilise water as they require, without the need for imposed operations and maintenance processes.

Sand dams can store enough water for 1,000 people for life

Sand dams are the most cost-effective method of water conservation in drylands. They can store enough water to serve the domestic and farming needs for 1,000 people for life, with virtually no operational and maintenance costs.

The relative cost, per 1,000 litres of water, of different water technologies.

	Range of cost ($) per 1,000 litres	
Technology	**Min**	**Max**
Sand dams and sub-surface dams	0.40	0.80
Run-off open reservoirs	1.80	3.00
Underground tanks	2.40	14.00
Above ground tanks	18.00	60.00

If they are built in the context of community self-supply, approximately 40% of the cost is provided by the community in the form of labour and the provision of local materials. Initiatives such as this, that emerge from local demand, build on local knowledge and skills and provide benefits that relate directly to the needs of the community. This inspires the ownership and commitment necessary for the technology to be sustainable.

One dam, endless possibilities

WHAT ARE THE BENEFITS?

In most rural communities, women and children shoulder the primary responsibility for household water provision; gathering water from distant and often contaminated water sources. It is a time consuming and arduous task; stealing time away from other, more productive activities, and thus representing an enormous economic cost for poor families.

In Kenya, it is common for women and girls to devote up to five hours collecting water each day. During periods of drought, this time investment can increase to as much as 12 hours; impacting on health and keeping young girls out of school. Research has shown that those spending more than half an hour per round trip progressively collect less water, and eventually fail to meet their families' minimum daily drinking-water needs.

Sand dams provide a lifetime of local, clean and reliable water within 30-90 minutes of peoples' homes

Sand dams provide a lifetime of local, clean and reliable water within 30-90 minutes of people's homes; improving access to water for people, crops and livestock in water stressed environments. The significant reduction in the time required to collect water affords the opportunity and energy to invest in sustainable farming activities, such as terracing.

Across much of Africa, 70-85% of rain water is lost from farms through run-off and evaporation. Terracing farms keeps this water where it can be productively utilised for irrigation and, as a result, can increase food production by as much as 20%.

An investment that lasts for generations

By re-charging the aquifer, sand dams also provide enough water to establish tree and vegetable nurseries. Together, sand dams, terraces and tree planting form a cycle of water and soil conservation that is self-perpetuating. Conserving water and soil on farms increases soil fertility, reduces the time spent collecting water, and increases the time available to farm, learn and innovate.

WHAT ARE THE IMPACTS?

1.5 million children die every year from diarrhoeal diseases. An additional 655,000 die from malaria. These deaths are entirely preventable.

Diarrhoea is a symptom of many water-borne diseases, caused by an array of bacterial, viral and parasitic organisms, although, in developing countries, the most common causes are Rotavirus and *E.coli*. Both of these are spread by water contaminated with faeces. Infection is most prevalent where there is a shortage of clean water.

By storing water within sand, sand dams protect it from contamination with animal faeces, and filter the water clean for abstraction. In this way, they increase access to an improved water source: One of the key measures for reducing incidences of diarrhoea. Compared to open water dams, sand dams do not provide a breeding habitat for mosquitoes. They therefore contribute to a reduction of malarial infections. It is estimated that 42% of malaria could be eliminated by control of mosquito breeding habitats.

When families can produce food and earn an income, they are able to afford education for their children

Further to this, sand dams provide the water and time necessary for people to productively farm. A year-round water

source and saved time enables farmers to invest in improved agricultural techniques such as: Inter-cropping, crop diversification, zero-grazing, and seed banks. Such activities facilitate the production of a year-round and diverse supply of food, even during periods of drought. Increased, more reliable and diversified crop production improves nutrition and food security, while the surplus can be sold at local markets; enabling the transition from subsistence to income generation.

When families can produce food and generate an income, they are able to afford education for their children. Children who now don't have to spend their time collecting water; who are less likely to suffer the acute health impacts of diarrhoea; who may now have the potential for a future outside of poverty.

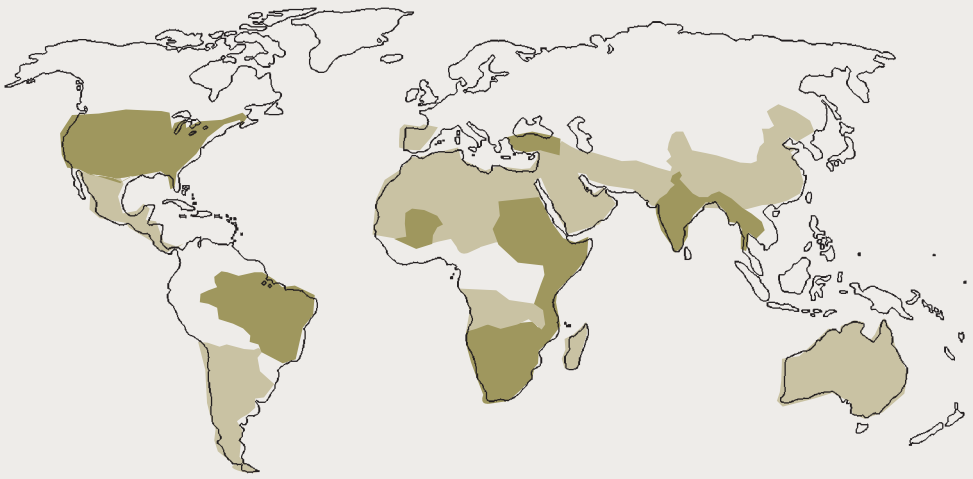
WHERE ARE THEY APPLICABLE?

As much as 40% of the worlds' land surface is classed as drylands, with significant areas found across six continents and in 110 countries. Sand dams are a water solution that is applicable to most dryland environments. They only require a seasonal river with sufficient sandy sediment and bedrock that is accessible in the river-bed.

Although sand dams are most common in Kenya, where currently 130 are built every year in the south-east counties of Machakos, Makueni and Kitui, there are examples of similar structures in Brazil, Angola and India.

Sand dams have a much broader geographical range of application than has yet been explored. However, geographical suitability alone is not enough to ensure the successful implementation of sand dams. They must be implemented in a framework that considers human, environmental and political factors.

Turning the map green



Countries with the potential for sand dams

Countries with sand dams or similar structures

OUR VISION AND PARTNERSHIP

Excellent
Pioneers of Sand Dams

Excellent Development is a UK based NGO that supports subsistence farmers and their families to gain access to clean water and grow more food to eat, store and sell.

Our model of development is founded on the fact that improved livelihoods and poverty alleviation in drylands can only be achieved through a sustained investment in water and soil conservation. We therefore support the implementation of sand dams, which conserve water and create the potential to invest in sustainable and improved farming techniques.

Africa
Sand Dam
Foundation

In Kenya, the Africa Sand Dam Foundation (ASDF) empowers marginalised rural communities to transform their environment for the sustainable and mutual benefit of the local ecosystem and people. They support communities to gain access to clean water for improved food security, health and income.

Since 2002, Excellent Development has supported over 95 Self Help Groups (SHGs) to build 325 sand dams. ASDF established in 2009, and have provided advice and support to 28 SHGs in Kenya, enabling improved access to water, building resilience to drought and improving farming techniques for improved food production.

Through a strategic partnership, we have committed to community-led sustainable development and the global promotion of sand dam technology.

It is our shared vision that sand dams will transform millions of lives.

SAND DAM SUPPORT AVAILABLE

To meet this vision, Excellent Development and ASDF provide a range of support to organisations with an interest in implementing sand dams. Through sharing knowledge and expertise, we hope to enable the proliferation of sand dams throughout drylands worldwide.

We jointly facilitate this by:

- Organising learning visits to ASDF in Kenya.
- Providing technical support for the design and construction of sand dams.
- Providing consultancy support to pilot and apply sand dam technology in new contexts.

We have recently provided technical consultancy support to: WaterAid UK, WaterAid Uganda, the Dabane Trust in Zimbabwe, Ukambani Christian Community Service in Kenya, and the Christian Council of Mozambique.

Additionally, this year we will publish a sand dam manual. This will act as a practical guide on sand dam design and application for any organisation with an interest in sand dam implementation.

For more information on the support available, or to request a sand dam manual, please contact by email: team@excellent.org.uk

SECRETS OF SUCCESS

Pre-conditions:
When locating sites for sand dams there are two pre-conditions that must be met:

- They must be built in a seasonal river with a sandy sediment.
- The bedrock must be accessible in the river-bed.

Golden Rules of Design:
If these conditions are present, there are then two golden rules that must be followed for successful dam construction:

- They must be built on a rock base that is at least 1.5m wider than the flood width of the river.
- They must allow the river to continue flowing in the same direction as before.

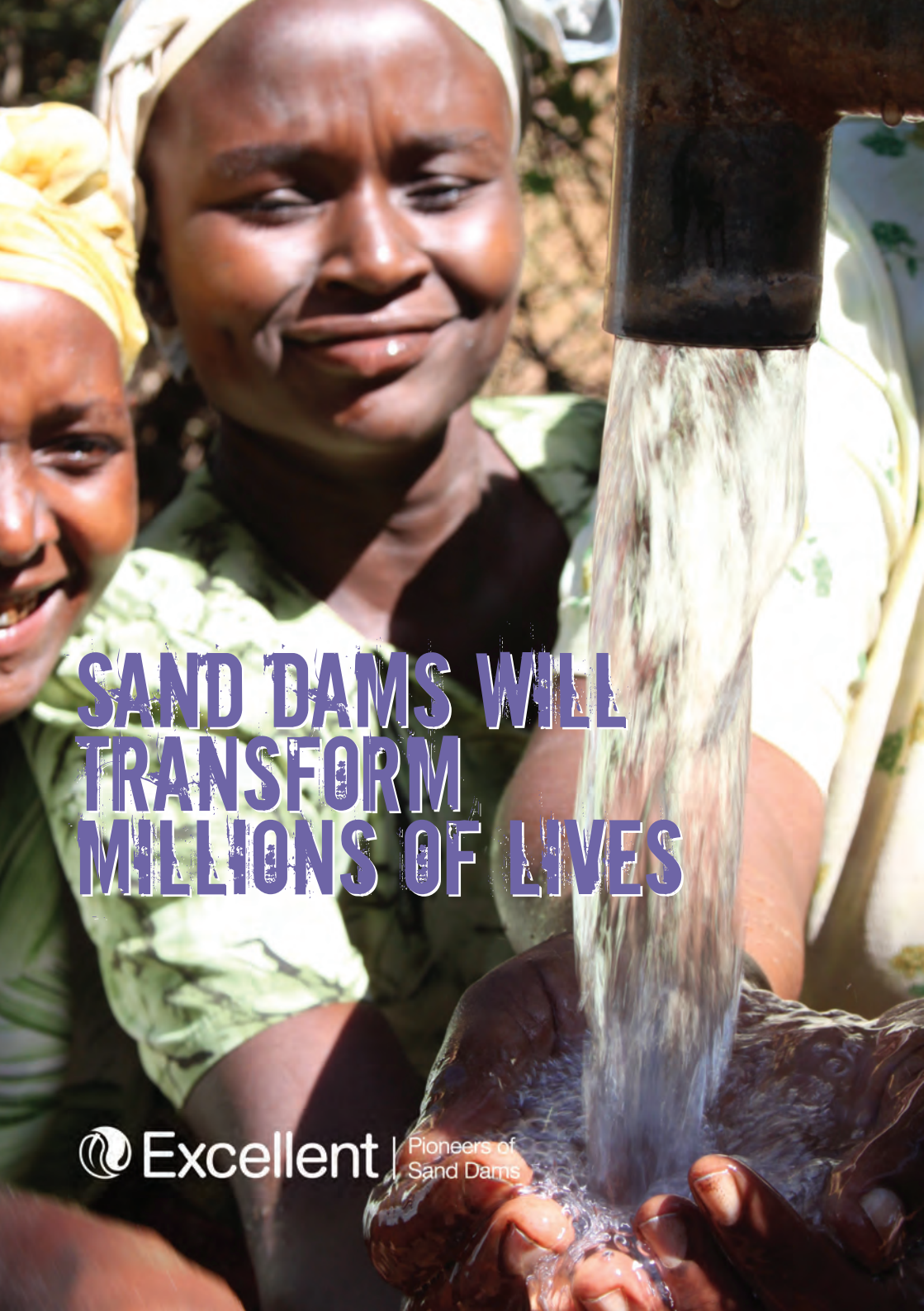
Rules of Construction:
The construction process is critical to building effective sand dams, especially in ensuring that the dam is built on, and adheres to, the bedrock.

Implementation of sand dams is a process of flexible application, not rigid replication

Application not replication:
Although these rules apply to many contexts, the implementation of sand dams must be considered as one of flexible application, not rigid replication. A Political, Economic, Social, Technical, Legal and Environmental (PESTLE) analysis is recommended.
The purpose of this is to ensure that any feasibility assessment of introducing sand dams is not solely technology focused. The PESTLE analysis helps to identify areas that need planning and design to make the project sustainable.

Sustainability:
The sustainability of sand dams, and any technology, depends on:

- Meeting the needs of the people.
- Being appropriately applied to the specific context.
- Enabling ownership for operation and maintenance.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