Sand dams: a sustainable solution for water scarce regions

UNDP is providing technical support to the government of Swaziland for a sand dam pilot project. The aim is to develop climate change resilient community schemes to improve water resource management. Ncamiso Mhlanga gives more details.

Global and regional studies reveal that climate change will adversely affect the availability of surface water resources in the Sub-Saharan Region. The anticipated impacts of climate change include severe droughts and overall drying in most parts. With this in mind, Swaziland is being supported by the United Nations Development Programme (UNDP) and the Special Climate Change Fund (SCCF) to build adaptation capacity through improved water resources management.

UNDP is providing technical support to the government of Swaziland to carry out climate change resilient projects at community levels to help them adapt to climate change. One such scheme is a sand dam pilot project where their effectiveness will be monitored and eventually inform strategic and policy directions across the country. A successful and cost-effective pilot sand dam project will guide the country into a wider national programme to be driven by the Swazi Government. The project is being supported by three government ministries that will eventually explore in more detail should they be successful. The key institutions are: Department of Water Affairs, Ministry of Agriculture and Ministry of Public Works and Transport.

Sand dams were identified as one potential adaptation measure that could be piloted in Swaziland. However there was limited knowledge and capacity to construct sand dams in Swaziland. In August 2013, a UK based consultant known as Excellent Development, which specialises in these structures, was engaged to conduct a national feasibility on sand dams in Swaziland. A successful national feasibility was subsequently completed in December 2013, identifying several potential sites in the Lowveld region of Swaziland where the climate is very dry.

Sand dams

A Sand dam is typical concrete embankment or wall built across an ephemeral (seasonal) stream. During the rainy season, the wall harvest sand and 20-40% of its total volume is water. The water is then abstracted using various methods depending on the intended use by the communities. In addition to working as water harvesting structures sand dams could be combined with road crossings to have greater benefit.

Water is abstracted from the sand dam using two basic methods:

- Traditional scoop holes - where water is simply accessed by digging scoop holes from the sand upstream of the dam wall.
- Alternatively a filtration gallery can be installed where water is drained from the sand using pipes with small slots into a chamber or shallow well connected with a submersible or hand pump.

A GIS tool and literature review were used for the Swaziland project to determine their feasibility. Indeed for sand dams to be successful, they must meet certain technical conditions:

- Dry land climate zones/agro-ecological zones – Sand dams were successfully proposed in areas with dry land climates. The lowveld of Swaziland was found to meet these criteria.
- Seasonal rivers – Areas with seasonal/ ephemeral streams were proposed for sand dam construction.
- Rainfall – Sand dams were found suitable where there is certain degree of rainfall capable for flooding at certain times. This allows the required amount of sand sediments to be deposited and fill the dam.
- Rock type – Sand dams are usually built across the river beds, anchored on the bedrock. To reduce the cost for this structure, a bed rock that outcrops to the surface is preferred.
- Soil types – Maps for soil types around the catchment were also used to ensure that the chosen sites have the potential to yield enough sand sediment to fill the dam during the rainy season. Suitability of sediment in the riverbed was determined through sediment sampling to determine particle

Sand Dam used as a road crossing in Kenya. A mature sand dam like this one stores up to 6-10 million litres of water (Photo: Ncamiso Mhlanga)

Recommended sites with the selection criteria used

River/locations	1.Sidvokodvo Luve area	2. Lugolo	3. Lower Matsenjeni	4. Upper Stilo	5. Ntjanini	6. Mphofu
Technical pre-conditions						
Drylands climate	Y	Y	Y	Y	Y	Y
Seasonal River	Y	Y	Y	Y	Y	Y
Accessible bedrock in river	Y	Y	Y	Y	Y	Y
Sandy river sediment	Y Excellent	Y Excellent	Y Excellent	Y Excellent	Y Excellent	Y Excellent
Degree of seasonality	Excellent	Excellent	Excellent	Good	Good	Good
Prioritisation factors						
Tenure	SNL	SNL	SNL	SNL	SNL	SNL
Land use/livelihood	Communal grazing dominant	Communal grazing dominant	Communal grazing dominant	Communal grazing dominant	Communal grazing dominant	Small scale ranifed cropping dominant
Poverty severity	20.1-28	20.1-25 and 30.1-35+	20.1-25	20.1-25	20.1-26	25.1-30
Access to safe drinking water	<25%	<25%	25-50%	<25%	<25%	<25%
Application	Sand Dam	Sand Dam	Sand Dam	Sand Dam Road Crossing	Sand Dam	Sand Dam
Primary intended use	Mixed use vegetable gardens and livestock	Livestock	Mixed use vegetable gardens and livestock	Mixed use vegetable gardens and livestock	Livestock	Drinking Water
Recommended for pilot	Y	Y	Y	Y	Y	Y

size distribution and suitability. Particle Size Distribution (PSD) is an indicator of the amount of water a sediment type can hold, and how much water can be abstracted. Sand holds a lot of abstractable water compared to other sediment types, particularly coarse and medium grained sand. Sediment samples were analysed for an indication of the potential performance.

The areas identified were validated through a field verification exercise, which was also used to further understand:

- Suitability of sediment in the riverbed.
- Degree of seasonality of rivers.
- Accessible bedrock.

The proposed sand dam sites fall within the lowveld and dry middleveld parts of Swaziland which receive the lowest amount of rainfall between 450 -600mm per annum, rendering sand dams to be very effective.

During the feasibility stage several key factors were considered using the PESTLE (political, economical, social, technical, legal and environmental) assessment tool. Other points which were also taken into consideration included dry climates, high poverty areas, limited employment and business opportunity areas, technical feasibility and legal factors. A national map showing potential sites for a pilot programme was developed.

Pilot project

The project will pilot six dams in the areas of Matsanjeni, Ntshanini, Mafutseni and Luve. Each dam will cost between US$8000-12000.

The envisaged benefits associated with this kind of dam are that they:

- Are cost-effective – they keep the water where it is needed.
- Are low maintenance.
- Their impact increases as they mature.
- Reduce time to collect water.
- Raise the water table around them.

Sand dam fitted with a filtration gallery

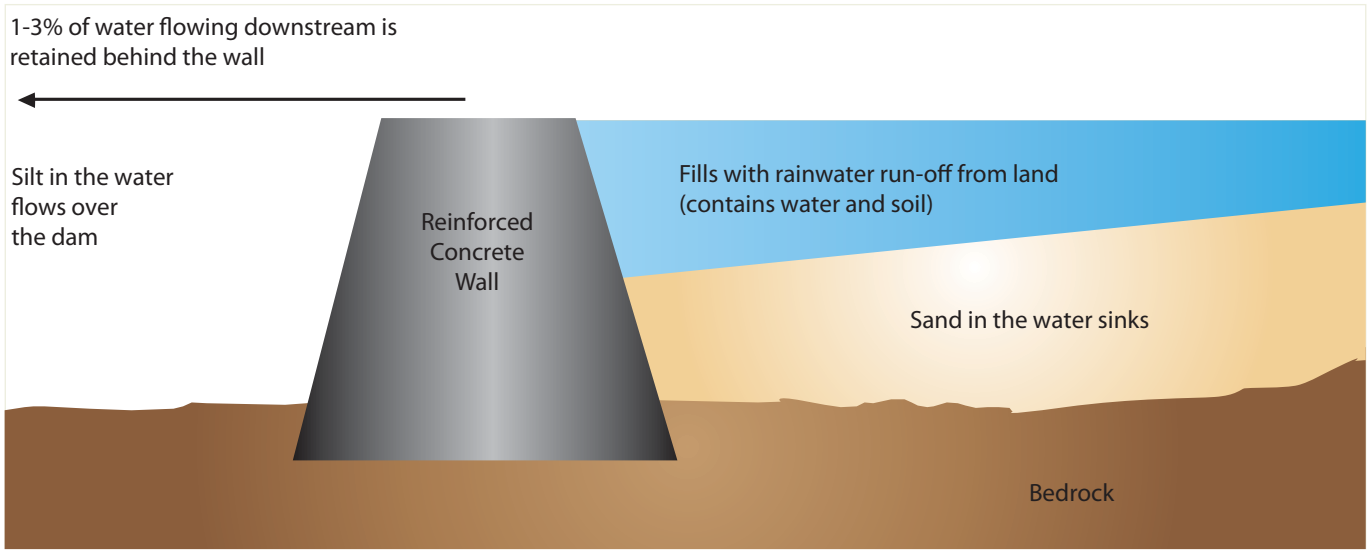
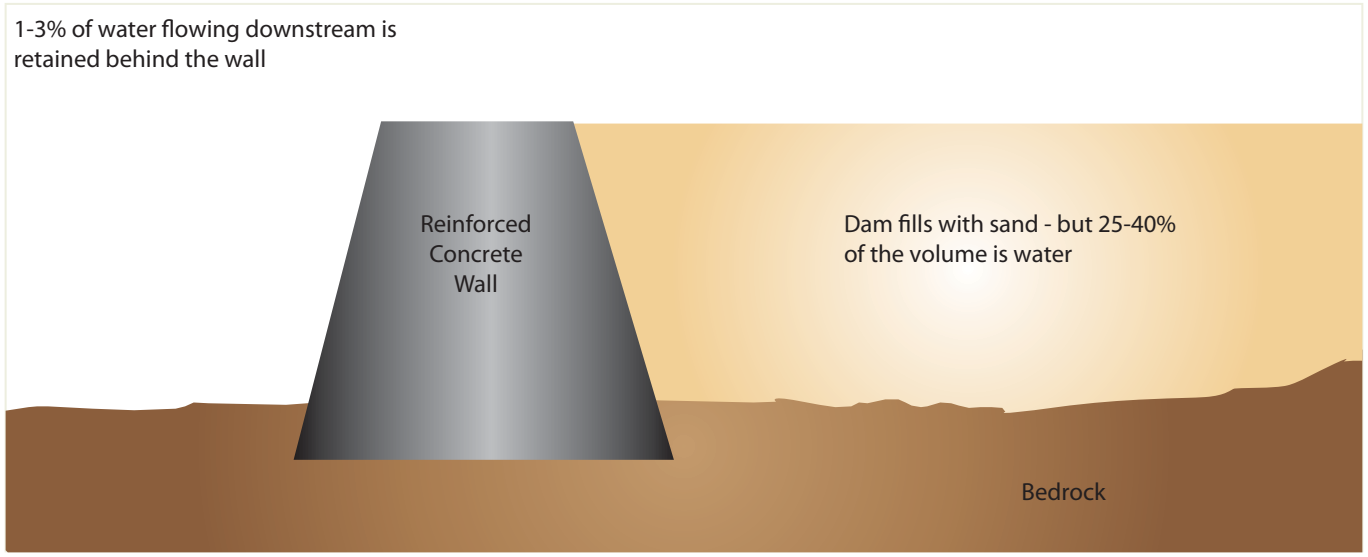


Diagram showing how sand dams work and mature with time (source: sand dams manual from excellent development)



A fully matured sand dam filled with sand sediment (source: sand dam's manual from excellent development)

- Help in the reclamation of eroded land.

The proposed sand dams will be constructed under the Swazi Nation Land (SNL) tenure where:

- Land use is reliant on rain fed agriculture (crops, and /or livestock).
- There is high poverty severity (15.1 to 35 on the Swaziland CSO Poverty Severity Index).
- Low access to safe drinking water (less than 25% and 25-50%).

The designing and pilot planning phase is currently underway and the actual construction is expected to commence in April until December 2014.

The construction is facilitated by the project in collaboration with the consultants, government and involvement of the communities and local authorities.

Though a detailed baseline is yet to be conducted, approximately 1000 households are expected to benefit from this intervention when fully completed in September 2014. The dams will provide water for both domestic and farming purposes and will further provide a safe and clean alternative source of water for the six communities.

Water-borne diseases that result from drinking dirty and unsafe water are reported to be high around the project areas, and are expected to be reduced with the sand dam intervention.

The sand acts as a natural filter for the water and therefore improves its colour, taste and odour. This project will further reduce the burden associated with water provision in dry areas by reducing the distance travelled to access clean water, and the distance travelled to get water for livestock. With a fully installed system, sand dams can reduce the distance to access potable water to less than 200m. This time can then be dedicated to other income generation activities. The burden placed on children on fetching water will also be drastically reduced with the sand dam's intervention.

Communities in the Swaziland project have also proposed to establish vegetable gardens alongside the river beds where irrigation can be practised. This is envisaging promoting food security within the household and increasing family income by selling excess produce.

Given the expected impacts of climate change and the anticipated drive from the communities, we are confident that the future is looking bright for more sand dams in Swaziland. ■

Author information

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