Echo Development notes, issue 111, April 2011

Water Harvesting Through Sand Dams

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Drs. Jacob and Alvera Stern, both service workers with Mennonite Central Committee (MCC) Kenya, shared information about sand dams at ECHO's 2009 Agriculture Conference in Florida and again at the February 2011 ECHO East Africa Symposium. Construction of a sand dam in a seasonal river basically leads to formation of an aquifer. A sand dam provides a low-cost, low-tech and low maintenance water point with large payback in easily accessible water year round. Community ownership and involvement is integral in the introduction of a sand dam.

*MCC has been supporting the building of sand dams in East and Southern Africa for the past 10 years. This article, and the Technical Note from which it is abstracted, are based on the work of Utooni Development Organization (UDO; **www.utoonidevelopment.org/**), for which the Sterns are working. The UDO Director, Joshua Mukusya, built his first sand dam in 1978. UDO currently constructs 50 or more sand dams a year in Eastern Province, Kenya. For more information contact **alverastern@yahoo.com**.*

What Is a Sand Dam?

A sand dam is a reinforced concrete wall built across a seasonal river to hold underground water in sand. It is initially built one meter high and up to 90 meters across. During heavy erratic seasonal rains, the water and silt flow over the dam, and the heavier sand settles to the bottom. Over one to three seasons of rain, the dam fills up with sand that acts as a storage tank for water. In good quality sand, the sand dam volume is approximately 35% water (Beimers *et al*, 2001). Most of this water does not evaporate, as it is protected by the sand. Evaporation decreases by 90% at 60 cm below the surface (Borst and Haas, 2006).

The sand dam is always built on bed rock. A natural aquifer is formed under the sand as water accumulates. Often there is already an aquifer present and the sand dam simply increases the water in it. Over time, the aquifer increases in size and the water table of the surrounding area rises.

How do people get water from the sand?

Water is collected from the sand dam in various ways: by a pipe near the bottom of the sand dam wall downstream; an off-take well upstream; a water tank built into the dam wall on the upstream; or scoop holes upstream. Most often, several of these methods of extracting water from sand are used at the site.

Where are sand dams appropriate?

Sand dams are most appropriate in semi-arid and arid areas that experience short, heavy, erratic downpours. These areas typically have seasonal (ephemeral) rivers with sand beds. At a point along a seasonal river bed, the local people may dig scoop holes for water. This indicates that an aquifer and rock bed are present and that it is a potential site to build a sand dam.

Sand dams are generally built in remote rural areas without supportive infrastructure, and where government is unlikely to provide for the water and sanitation needs of the people. People in these areas know that their survival depends on their own efforts. They are also familiar with getting water from sand, as their families have been doing this for generations. Many of them walk miles every day to their 'hole' and may spend hours in a queue waiting for their turn to draw water.

Areas with community self help groups (SHG) that work together on tasks of mutual assistance are ideal for sand dam building. Sand dams are low cost and low tech, but someone needs to own them, take care of them and use the water for maximum benefit to all. An active community group that already has an agenda for self and community benefit is a good potential partner in sand dam building. Our organization always works with community self help groups in building sand dams. Their members are an active part of the planning process, handle the local and government agreements for the dam, and provide about half the cost of the dam by their labor and collection of local materials such as stones, sand, and water used in building the dam. More information about how MCC works with community self help groups can be found at the end of this article.

What are the benefits of sand dams to people?

Each sand dam has potential to provide a clean supply of water for up to 1,200 people, animals, tree nurseries and vegetable gardens. The increased water availability in a 10 kilometer radius means that a sand dam may indirectly benefit up to thousands of people, as the use of the stored water is never restricted to the people who built the sand dam.

Sand dams change the lives of people by providing water for their needs:

- They provide a year-round source of water near community members' homes so they do not have to spend hours walking and queuing to fetch water.
- Saline water becomes less salty over time as less evaporation occurs: as more water comes into the sand dam, the concentration of salt lessens.
- The water is cleaner, having been filtered through the sand.
- The water is protected from parasites and people are less likely to get ill.
- Increased water capacity allows communities to set up tree nurseries in semi-arid areas where tree planting is otherwise very difficult.
- Increased water for irrigation provides more food for humans and animals, and more income

as food security is realized. People can grow vegetables as soon as a sand dam has water in it, even if there is no rain. Sand dams often fill with underground water coming from upstream, even though there has been no rain in the immediate area.

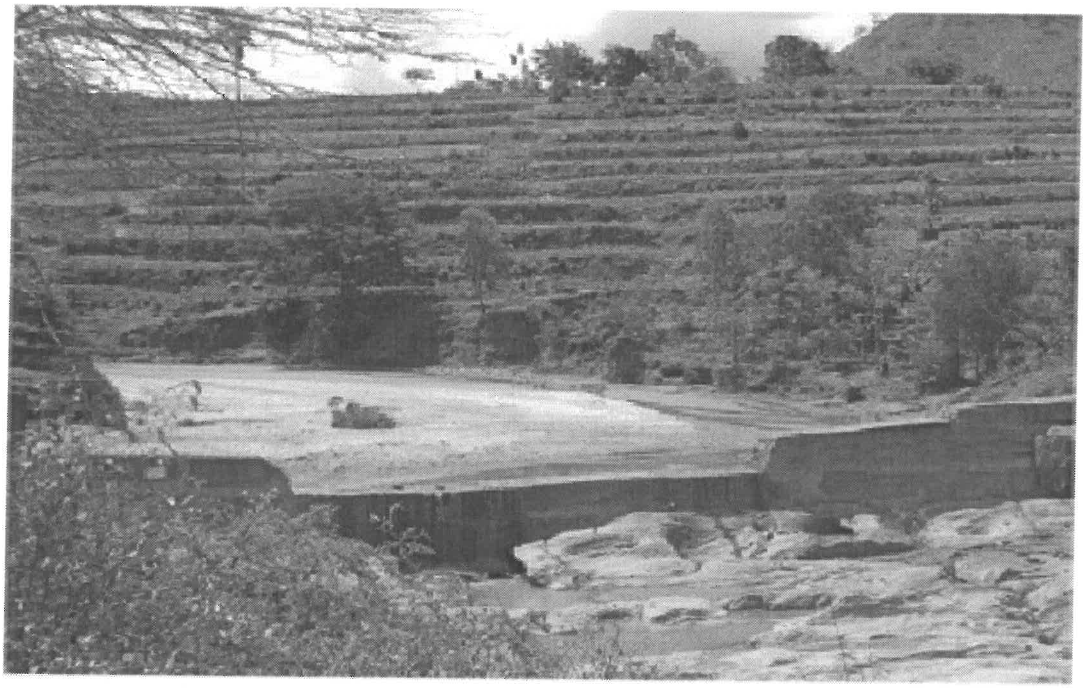

Figure 1: Nzaaya Muisyo sand dam, Eastern province, Kenya

What are the benefits of sand dams to the environment?

Sand dams change the environment by restoring and enhancing it:

- Sand dams transform the environment as the stored water raises the water table level both upstream and downstream from the dams (Brandsma *et al*, 2009; Frima *et al*, 2002). As the aquifer increases in size, wells and boreholes have more water and springs may return to the area.
- The higher water table increases the natural vegetation. Indigenous trees and riparian plants return to the area, and birds and fish return to the restored ecosystem (fish come over the dam wall and live in new pools that form downriver). Bio-diversity increases significantly as the river bed, banks and water catchment area are replenished (Ertsen, 2006).
- Increased bio-diversity makes it possible for community members to create a sustainable livelihood in harmony with their environment.

What are the criteria for locating the sand dam?

Solid bed rock: There must be a good rock bed on which to lay the foundation of the dam. Without this rock foundation the sand dam is likely to wash away after a heavy rain.

- The quality of the bed rock should be dense, non-porous and without cracks.
- The rock bed should be on the surface or fairly near the surface, and optimally extend across the river bed. This bed rock should be reached by digging a trench in the river bed to expose the

rock before a final decision on a site is reached. If the rock bed does not extend across the river bed, you would need to dig down very far and put in a concrete foundation.

- This trench should be extended into the river banks to see what kind of foundation will be needed for the wings.

Topography of the area:

- The river valley should be narrow and well defined, to ensure the length of the dam wall is as short as possible. Ideally, the site should be in a deep gorge section of the valley to maximize storage capacity and minimize surface area and length of the dam wall. However, many sand dams have been built in fairly level areas and they work very well even though they are typically quite long.
- The river banks should be high enough to construct a dam wall that will ensure a large storage volume and hold the wing walls.
- The location should be away from bends in the river and soil erosion.
- The stretch behind the dam should be large enough to enable the maximum amount of sand storage. The gradient should be ideal to facilitate good storage of sand behind the dam.
- The presence of lots of tributaries upstream is ideal.
- The basin should be as free as possible of cracks and fissures to minimize water leakage.
- The location should be easily accessible to aid in the construction, use, and maintenance of the dam.
- Valuable property and land should not be submerged due to the construction of the dam.

Type of sand:

- The coarser the sand in the river, the better the site. Fine sand is not suitable because there is less storage space for water between the particles.

The amount of water available for extraction in different sands soils is given in Table 1.

Table 1: Extractable water from silt, sand and gravel (3)

Material	Silt	Fine sand	Medium sand	Coarse sand	Fine gravel	Gravel
Size (mm)	≤0.5	0.5-1	1-1.5	1.5-5	5-19	19-70
Sample (l)	4.00	4.00	4.00	4.00	4.00	4.00
Saturate (liters)	1.52	1.58	1.63	1.80	1.87	2.05
Porosity (%)	38.0	39.5	40.8	45.0	46.8	51.3
Extract* (liters)	0.18	0.75	1.00	1.40	1.65	2.00
Extractability (%)	5	19	25	35	41	50

* Extract is the amount of water that would come out if a sample was placed in a container with drainage holes in the bottom.

Community input:

- Walk the river bed with elders and the women who fetch water. Ask questions, listen, and look. They will know where water can be found in dry seasons or drought.
- Walk up and down the river bed to find a good rocky formation as near to the beneficiaries as possible.
- Talk to the leaders and elders of the community to find where the high water mark for most floods is. This is the height of the primary spillway.
- Talk to the elders to find where the high water mark is of the worst flood in their memory. This needs to be marked with stakes so that the secondary spillway and wing height is higher than these stakes.
- Check out the community politics of the area to see if the owners of land around the dam site will be willing to give people passage across the land to access the water.
- Engage the community in identifying several sites and explain the benefits of building a cascade or series of dams on the river for maximum benefit and the creation of a green belt around their sand dams.

What types of permits are required before construction can begin?

Generally two types of permits must be obtained before starting construction. One is an agreement between the local group who is doing the project and the landowners whose land borders the area of the dam site. The other is the permit that the government requires for construction on a seasonal river.

Sand Dam Construction Agreement: this agreement is signed by the group. This agreement should list at a minimum:

- the consent necessary from land owners on land use and access to water issues;
- the consent necessary from the government to construct the sand dam;
- the amount of terracing (terracing is explained below) to be dug before dam construction starts;
- the labor and materials such as stones, sand and water (inputs) expected from the community group; and
- the requirement of on-going monitoring and maintenance of the dam by the group.

Government Agreement for the construction of a sand dam on a seasonal river: the group must go to the local government entity and identify all the permissions necessary for the construction of the sand dam, and get all the necessary forms. In the Eastern Province of Kenya there is one form: this agreement is signed by the Community Representatives of the group and regional government water representatives.

What is the best time to build a sand dam?

The timing of construction depends upon:

- the availability of resources;
- the agreement of the community group to that time;
- availability of the members to work;
- the presence of sand, stones, and water ready at the site;
- the preparation of the terraces around the sand dam site;
- the time that it takes to get the necessary government permit(s); and
- the rainy season, as sand dam construction should be finished before the rains start.

How do you design the sand dam?

UDO has qualified water engineers, called Dam Coordinators, who work with the SHG to site the sand dam, and then draw up the dam design which is submitted with the other paperwork to the government for approval. Figure 2 shows what the final design might look like.

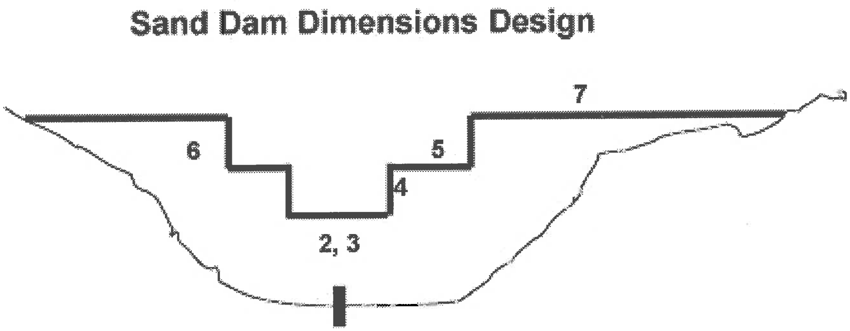

Figure 2: Summary of steps taken to figure out sand dam dimensions. A step-by-step diagram is found in the online Supplement to this issue of EDN.
1) Identify the center of river flow and mark
2) Identify height of primary spil n way
3) Identify normal width of main river channel for length of primary spillway
4) Add ½ to 1 m height for secondary spillway height
5) Identify length of flood river flow channel for length of secondary spillway
6) Add ½ to1 m height
7) Identify length of wings
8) From center mark of river take measurements

Here is the basic methodology for the design:

Primary spillway: The dam will fill very quickly when the rains come (rains in the semi-arid areas where we live are short and erratic but very heavy). The primary spillway will center and discharge the normal flow into the normal river channel during the rainy season.

- At the chosen site, find the narrowest place with the best rock bottom. Place a stake here.

Now find the center of the river bed at this point.

· Identify the center of the river bed to center the primary spillway directly above this point. Make sure that the dam can be secured to the best rock bed available and the primary spillway will be centered in the center of the natural river bed. The river must continue to flow where it flowed before or it will cause erosion. Place a stake here.

· Determine the height of the primary spillway from the historical normal height of the flow of water after rains. Use a line level and mason's line and identify and mark two points, one on each bank with the same height. This height at the center will be the primary spillway height.

· Determine the length of the primary spillway along this line level and mason's line. The length of the spillway is the length needed to guide water through this channel and keep it in the normal river channel during the normal course of its running during the rainy season.

· Mark the height and length of the primary spillway. Use a tape measure. Mark its location with pegs, string, and level.

Height: The primary spillway is normally one meter or slightly higher. The chief factor is the height of the normal flow during the rainy season. Other factors are: the size of the river, the amount of normal flow, the bank heights, and the amount of storage and sand deposition area desired. After the sand has filled the dam to this primary spillway level, the community often decides to raise the level of the dam by another 0.5 meters to accommodate more sand and water. The wings will need to be extended then also.

Length: The length of the primary spillway depends on the width of the river banks, slope of the river banks, and the amount of water contained in the river. The length of the secondary spillway depends on these factors and the anticipated amount of water that will flow down the river after heavy rainfalls upstream.

Width: The width of the dam wall at the top is always wide enough for a person to walk on the top, a minimum of one meter. The foundation width at the bottom depends on the river size and flow. The average sand dam is one and a half meters wide at the foundation level and tapers up to the top. If the river is very big and the dam is high, the foundation will be thicker.

Secondary spillway: The secondary spillway is built to guide water into the center of the regular river channel when there are heavy rains and heavy stream flow. The primary spillway keeps the water in the center of the river when there is less rain. The secondary spillway is important to prevent soil erosion during heavy rains as it centers the water within the river bed.

· Determine the height of the secondary spillway. This will be the flood level of the rivers in very heavy rains.

· Use a line level and mason's line and identify and mark two points, one on each bank, at the flood level of the river in very heavy rains. This height will be the secondary spillway height.

· Determine the length of the secondary spillway. It is the length needed to control the flow of the flood water and keep it within the river channel during a very heavy rain.

- Mark the height and length of the secondary spillway. Use a tape measure. Mark its location with pegs, string, and level.

Height: The secondary spillway is usually 1 meter higher than the primary spillway.

Length: The length extends to the wings, and depends on the width of the flow of the river at flood level.

Width: The width is usually 1 meter wide.

Tertiary spillway

In the case of a very large and wide sand dam, you may need to lay out a tertiary (i.e. an additional) spillway. The height will be the height of the highest flood in the memory of the members of the SHG and elders in the area. Follow the above method to lay out and level the tertiary spillway.

Wings

Wings are built to keep the flood waters from going around the sand dam and causing erosion and eventual undercutting of the dam walls. They may not be necessary depending on the size of the banks and the volume of flow.

- The wings must be constructed to guide the river water back to its natural course in case of flooding.
- Determine the path of flood waters on both sides of the banks of the river. Mark this path of flood water with stakes.
- Determine the length of the wings, making sure they are long enough and high enough to meet the height of the highest flood in memory of the elders. Use a tape measure and level. Stake out the wings.

Height: The wings of the dam go up 1 meter high or more above the secondary spill way to prevent erosion and contain the water in the river bed. The height of the wings depends on the amount of flow of the river, the curve of the river and the current of the river.

Length: The wings may extend in length from three meters up to 50 or more meters. If the river banks are very steep the wings may just extend a few meters. If the banks are very flat, the wings can go many meters. The wings have to be long enough so that the water never diverts around the wings: sometimes we need to go back and extend the wings to ensure that flood waters are contained within the river channel.

Width: The base of the wings is thicker than the top of the wings, and tapers off towards the ends of the wings. The wings are made of the same materials as the dam wall.

Make a record of all measurements and keep them. Check to see that you have all the required measurements for the design.

The Sand Dam Dimensions Design is drawn on site by the Dam Coordinator and used to do the Design Measurements, which is then used on site by the Artisan who constructs the spillways and wings according to these specifications. An example of a Sand Dam Dimensions Design can be accessed in the **online Supplement** to this issue.

How do you construct the sand dam?

Foundation: The foundation is dug down to the rock bed. If any rock is porous it must be removed to leave only hard rock for the foundation. Clean the rocks with a brush and water and bail out the dirty water. Dig away any loose or partially decomposed rock. Pour dry cement on this rock after it is clean to fill in any cracks in the rock bed.

Diverting flowing water: If there is water flowing in the river, build shuttering (a timber frame) to divert the water to one side. Then start construction from the side free of water.

Twisted steel reinforcement bars: Using a hammer and chisel, dig holes 2.5 cm in diameter and 7.5 cm deep, one and a half meters apart in a zigzag fashion in the rock foundation within the space where you will place the timber form work (shuttering) for the sand dam wall. These holes will anchor the twisted steel bars (also called rebar) that reinforce the concrete wall. Into each hole place a 1 ½ meter length of twisted steel rebar. The rebars should zigzag within the dam wall, always at least 20 cm from the sides of the timber form work. When the lengths of rebar are in place, the form work is constructed around them. The bars are kept in place by the rock holes. Barbed wire is placed around the rebar for reinforcement. When the form work is in position, the artisan supervises the placing of barbed wire through the middle of the form work to keep it reinforced and in place with the right measurements. The barbed wire keeps the timber form work from spreading (Figure 3).

Figure 3: Artisan in trench showing form work, steel rebars, and barbed wire

Timber forms (form work): Two timber forms must be constructed, one each for the upstream and the downstream side of the dam. These forms will contain the concrete until it is hardened. The artisan supervises their construction. The two forms are made from horizontal boards and upright timbers. The horizontal boards are 2.5 cm by 15 cm and several meters long, depending upon the width of the sand dam desired. The uprights are 5 cm by 10 cm and one and a half meters high from the bottom to the top. The horizontal boards and upright timbers are nailed together and create the form work. The forms are made on the bank and then taken to the prepared foundation site and fitted into position over the rebar anchored in the rock bed.

Supports need to be nailed to the form work when it is placed in position over the dam wall foundation site, before concrete is poured in. These supports secure the form work into position.

Concrete walls: The community members, under the supervision of the Artisan, fill the form work with mortar and stones. The experienced Artisan supervises the placement of the mortar and stones. The mortar is made by mixing cement, sand and water as close to the sand dam wall as possible. The mortar is mixed by the group members on the ground using shovels (Figure 4). When it is ready, it is shoveled onto large flat metal pans. These pans are passed along a line of people to the dam wall. Stones are passed along the line when the artisan requests them. This community assembly line process is continued until the form is full of mortar and stones.

Figure 4: Community members mixing mortar at Woni Wo Tithi, Kenya

The stones gathered by the community must be clean, high quality impermeable stones. If the stones have soil on them, brush them well with a wire brush to remove the dirt. There should be three sizes: large flat stones, medium stones, and small stones.

The ratio for the mortar for the first 50 cm layer of wall is one bag of cement to two wheelbarrows of sand. After this first 50 cm layer of mortar is laid, large stones are carefully placed by the artisan into the mortar. These large stones are then followed by medium and small stones.


Figure 5: Sand dam construction at Woni Wo Tithi by Emali SHGs and UDO staff, Kenya

After this initial layer the ratio of cement to sand is reduced (from 1:2) to one bag of cement to three wheelbarrows of sand. This ratio of 1:3 is then maintained for the rest of the dam wall. Strands of barbed wire are placed in this mixture of mortar and stones at 25 cm intervals.

Large flat stones are placed perpendicular to the basement layer. Then smaller stones fill in the gaps. Use a mason hammer to hit the small stones to remove air spaces and fill all spaces between the big stones. Then add 15 cm of mortar. Repeat layers. Leave 8 cm of space for the mortar between the stones and the form work on both sides.

What needs to be done for immediate maintenance?

Dam wall curing:
For the first 21 days after the sand dam is completed, the artisan and the community SHG need to keep a close watch on the dam wall. The concrete must be kept damp to cure it properly. If the concrete is not kept damp for 21 days, the dam wall may crack and leak. If the weather is very hot, the dam wall will need to be monitored carefully as the curing takes place, and more water may be needed to dampen the walls more frequently. We place sand on the dam wall to keep it moist. Heavy rainfall during this time of curing will hinder the process. It is best not to build during the rainy season.

Figure 6: Completed sand dam undergoing curing, Woni Wo Tithi, Kenya

Protecting the banks and catchment area around the sand dam:

- Terracing: Terracing will prevent excessive soil deposits upstream from the dam, by controlling fast, high volume run-off of water that causes soil erosion. It keeps silt out of the dam. Terraces will also conserve water in the embankments and trenches.
- **Terraces are built and maintained so silt is kept out of the sand dam. Silt does not store water well**. If silt fills the dam, there is little space for water in the voids. UDO requires the terraces above the dam wall to be dug before the dam wall is started (Figure 7).

Figure 7: Self help groups digging terrace in Makueni, Eastern Province, Kenya

The community SHG needs to understand that the sand dam will not work properly if terraces are not built and maintained. The soil will wash down the banks into the river, filling the dam with silt rather than sand. Also, the terraces capture water in the soil, so that more water is available on the slopes for the grasses, trees, and crops that are growing there.

Terracing is important! With terracing,
"Where the rain runs, we make it walk.
Where the rain walks, we make it crawl.
Where the rain crawls, we make it sink into the ground."
-National Geographic, November 2009

Napier or other grass and/or legumes must be planted on the terrace ridges. Napier grass provides good fodder and serves as an anchor for the terrace, further preventing erosion. [Editor: You can use vetiver grass if free-range livestock might destroy the edible grasses.] The terraces keep manure from being washed away and increase the aeration of the soil. Farmers see a distinct increase in crop yield if their land is terraced. Farmers benefit with terracing even at 2% slopes or lower (Figure 8).

- Plantings downstream: The planting of Napier grass or other grasses or trees is important on the sides of both banks downstream to stabilize the site and prevent erosion. This planting needs to be done immediately after construction.
- Fencing: The community group may want to build a fence around the water points in the river bed upstream to protect the area from animals fouling the sand and reducing the dam's water storing capacity.
- Potential erosion spots: Small rills or gullies near the site should be blocked to prevent soil erosion. These may be blocked by sand sacks or grasses. Many communities build small sand

dams on these rills and gullies for additional water harvesting.

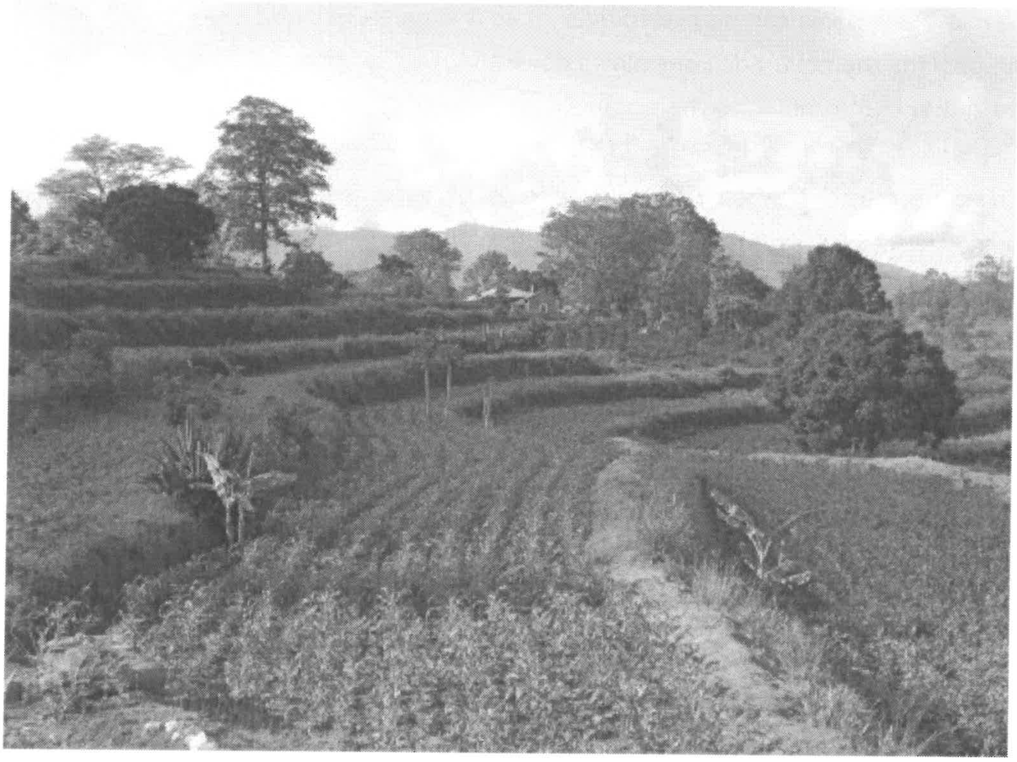

Figure 8: Completed terracing near Kola, Kenya

What is involved in long term maintenance?

The community SHG needs to recognize and accept the responsibility for long term maintenance of the sand dam and its banks and terraces. The following are the most important things to check:

- Immediately after a heavy rain, inspect the sand dam for damage.
  - o Check to make sure no water is going around the wings. If it is, extend the wings. If this is not done, the dam will wash out on that side and the work is lost.
  - o Check to see that tree trunks, branches and other materials that have been carried down the river are removed.
- Check for erosion downstream and renew plantings of Napier grass. Sometimes the length of the wings can be extended to prevent this erosion.
- Check that erosion is not occurring at the apron (i.e. the area directly under the primary and secondary spillways), along the bottom of the spillway and along the bottom of the wings downstream. If it is, reinforce the apron with cement and/or stones. If this is not done, the dam wall will wash away in the next rains.
- Check for leaks and/or cracks in the masonry of the dam wall and wings and repair immediately.
- Check the banks upstream and downstream and renew any plantings to control erosion.
- Check the terraces and replant any embankments that are damaged.
- Consider fencing if you see damage from animals on the terraces (or use vetiver grass).
- Think seriously of making more sand dams above and/or below the first one. A series of

sand dams creates much more water storage, raises the water table, and increases the vegetation in the area. In the long term, this change will significantly improve the ecology of the area and the lives of the people. Sand dams can be placed every 1 to 2 kilometers along a seasonal river bed, and each one benefits the next. Each one slows down the rush of flood water, and allows water to be stored rather than running to the ocean.

Why do you often extend the sand dam height after a year or so? Why don't you just build it higher to begin with?

If the sand dam wall is built higher than 1 meter at first, it may fill up with silt. We want only coarse sediment (sand) to settle behind the dam wall. Once the sand dam is filled with sand, the wall can then be raised another meter and the sand will fill this extended space. Coarse sand increases the storage capacity of the dam because of its high porosity.

How do you prevent silt from clogging up the sand dam?

If a sand dam is poorly located, badly designed or not regularly maintained, it will fill with silt instead of sand and the amount of water it stores will be significantly reduced.

- The site must be on a seasonal river with a sandy river bed and coarse sand.
- The height of the first spillway should be 1 meter so that the lighter silt flows over the spillway and the heavier sand sinks to the bottom and is stored by the dam.
- Terraces must be built upstream on the banks of the river to stop the rapid flow of water and silt into the river bed.
- The ridges of the terraces must be planted with napier or vetiver grass to anchor the terraces, prevent erosion and keep silt on the banks.
- The banks of the river bed can be planted with more grasses and trees to further anchor the soil and provide good quality fodder for animals during drought periods.

What about the people downstream? Do they lose water?

In our area it is clear that the total amount of water spilling over a sand dam after a rain is much higher than the volume stored in its reservoir. Only about 2% of the total water coming from the particular catchment of one dam is stored in its reservoir (Hut *et al*, 2006).

What is the cost benefit of a sand dam?

These calculations were done at Utooni Development Organization, Kola, Kenya in 2010.

We calculated the cost of building a sand dam by adding a) the average cost of the dam including all staff and materials and b) the community self help group (SHG) contribution as detailed below*.

Our water engineers estimated the volume of water in an average dam.

The cost of water is the current rate in 2010 in the target area if people buy water.

For the average sand dam alone: (US$ 1= KSH 75/-)

	KHS	US$
Cost of average dam:	575,184/-	7,669
*SHG contribution:	640,000/-	8,533
Total cost:	**1,215,184/-**	**$16,202**

Volume of water in average dam		100,000 cu. m
Cost of water per cu meter:	100/-	$1.33
Value of water:	**10,000,000/-**	**$133,000**

Cost benefit ratio in first year of operation: 1,215,184: 10,000,000 or**1:12**

(US$ 16,202: 133,000 or 1:12)'

*SHG contribution includes the volunteer labor and meals that the SHG members contribute to the sand dam construction. The rate of 250/- per day is the average rate for casual labor in the area.

SHG member Contribution	**# members**	**# days**	**# rate/day**	**total**
Digging Foundations	40	6	250/-	60,000/-
Collecting Stones and Sand	40	30	250/-	300,000/-
Collecting Water	40	2	250/-	20,000/-
Building	40	20	250/-	200,000/-
Food during Building		20 days	3000/-	60,000/-
Total contribution for 1 dam				**640,000/-**

Why do you always work with community self help groups in building dams?

Our organization, UDO, works among the Kamba people in Eastern Kenya. UDO was founded by a local farmer, Joshua Mukusya, and makes use of cultural knowledge and practice. One of the Kamba's strongest cultural traditions is 'mwethya' or people working together in unity on a task for the common good. This cultural tradition is a major part of the success of the sand dam project. People are very comfortable getting groups together for mutual tasks such as building houses, raising money for weddings and funerals, and doing merry-go-rounds (the latter is a traditional method of micro-finance, in which each person contributes a set amount of money each month and the total amount is given to a different member each month). UDO has used this valuable tradition to help groups get together for holistic plans and long-term action to move group members together from subsistence to prosperity through water, food, and income security. Water security always comes first. As one woman said to us, "We don't want relief. Give us water and we can grow our own food."

Sustainable development projects are best started and maintained by local people with local ownership, local decision making and local resources. A community self help group that already works, or wants to work, on water and food security is a natural partner for development organizations seeking the same goals.

The advantages of working with self help groups in building sand dams are:

- The group takes charge and develops local ownership of the sand dam;
- The group's contribution of labor and materials reduces the cash cost of the sand dam by approximately half;
- The group feels ownership of the developing assets, water and sand and the restored vegetation;
- Training with the group helps in strengthening group knowledge, skills and practice to initiate other projects;
- Groups can get together and exchange knowledge and skills, motivating and helping each other; and
- Income generated from the dam assets (e.g. from sales of water, vegetables, fruits and fodder) is then available for other group projects.

Roland Bunch's book ***Two Ears of Corn*** is a good text that reflects the UDO philosophy of working together with community groups. We use this text when training new staff in our organization. [The book is available from ECHO's bookstore: **www.echobooks.org**.)

How do you work with community self help groups to build sand dams?

We work only with registered self help groups that are active in other projects before they come to us and request assistance in building sand dams. We work with the group for six months to make sure that they are motivated and ready to start a sand dam project.

We use another traditional cultural practice, 'kuthiana,' in working with the community self help group. 'Kuthiana'is the spying out of the land and then copying good ideas. We have used this method of oral and visual learning as a major communication strategy for training of community groups through exchanges. Groups travel together to observe other successful groups and learn from them, thus accelerating learning and knowledge sharing on water and food security in the most efficient method possible—one based on their own oral tradition of learning from observation of others. Successful local self-help members conduct much of the training.

Groups get together to help each other build sand dams, most often when a group is building its first sand dam, when the group is very small, or when the sand dam is especially big. It is common to have three or four groups working on one dam. Groups that have built many dams are very experienced: they work fast with little direction except from the Dam Coordinator and the Artisan who make sure the design is followed and the quality of the construction is high.

We have designed and used trainings on six sets of capacity building skills to support and encourage 'mwethya,' using the learning technique of 'kuthiana.' The first three sets are given to the group in their first year of partnership with us (Stern, 2009). We have found that these trainings must often be repeated throughout their association with us. These capacity building sets are:

- identity and vision
- governance and leadership
- strategic planning
- performance and results
- relationships and communication
- resource development.

Our best trainers are members who have built many dams, made many mistakes and learned from them, and are in groups that are now economically successful (making money).

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We often come across interesting material related to articles in *EDN* that could not fit into the available space in the issue. We share the most relevant of those here. For more information on the following, click on the article name:

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Water Harvesting Web Pages

www.utoonidevelopment.org
This website provides more detailed information about Utooni Development Organization, a Kenyan non-governmental organization working with community self help groups. It also gives the story of its founder, Joshua Mukusya, who has played a leading role in promoting and initiating sand dam projects in Kenya.

www.sanddams.org
On this page, note in particular the 'films' link underneath the brief video. This link will lead you to another page with an option to view a video titled 'Walking on Water.' Once you click on this, you will see a list of supporting films that can also be viewed. A more complete DVD is available for purchase.

www.waterforaridland.com
This website contains a wealth of materials (e.g. handbooks, manuals, slide shows, and videos) on methods for harvesting rainwater in areas with long dry seasons. Some of the information is available for a fee; however, a substantial amount of information can be read online at no cost.

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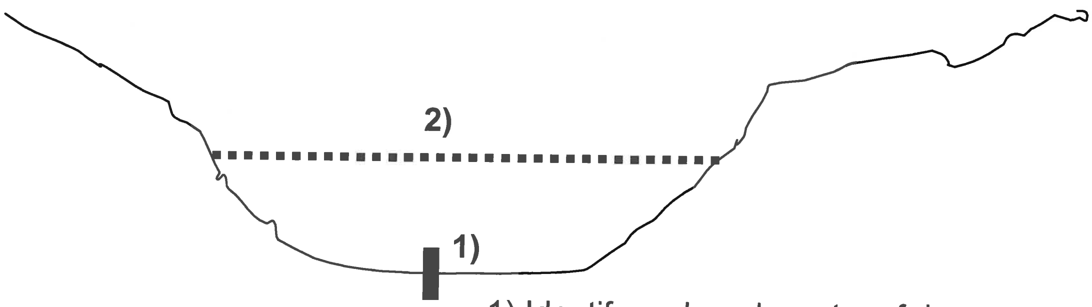
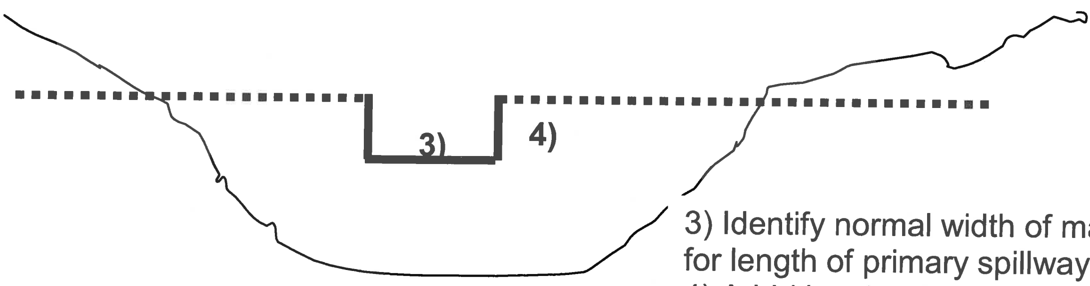
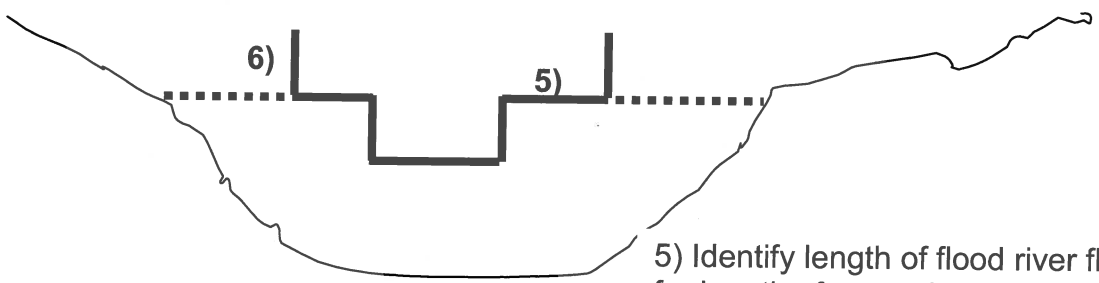
Sand Dam Dimensions Design



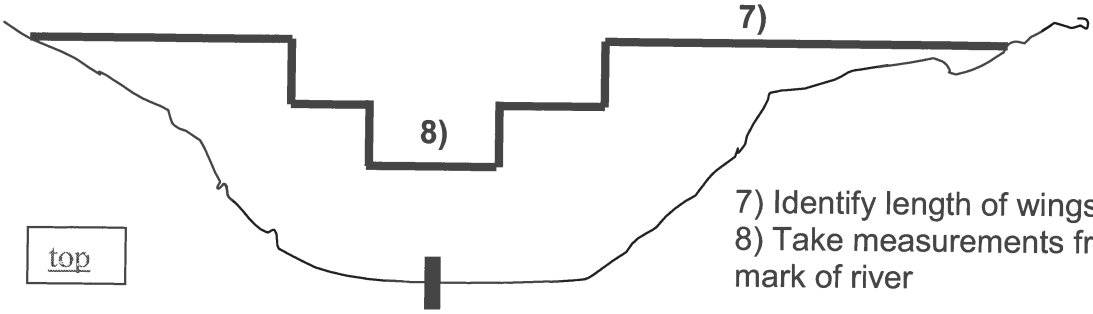
1) Identify and mark center of river
2) Identify height of primary spillway



3) Identify normal width of main river channel for length of primary spillway
4) Add ½ to 1 m height for secondary spillway height



5) Identify length of flood river flow channel for length of secondary spillway
6) Add ½ to 1 m height for secondary spillway



7) Identify length of wings
8) Take measurements from center mark of river

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