Rock catchment (Kenya)

**DESCRIPTION**

A rock catchment system is a water harvesting structure comprising a bare sloping rock surface (impounded area), a constructed concrete wall at a strategic point (weir), pipeline from the weir to the storage tank(s), storage tanks and water kiosk(s) connected to the water tanks by pipelines.

The Technology is built on a gently sloping outcrop on the hillside. The bare rockface is the surface from which rainwater is harvested. A weir is constructed at a strategic point for maximum collection towards the foot of the hill. The weir dams hold harvested water in the rock catchment and channels the water through a piping system to reservoirs, generally masonry tanks, located below the hill. A weir is usually a concrete wall constructed and reinforced with iron bars to give it adequate strength to withstand the weight of the dammed water. The length, height and thickness of a weir varies with the size and the slope of the rock catchment area. On average, a weir will be 10 meters long, 2 meters high and 0.5 meters thick. At the base of the weir, an infiltration box of approximately 1 square meter is constructed and filled from the bottom with fine sand, coarse sand and gravel (in that order) for the purpose of sieving out impurities before the water reaches the tanks. Metal piping is recommended for connecting the weir to the storage tanks downhill due to the high pressure exerted by owing water. The piping distance ranges from 15 to 300 meters from the weir to the storage tanks. Provision is usually made for additional pipelines in case there is need for expansion of the system. At the bottom of the hill, masonry tanks are constructed, ranging from 100 cubic meters capacity, or greater, depending on the impounded area, population, and available resources. The pipes join the tanks through a control chamber meant for regulating water flow into the tanks. Adjacent to the tanks are water ‘kiosks’ where the community draws water. To gauge how much water is issued, a meter is fitted inside the kiosk. Metering the water is a measure for accountability and control. Construction of a rock catchment system needs heavy investment in materials - cement, quarry stones, ballast, iron bars, sand, hard-core stones, water, metallic (galvanised iron) pipes and plumbing installations. Construction of the system is labour intensive in terms of both skilled and non-skilled personnel. The main purpose of the rock catchment system is to harvest, and store rainwater for domestic - and some livestock - use. In the case of the documented project, the benefiting communities are pastoralists who live in northern Kenya, a region characterised by chronic droughts, seasonal floods and acute water shortages. The water situation is aggravated by increasing drought frequency and severity. On the other hand, the little rain received has often been destructive downstream, cutting through roads and causing massive soil erosion due to high water velocity. During the dry periods when open water sources such as earth pans dry up, women travel long distances to search for water from hand dug shallow wells within dry seasonal riverbeds ('sand rivers').

**LOCATION**

Location: Implemented with three different communities in three locations, Ndikir, Manyatta Lengima and Mpagas., Laisamis sub county, Marsabit County, Kenya, Kenya

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 37.7047, 1.65635

Spread of the Technology: applied at specific points/ concentrated on a small area

In a permanently protected area?:

Date of implementation: 2015

Type of introduction
- through land users' innovation as part of a traditional system (> 50 years)
- during experiments/ research
- through projects/ external interventions
CLASSIFICATION OF THE TECHNOLOGY

Main purpose
- improve production
- reduce, prevent, restore land degradation
✓ conserve ecosystem
- protect a watershed/ downstream areas – in combination with other Technologies
- preserve/ improve biodiversity
✓ reduce risk of disasters
✓ adapt to climate change/ extremes and its impacts
- mitigate climate change and its impacts
✓ create beneficial economic impact
✓ create beneficial social impact
✓ The common hazard in the region where the Technology has been implemented is drought. The Technology aims at reducing the drought impacts among the pastoralists

Purpose related to land degradation
- prevent land degradation
✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

Land use
- Grazing land
  - Semi-nomadic pastoralism
  - Animal type: camels, goats, mules and asses, sheep, cattle

Water supply
✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Degradation addressed
- soil erosion by water - Wg: gully erosion/ gullying
- water degradation - Hs: change in quantity of surface water, Hp: decline of surface water quality

SLM group
- pastoralism and grazing land management
- cross-slope measure
- water harvesting

SLM measures
structural measures - S5: Dams, pans, ponds, S7: Water harvesting/ supply/ irrigation equipment

TECHNICAL DRAWING

Technical specifications
A Rock catchment consists of the following main components:
- Catchment area - vary between more or less than 100 square meters
- Infiltration box - concrete box with approximately one square meter and 0.5 meters deep
- Weir - a wall approximately 20 meters length, approx. 0.3-0.5 meters width, and 1.5 meters height; depending on the site the catchment can store between 150 and 700 cubic meter above the weir
- Pipes - Galvanised steel pipes of varying diameters and length depending on catchment size and storage location and capacity
- Tanks - tanks with varying capacities, of the same order of magnitude as the catchment storage capacity above the weir. Together, tanks and catchment can store some 10-20% of the annual precipitation falling over the rock catchment, which is enough to sustain water use during a normal year, but not during a year of exceptional water scarcity.

Here is a link where you can see a sketch of typical rock catchment:
http://www.climatetechwiki.org/sites/climatetechwiki.org/files/images/extra/media_image_3_22.png
**ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS**

### Calculation of inputs and costs
- Costs are calculated per Technology unit (unit: A unit comprises the key component of the Technology. The rock catchment technology has four components - the weir, piping, tanks and water kiosk volume, length: N/A)
- Currency used for cost calculation: USD
- Exchange rate (to USD): 1 USD = n.a
- Average wage cost of hired labour per day: 15 dollars per day for skilled labour and 3 dollars per day for unskilled labour.

#### Most important factors affecting the costs
1. Availability of parts, whether they can be bought locally or from far
2. Quality of parts
3. Extent of the system exposed to vandalism and/or destructive weather events
4. Early detection of broken/spoil parts

### Establishment activities
1. Surveys - topographical, environmental impact assessment (Timing/ frequency: no specific time)
2. Drawings and bill of quantities (Timing/ frequency: no specific time)
3. Procurement of materials (Timing/ frequency: advisable should be done during the dry season when roads are passable without difficulties)
4. Recruitment of artisans (Timing/ frequency: no specific time)
5. Start of construction works (Timing/ frequency: no specific time)
6. Continuous technical supervision and completion (Timing/ frequency: Continuous throughout the year)

### Establishment inputs and costs (per A unit comprises the key component of the Technology. The rock catchment technology has four components - the weir, piping, tanks and water kiosk)

<table>
<thead>
<tr>
<th>Specify input</th>
<th>Unit</th>
<th>Quantity</th>
<th>Costs per Unit (USD)</th>
<th>Total costs per input (USD)</th>
<th>% of costs borne by land users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skilled labour</td>
<td>Days</td>
<td>607.7</td>
<td>15.0</td>
<td>9115.5</td>
<td></td>
</tr>
<tr>
<td>Unskilled labour</td>
<td>Days</td>
<td>1973.0</td>
<td>3.0</td>
<td>5919.0</td>
<td>40.0</td>
</tr>
<tr>
<td>Construction material</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction materials for all the four components together</td>
<td>1 catchment system</td>
<td>1.0</td>
<td>75407.0</td>
<td>75407.0</td>
<td></td>
</tr>
<tr>
<td>Total costs for establishment of the Technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total costs for establishment of the Technology in USD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Maintenance activities
1. Periodic washing of tanks and scooping out of sand and silt at the weir (Timing/ frequency: Twice a year)
2. Repairs of broken parts - valves, pipes, taps etc.. (Timing/ frequency: Through the year)

### Maintenance inputs and costs (per A unit comprises the key component of the Technology. The rock catchment technology has four components - the weir, piping, tanks and water kiosk)

<table>
<thead>
<tr>
<th>Specify input</th>
<th>Unit</th>
<th>Quantity</th>
<th>Costs per Unit (USD)</th>
<th>Total costs per input (USD)</th>
<th>% of costs borne by land users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seasonal scooping of sand and silt from the weir</td>
<td>seasons/year</td>
<td>2.0</td>
<td>100.0</td>
<td>200.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Broken parts and repairs</td>
<td>lumpsum</td>
<td>1.0</td>
<td>300.0</td>
<td>300.0</td>
<td></td>
</tr>
<tr>
<td>Total costs for maintenance of the Technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>500.0</td>
</tr>
<tr>
<td>Total costs for maintenance of the Technology in USD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>500.0</td>
</tr>
</tbody>
</table>
### Natural Environment

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average annual rainfall</strong></td>
<td>&lt; 250 mm, 251-500 mm, 501-750 mm, 751-1,000 mm, 1,001-1,500 mm, 1,501-2,000 mm, 2,001-3,000 mm, 3,001-4,000 mm, &gt; 4,000 mm</td>
</tr>
<tr>
<td><strong>Area used per household</strong></td>
<td>very shallow (0-20 cm), shallow (21-50 cm), moderately deep (51-80 cm), deep (81-120 cm), very deep (&gt; 120 cm)</td>
</tr>
<tr>
<td><strong>Sedentary or nomadic</strong></td>
<td>Nomadic, Semi-nomadic, Sedentary</td>
</tr>
<tr>
<td><strong>Markets orientation</strong></td>
<td>Subsistence (self-supply), mixed (subsistence/commercial), commercial/ market</td>
</tr>
<tr>
<td><strong>Relative level of wealth</strong></td>
<td>very poor, poor, average, rich, very rich</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>Women, Men</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>Children, Youth, Middle-aged, Elderly</td>
</tr>
<tr>
<td><strong>Technology is applied in</strong></td>
<td>Convex situations, Concave situations, Not relevant</td>
</tr>
</tbody>
</table>

### Specifications on climate

The are two rainy seasons annually. The long rainy season start in March to May and short rainy season begins in October and ends in December. There has been however variations in the recent years mostly seen on rainfall variability in distribution, amounts and seasonality. Amount of rainfall received annually coupled with high rates of evapotranspiration cannot sustain crop farming.

### Characteristics of land users applying the technology

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Market orientation</strong></td>
<td>Subsistence (self-supply), mixed (subsistence/commercial), commercial/ market</td>
</tr>
<tr>
<td><strong>Off-farm income</strong></td>
<td>less than 10% of all income, 10-50% of all income, &gt; 50% of all income</td>
</tr>
<tr>
<td><strong>Level of mechanization</strong></td>
<td>Manual work, Mechanized/motorized</td>
</tr>
<tr>
<td><strong>Land ownership</strong></td>
<td>State, Communal/village group, Individual, not titled, Individual, titled</td>
</tr>
<tr>
<td><strong>Land use rights</strong></td>
<td>Open access (unorganized), Communal (organized), Leased, Individual</td>
</tr>
<tr>
<td><strong>Water use rights</strong></td>
<td>Open access (unorganized), Communal (organized), Leased, Individual</td>
</tr>
<tr>
<td><strong>Access to services and infrastructure</strong></td>
<td>Health, Education, Technical assistance, Employment (e.g. off-farm), Markets</td>
</tr>
</tbody>
</table>
## IMPACTS

### Socio-economic impacts

<table>
<thead>
<tr>
<th>Impact</th>
<th>Before SLM</th>
<th>After SLM</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinking water availability</td>
<td>decreased</td>
<td>✓ increased</td>
<td></td>
</tr>
<tr>
<td>Drinking water quality</td>
<td>decreased</td>
<td>✓ increased</td>
<td></td>
</tr>
<tr>
<td>Water availability for livestock</td>
<td>decreased</td>
<td>✓ increased</td>
<td></td>
</tr>
<tr>
<td>Water quality for livestock</td>
<td>decreased</td>
<td>✓ increased</td>
<td></td>
</tr>
<tr>
<td>Diversity of income sources</td>
<td>decreased</td>
<td>✓ increased</td>
<td></td>
</tr>
<tr>
<td>Workload</td>
<td>increased</td>
<td>✓ decreased</td>
<td></td>
</tr>
<tr>
<td>Reduced conflicts over scarce water resources</td>
<td>None</td>
<td>✓ None</td>
<td></td>
</tr>
</tbody>
</table>

### Health situation

Quantity before SLM: 600 cubic meters
Quantity after SLM: 3800 cubic meters
The community almost every year would need emergency water trucking. This is not so anymore.

### Community institutions

Quantity before SLM: Borehole water was the only alternative source during dry season
Quantity after SLM: Water free of salt is now available and adequate for domestic use
They no longer use the the highly saline water which has been reported to have adverse negative health effects. The harvested water is easy to treat for microbial contamination at the household level.

### Diversity of income sources

Quantity before SLM: N/A
Quantity after SLM: N/A
The harvested water from the rock catchment is mostly for household use.

### Workload

Quantity before SLM: N/A
Quantity after SLM: N/A
The harvested water from the rock catchment is mostly for household use.

### Conflict mitigation

Quantity before SLM: None
Quantity after SLM: None
The pastoralist communities have in the recent decades experienced resources-based conflicts. These conflicts happen at regional, communal and family scales. The communities and families benefiting from this intervention no longer have to fight over the resource because it is adequate.

### Situation of socially and economically disadvantaged groups (gender, age, status)

Quantity before SLM: About 6 hours spent a day in search of water especially during the dry season
Quantity after SLM: A maximum of 30 minutes spent

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**Wocat SLM Technologies**

Rock catchment
The Technology benefits women most who traditionally are socially and economically disadvantaged. Now they have more time to engage in other profitable activities. The Technology has also taken away the burden of proving water for the households, freeing them for greater social engagement.

| Ecological impacts | 
|-------------------|---|
| harvesting/ collection of water (runoff, dew, snow, etc) | reduced | improved |
| surface runoff | increased | decreased |
| groundwater table/ aquifer | lowered | recharge |
| soil loss | increased | decreased |
| drought impacts | increased | decreased |

Water that would normally be lost almost after it has rained is now stored and kept for future use. Quantity before SLM: All rainwater from the developed catchment was lost each time it rained. Quantity after SLM: About 3500 cubic meters of water is retained within the locality of the community. There is increased control of surface runoff reducing its damaging effects on soil, vegetation and infrastructure. However, the the scale to which this is realised is low.

Quantity before SLM: N/A
Quantity after SLM: N/A
The rock catchment do not in any way lead to increased groundwater recharge.

Quantity before SLM: N/A
Quantity after SLM: N/A
Due to reduced amount of water flowing from the hillside downstream, the ability of water to erode soil downstream is reduced though at very low scale.

Quantity before SLM: Water emergency supply at least two a year during the two dry spells.
Quantity after SLM: No single water trucking done in the last two years
Water has been the most affected livelihood commodity during drought events among the benefiting community. The impact had been acute water shortage leading to external emergency interventions. It was also happened that sometimes when food aid was provided, the community would have no water to cook. There is no longer need for water emergency in these communities.

Quantity before SLM: 
Quantity after SLM: 
The rock catchment do not in any way lead to increased groundwater recharge.

The high velocity water from the hills have been a constant menace in cutting or blocking roads downstream with debris. The harvesting of water has reduced the impact of this water at some sections of the hilly landscape.

| Off-site impacts | 
|-----------------|---|
| damage on public/ private infrastructure | increased | reduced |

The benefits are instantaneous as soon as the structure is completed and especially if it is during a rainy season. The technology has minimum to near zero maintenance costs which remains relatively the same in the long term. The main tasks for maintenance is seasonal removal of silt at the weir and the washing of the tanks.

| COST-BENEFIT ANALYSIS |

Benefits compared with establishment costs

<table>
<thead>
<tr>
<th>Short-term returns</th>
<th>Long-term returns</th>
</tr>
</thead>
<tbody>
<tr>
<td>very negative</td>
<td>very positive</td>
</tr>
</tbody>
</table>

Benefits compared with maintenance costs

<table>
<thead>
<tr>
<th>Short-term returns</th>
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| CLIMATE CHANGE |

Gradual climate change

<table>
<thead>
<tr>
<th>Seasonal temperature increase</th>
<th>Annual rainfall decrease</th>
<th>Seasonal rainfall increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>not well at all</td>
<td>very well</td>
<td>not well at all</td>
</tr>
<tr>
<td>not well at all</td>
<td>very well</td>
<td>not well at all</td>
</tr>
<tr>
<td>season: dry season</td>
<td>season: dry season</td>
<td></td>
</tr>
</tbody>
</table>

Climate-related extremes (disasters)

<table>
<thead>
<tr>
<th>Local rainstorm</th>
<th>Local thunderstorm</th>
<th>Drought</th>
</tr>
</thead>
<tbody>
<tr>
<td>not well at all</td>
<td>very well</td>
<td>not well at all</td>
</tr>
<tr>
<td>not well at all</td>
<td>very well</td>
<td>not well at all</td>
</tr>
<tr>
<td>not well at all</td>
<td>very well</td>
<td></td>
</tr>
</tbody>
</table>

ADOPTION AND ADAPTATION
Percentage of land users in the area who have adopted the Technology

- single cases/ experimental: 1-10%
- 11-50%
- ✔ > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?

- 0-10%
- 11-50%
- 51-90%
- ✔ 91-100%

Number of households and/or area covered
This is a one Technology which is benefiting the entire community. At the time of project implementation the estimated total population was 1000 people.

Has the Technology been modified recently to adapt to changing conditions?
- Yes
- ✔ No

To which changing conditions?
- climatic change/ extremes
- changing markets
- labour availability (e.g. due to migration)

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view
- 1. Relatively low cost of operation and maintenance.
- 2. The technology does not require specialised technical skills for the day to day operations.

Strengths: compiler’s or other key resource person’s view

Weaknesses/ disadvantages/ risks: land user’s view → how to overcome
- 1. Relatively high initial investment cost that is unlikely to be raised by communities themselves. Without external financial support it is therefore unlikely that the system can be expanded when water needs increase.
- 2. Funds could also potentially be acquired from the county government or NGOs.

Weaknesses/ disadvantages/ risks: compiler’s or other key resource person’s view → how to overcome

REFERENCES

Compiler
Fredrick Ochieng

Reviewer
Boris Orlowsky
Renate Fleiner
Alexandra Gavilano

Date of documentation: Sept. 21, 2016

Last update: April 29, 2019

Resource persons
Fredrick Ochieng - None

Full description in the WOCAT database

Linked SLM data
Approaches: Partnership with beneficiary communities in project implementation

Documentation was facilitated by
Institution
- CARITAS (Switzerland) - Switzerland
Project
- Book project: where people and their land are safer - A Compendium of Good Practices in Disaster Risk Reduction (DRR) (where people and their land are safer)

Key references
- A Handbook of gravity-flow water systems for small communities; Thomas D. Jordan Junior; 1980; 978 0 94668 850 0: CACH office library, Nairobi

Links to relevant information which is available online
- Adopting locally appropriate WASH solutions: a case study of rock catchment systems in South Sudan: http://wedc.lboro.ac.uk/resources/conference/37/Leclert-1935.pdf