An overview of the staggered contour trenches applied across the slope on a hilly slope of Zai Mahmood village in Bamyan center. (Jalil Altaf (Agha Khan Foundation (AKF)))

Staggered Contour Trench (Afghanistan)

Jerma (Dari)

DESCRIPTION

Earthen trenches with soil bunds built along contours in staggered design

The SCTs technology is documented by Sustainable Land Management Project/HELVETAS Swiss Intercooperation which is funded by Swiss Agency for Development and Cooperation (SDC), with close support and cooperation of the Agha Khan Foundation (AKF). The staggered Contour Trenches (SCTs) were constructed at a degraded site in Bamyan center (Bamyan province) by Agha Khan Foundation (AKF) project with financial support of the Canadian International Development Agency (CIDA). Totally 1470 contour trenches were constructed at the site, which has an area of 24 hectares.
The size of each trench measured 10 m in length, 0.6 m in width and 0.5 m in depth. The trenches had soil bunds on the lower side having a width of 1 m and height of 0.3 m. Contour lines were prepared using an A-frame and lime and the spacing between two contour lines was 8 m considering the slope. All the trenches were dug out manually. Local people were employed for construction works. Along with the SCTs, other measures were applied such as plantation of fodder grass, shrub and non-fruit trees, gully plugs, water harvesting tanks and brushwood plugs. The area is excluded from grazing and shrub cutting.

The land was extensive grazing land before the project implementation and got extremely degraded due to a lack of management by the land users. There was rampant exploitation of natural vegetation for meeting domestic energy needs and for grazing. Droughts, which frequently occur in the region, contributed to the slow degradation of the vegetation.

Purpose of the Technology: The main purpose of the technology is to reduce flash flood risks and improve land productivity (both upstream and downstream) so that more fodder, fuel wood and fruits could be produced and farmers affected by flash floods could grow more crops. The technology, which is part of a watershed technology system, helps in retaining runoff and sediment and improves soil moisture content. It also helps in water infiltration which eventually contributes to improved ground water recharge.

Establishment / maintenance activities and inputs: SCTs were established in a step-wise manner; as follows: (1) Site surveying, (2) Site mapping, (3) Planning, (4) Marking contour lines with the help of an A-frame, and (5) Trench excavation and bund construction.

The establishment cost for staggered contour trenches, was about 15,500 USD or 645 USD/ha. Most of the money was spent on labour. There have been no expenses in maintenance of SCTs since their establishment in 2008.

Natural / human environment: The technology is applied in semi-arid condition as the area receives annual rainfall of about 400 mm to address land degradation. The site formally belonged to the state but the local communities have use rights. AKF is still maintaining the site and using it for training and demonstration purpose. Several exposure visits for SLM specialist, land users, students and teachers have been also organized at the site.

LOCATION

Location: Zai Mahmood village, Bamyan center, Afghanistan, Afghanistan

No. of Technology sites analysed:

Geo-reference of selected sites
- n.a.

Spread of the Technology: evenly spread over an area (approx. 0.1-1 km2)

In a permanently protected area?:

Date of implementation: less than 10 years ago (recently)

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

Close view of a 2-years old contour trench with a soil bund trap run-off and reduce slope length and trap run-off (Reza Ahmadi (Bamyan, Afghanistan))

CLASSIFICATION OF THE TECHNOLOGY

Main purpose
- [x] improve production
- [ ] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [x] 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

Land use

Grazing land

Forest/ woodlands
- Tree plantation, afforestation

Water supply
- [ ] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation

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

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion

biological degradation - Bc: reduction of vegetation cover

water degradation - Hs: change in quantity of surface water

SLM group
- area closure (stop use, support restoration)
- cross-slope measure
- ground water management

SLM measures

structural measures - S4: Level ditches, pits

TECHNICAL DRAWING

Technical specifications
A detailed staggered contour trenches layout and its specifications (Fig. 1), and the cross section of soil bunds (Fig. 2)

Location: Bamyan. Bamyan center/Bamyan province

Technical knowledge required for land users: high

Technical knowledge required for SLM specialist: high

Main technical functions: control of dispersed runoff: retain / trap, increase of infiltration, sediment retention / trapping, sediment harvesting, increase of biomass (quantity), promotion of vegetation species and varieties (quality, eg palatable fodder)

Secondary technical functions: reduction of slope length, improvement of ground cover, increase in organic matter, increase / maintain water stored in soil, improvement of water quality, buffering / filtering water, spatial arrangement and diversification of land use

Retention/infiltration ditch/pit, sediment/sand trap

Spacing between structures (m): 8

Bund/ bank: level
Spacing between structures (m): 8
Height of bunds/banks/others (m): 0.5

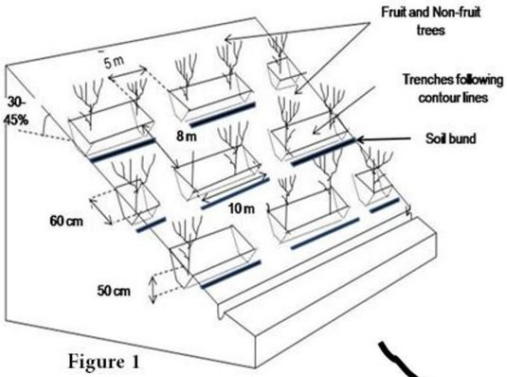

Figure 1

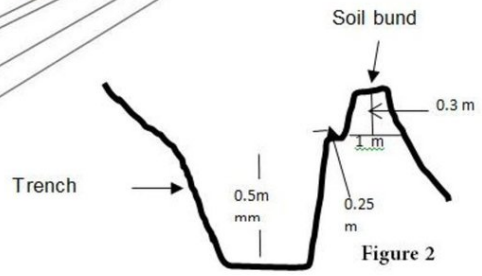

Figure 2

Author: Adapted from Bertran

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: **1 ha**)
- Currency used for cost calculation: **USD**
- Exchange rate (to USD): 1 USD = n.a
- Average wage cost of hired labour per day: n.a

Most important factors affecting the costs
Despite the application of the structural measure of the SCTs AKF is still continuing its financial support for the plantation of the area. Thus irrigation which is a costly activity is still continued by AKF's support. The planted saplings of fruit and non-fruit trees are irrigated for six months/year, i.e. from April to September. Water is carried to the site by tankers. Each month, 75 tankers are used and the cost of one tanker is 12 USD or 600 Afghani. In addition, 16 persons are employed for one time irrigation.

Establishment activities
1. Digging of the contour trenches and construction of the soil bunds (Timing/ frequency: None)
2. Marking contour lines (A frame and lime) (Timing/ frequency: None)

Establishment inputs and costs (per 1 ha)

Specify input	Unit	Quantity	Costs per Unit (USD)	Total costs per input (USD)	% of costs borne by land users
Labour					
Digging of the contour trenches and construction of the soil bunds	persons/day/ha	100.0	6.43	643.0	
Equipment					
A frame and lime	ha	1.0	1.8	1.8	
Total costs for establishment of the Technology				**644.8**	
Total costs for establishment of the Technology in USD				*644.8*	

Maintenance activities
1. No maintenance activities have been implemented for staggered contour trenches and soil bunds up to now. (Timing/ frequency: None)

NATURAL ENVIRONMENT

Average annual rainfall
- < 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
- > 4,000 mm

Agro-climatic zone
- humid
- sub-humid
- ✓ semi-arid
- arid

Specifications on climate
Bamyan receives heavy snow falls and rain falls in winter season
Thermal climate class: temperate

Slope
- flat (0-2%)
- gentle (3-5%)
- moderate (6-10%)
- rolling (11-15%)
- hilly (16-30%)
- ✓ steep (31-60%)

Landforms
- plateau/plains
- ridges
- ✓ mountain slopes
- ✓ hill slopes
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- 501-1,000 m a.s.l.
- 1,001-1,500 m a.s.l.
- 1,501-2,000 m a.s.l.
- 2,001-2,500 m a.s.l.

Technology is applied in
- convex situations
- concave situations
- not relevant

- [ ] very steep (>60%)

- [x] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.
- [ ] > 4,000 m a.s.l.

Soil depth
- [ ] very shallow (0-20 cm)
- [x] shallow (21-50 cm)
- [ ] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [ ] very deep (> 120 cm)

Soil texture (topsoil)
- [x] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Soil texture (> 20 cm below surface)
- [ ] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Topsoil organic matter content
- [ ] high (>3%)
- [ ] medium (1-3%)
- [x] low (<1%)

Groundwater table
- [ ] on surface
- [ ] < 5 m
- [ ] 5-50 m
- [x] > 50 m

Availability of surface water
- [ ] excess
- [ ] good
- [ ] medium
- [x] poor/ none

Water quality (untreated)
- [ ] good drinking water
- [ ] poor drinking water (treatment required)
- [x] for agricultural use only (irrigation)
- [ ] unusable

Water quality refers to:

Is salinity a problem?
- [ ] Yes
- [ ] No

Occurrence of flooding
- [ ] Yes
- [ ] No

Species diversity
- [ ] high
- [ ] medium
- [x] low

Habitat diversity
- [ ] high
- [ ] medium
- [ ] low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [x] subsistence (self-supply)
- [x] mixed (subsistence/ commercial)
- [ ] commercial/ market

Off-farm income
- [ ] less than 10% of all income
- [x] 10-50% of all income
- [ ] > 50% of all income

Relative level of wealth
- [ ] very poor
- [ ] poor
- [x] average
- [ ] rich
- [ ] very rich

Level of mechanization
- [ ] manual work
- [ ] animal traction
- [ ] mechanized/ motorized

Sedentary or nomadic
- [ ] Sedentary
- [ ] Semi-nomadic
- [ ] Nomadic

Individuals or groups
- [ ] individual/ household
- [ ] groups/ community
- [ ] cooperative
- [x] employee (company, government)

Gender
- [ ] women
- [ ] men

Age
- [ ] children
- [ ] youth
- [ ] middle-aged
- [ ] elderly

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 2-5 ha
- [x] 5-15 ha
- [ ] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

Scale
- [ ] small-scale
- [ ] medium-scale
- [ ] large-scale

Land ownership
- [x] state
- [ ] company
- [ ] communal/ village
- [ ] group
- [ ] individual, not titled
- [ ] individual, titled

Land use rights
- [x] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [ ] individual

Water use rights
- [x] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [ ] individual

Access to services and infrastructure

employment (e.g. off-farm)	poor	✓	good
markets	poor	✓	good
energy	poor	✓	good
roads and transport	poor	✓	good

IMPACTS

Socio-economic impacts

fodder production	decreased	✓	increased
fodder quality	decreased	✓	increased
animal production	decreased	✓	increased
risk of production failure	increased	✓	decreased
product diversity	decreased	✓	increased
production area (new land under cultivation/ use)	decreased	✓	increased
water availability for livestock	decreased	✓	increased
farm income	decreased	✓	increased

Decreased production area

Socio-cultural impacts

food security/ self-sufficiency	reduced	✓	improved
health situation	worsened	✓	improved
cultural opportunities (eg spiritual, aesthetic, others)	reduced	✓	improved
recreational opportunities	reduced	✓	improved

As the site is greener now

national institutions	weakened	strengthened	Especially of DAIL (Department of Agriculture, Irrigation and Livestock) and the persons who visit the site
SLM/ land degradation knowledge	reduced	improved	
livelihood and human well-being	reduced	improved	

Ecological impacts

harvesting/ collection of water (runoff, dew, snow, etc)	reduced	improved	Runoff, dew, snow, etc.
surface runoff	increased	decreased	
groundwater table/ aquifer	lowered	recharge	
soil cover	reduced	improved	
plant diversity	decreased	increased	
animal diversity	decreased	increased	
pest/ disease control	decreased	increased	
fire risk	increased	decreased	

Off-site impacts

downstream flooding (undesired)	increased	reduced	
downstream siltation	increased	decreased	
wind transported sediments	increased	reduced	Due to better vegetation cover

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative	very positive
Long-term returns	very negative	very positive

Benefits compared with maintenance costs

Short-term returns	very negative	very positive
Long-term returns	very negative	very positive

The benefits stated are the combined impacts of all measures-structural, vegetative and management. SCTs have helped in the establishment of vegetative measures by contributing to increased soil moisture, reduced runoff and soil loss.

CLIMATE CHANGE

Gradual climate change

annual temperature increase	not well at all	very well

Climate-related extremes (disasters)

local windstorm	not well at all	very well
drought	not well at all	very well
general (river) flood	not well at all	very well

Other climate-related consequences

reduced growing period	not well at all	very well

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%

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

- The land users views were not considered.

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

- Helps in reducing flash flood risks due to less runoff

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

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

- Establishment costs are very high → Voluntary community

How can they be sustained / enhanced? Proper institutional mechanisms, involving the government, non-government and community institutions should be developed for sustaining project activities. Department of Agriculture, Irrigation and Livestock DAIL; (Bamyan) should take lead
- Conserves soil and enhances soil cover and fertility leading to more on-site production

How can they be sustained / enhanced? Vegetative measures should be strengthened
- Complements re-greening efforts by reducing erosion and conserving moisture
- The quality of contour trenches and soil bunds are very good and maintenance costs negligible
- The site is used for demonstration, training and exposure visits

contributions, if they have an active stake in the project, would reduce the costs, otherwise, there has to be external support at least for the establishment phase
- Loss of land for production → Planting suitable plants inside the trenches and along soil bunds
- Requires high level of technical knowledge for establishment → Practical training for the target groups

REFERENCES

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Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_1715/

Linked SLM data
Approaches: Community-based Natural Resource Management https://qcat.wocat.net/en/wocat/approaches/view/approaches_2542/
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