Meticulously built terrace risers reaching a height of 1.5 – 2 meters; frequent maintenance is needed to enhance risers and repair breaches (Hanspeter Liniger (Centre for Development and Environment, University of Bern))

Konso Bench Terrace (Ethiopia)

Kawata (Konso)

DESCRIPTION

It is a stone wall embankment along the contour with land leveling in between two terrace walls to control erosion.

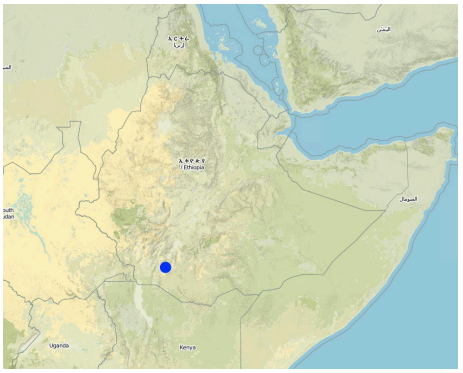
The traditional Konso Bench Terraces are established by building up stone embarkments along the contour and gradually levelling the land in between risers. Levelling is done actively and by siltation processes. Stone walls have to be enhanced periodically. The appearance of the technology evolves over time from stone empankments to bench terraces. The stone walls are supported on the downslope side by trees and / or legumes including coffee, pigeon pea, etc.

Purpose of the Technology: The purpose of the structures is to break the slope length and reduce run-off concentration thereby controlling erosion, increasing water stored in soil and harvesting eroded sediments.

Establishment / maintenance activities and inputs: Terraces have a long tradition in the area, and farmers are specialists in construction of stone walls. The first step during terrace establishment is to dig foundation up to 30 cm. Then stone walls are gradually built up to an impressive height of 1.5-2m above ground. The technology is very labour intensive: establishment takes 5 years and bi-annual maintenance is required. However, it is worth the effort, since without terracing crop production would not be thinkable in a marginal area characterised by shortage and high variability of rainfall, shallow, stony soils on steep slopes, high levels of soil erosion and (thus) frequent food shortages.

Natural / human environment: Social systems for labour-sharing and voluntary assistance have evolved to manage heavy labour inputs. Multiple cropping is practised for rist aversion. Growing leguminous crops helps to further improve soil fertility. Additional water harvesting measures are needed to further raise yields.

LOCATION



Location: SNNPR, Konso, Ethiopia

No. of Technology sites analysed:

Geo-reference of selected sites
- 37.3539, 5.293

Spread of the Technology: evenly spread over an area (approx. 1,000-10,000 km2)

In a permanently protected area?:

Date of implementation: more than 50 years ago (traditional)

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

Overview of a terraced hillside with annual crops and trees (Hanspeter Liniger (Centre for Development and Environment, University of Bern))

(Hanspeter Liniger (Centre for Development and Environment, University of Bern))

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [x] improve production
- [x] 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

Land use

Cropland

- Annual cropping: oilseed crops - sunflower, rapeseed, other, cereals - maize, cereals - sorghum, legumes and pulses - other, legumes and pulses - peas, pigeon pea
- Tree and shrub cropping: coffee, open grown

Number of growing seasons per year: 2

Is crop rotation practiced? Yes

Water supply

- [x] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation

Purpose related to land degradation

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

Degradation addressed

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

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

water degradation - Ha: aridification

SLM group

- cross-slope measure

SLM measures

agronomic measures - A1: Vegetation/ soil cover

vegetative measures - V1: Tree and shrub cover

structural measures - S1: Terraces

TECHNICAL DRAWING

Technical specifications

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs	Most important factors affecting the costs

- Costs are calculated: Labour, farm implements, soil workability, surface stoniness
- Currency used for cost calculation: **Ethiopian Birr**
- Exchange rate (to USD): 1 USD = 8.5 Ethiopian Birr
- Average wage cost of hired labour per day: 0.60

Establishment activities

1. Survey (traditional) (Timing/ frequency: dry season)
2. Stone collection (Timing/ frequency: dry season)
3. Digging foundation (Timing/ frequency: dry season)
4. Soil sealing & land leveling (Timing/ frequency: dry season)
5. Constructions of stone wall (Timing/ frequency: dry season)

Establishment inputs and costs

Specify input	Unit	Quantity	Costs per Unit (Ethiopian Birr)	Total costs per input (Ethiopian Birr)	% of costs borne by land users
Labour					
Labour	ha	1.0	1650.0	1650.0	100.0
Equipment					
Machine use	ha	1.0	70.0	70.0	100.0
Plant material					
Seeds	ha	1.0	40.0	40.0	100.0
Construction material					
Stone	ha	1.0	300.0	300.0	100.0
Total costs for establishment of the Technology				**2'060.0**	
Total costs for establishment of the Technology in USD				*242.35*	

Maintenance activities

1. Stabilizing by putting additional stones (Timing/ frequency: after rain/once a year)
2. The stone wallsupported by soil (Timing/ frequency: after rain/once a year)
3. Planting on the bench (Timing/ frequency: during the rain/once a year)
4. Land preparation (Timing/ frequency: dry season / 2-3 times per year)
5. Sawing/planting (Timing/ frequency: first rain / 1 per year)
6. Weeding/cultivation (Timing/ frequency: rainy season / 1-2 times per year)

Maintenance inputs and costs

Specify input	Unit	Quantity	Costs per Unit (Ethiopian Birr)	Total costs per input (Ethiopian Birr)	% of costs borne by land users
Labour					
Labour	ha	1.0	500.0	500.0	100.0
Plant material					
Seeds	ha	1.0	40.0	40.0	100.0
Total costs for maintenance of the Technology				**540.0**	
Total costs for maintenance of the Technology in USD				*63.53*	

NATURAL ENVIRONMENT

Average annual rainfall

- [ ] < 250 mm
- [ ] 251-500 mm
- [x] 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
- [x] semi-arid
- [ ] arid

Specifications on climate

Average annual rainfall in mm: 500.0
Thermal climate class: tropics

Slope

- [ ] flat (0-2%)
- [ ] gentle (3-5%)
- [x] moderate (6-10%)
- [ ] rolling (11-15%)
- [x] hilly (16-30%)
- [ ] steep (31-60%)
- [ ] very steep (>60%)

Landforms

- [ ] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [x] 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.
- [x] 1,501-2,000 m a.s.l.
- [ ] 2,001-2,500 m a.s.l.
- [ ] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.
- [ ] > 4,000 m a.s.l.

Technology is applied in

- [ ] convex situations
- [ ] concave situations
- [ ] not relevant

Soil depth

- [x] very shallow (0-20 cm)

Soil texture (topsoil)

- [x] coarse/ light (sandy)

Soil texture (> 20 cm below surface)

Topsoil organic matter content

- [ ] high (>3%)

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

- [x] medium (loamy, silty)
- [ ] fine/ heavy (clay)

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

- [x] medium (1-3%)
- [x] low (<1%)

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

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

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

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

Occurrence of flooding
- [ ] Yes
- [ ] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

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

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

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

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

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

Gender
- [ ] women
- [ ] men

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

Area used per household
- [ ] < 0.5 ha
- [x] 0.5-1 ha
- [x] 1-2 ha
- [ ] 2-5 ha
- [ ] 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
- [x] small-scale
- [ ] medium-scale
- [ ] large-scale

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

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

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

Access to services and infrastructure

IMPACTS

Socio-economic impacts

Crop production: decreased [ ][ ][ ][ ][ ][ ][x] increased

Quantity before SLM: 0.4
Quantity after SLM: 0.6
Sorghum yield raised by 50%

farm income: decreased [ ][ ][ ][ ][ ][x][ ] increased

Socio-cultural impacts

cultural opportunities (eg spiritual, aesthetic, others): reduced [ ][ ][ ][ ][x][ ][ ] improved

Maintenance of cultural heritage

community institutions: weakened [ ][ ][ ][ ][x][ ][ ] strengthened

Mise en place d'une organisation des communautés et renforcement des groupes

Ecological impacts

surface runoff: increased [ ][ ][ ][ ][ ][ ][x] decreased

soil moisture: decreased [ ][ ][ ][ ][ ][x][ ] increased

Due to increased infiltration

soil loss: increased [ ][ ][ ][ ][ ][ ][x] decreased

soil organic matter/ below ground C: decreased [ ][ ][ ][ ][ ][x][ ] increased

Sediment harvesting

Off-site impacts

downstream flooding (undesired)	increased	reduced
downstream siltation	increased	decreased

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

La marge bénéficiaire est très faible, mais sans terrasses, pas de cultures possibles. Les exploitants continueront à investir dans des terrasses tant qu'ils pourront en tirer un moyen d'existence

CLIMATE CHANGE

Gradual climate change

annual temperature increase	not well at all	very well

Climate-related extremes (disasters)

local rainstorm	not well at all	very well
local windstorm	not well at all	very well
drought	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%
- [x] 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

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

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome

- Les terrasse nécessitent un entretien très fréquent, ce qui rend cette technologie très exigeante en main-d'œuvre utiliser de plus grosses pierres lors de la construction ; éviter le pâturage libre (les animaux endommagent les structures)

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome

- The terraces require very frequent maintenance which makes the technology highly labour-demanding. Use bigger stones for construction; avoid free grazing (animals damage the structures).

REFERENCES

Compiler
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Resource persons
Daniel Danano - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_949/

Linked SLM data
Approaches: Labour exchange https://qcat.wocat.net/en/wocat/approaches/view/approaches_2674/
Approaches: Local Level Participatory Planning Approach (LLPPA) https://qcat.wocat.net/en/wocat/approaches/view/approaches_2389/

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Key references
- Danano, D. 2008 (unpublished). Soil and Water Conservation Practices for Sustainable Land Management in Ethiopia. Ethiocat.: