# Sorghum Terrace of Diredawa (STD) (Ethiopia)

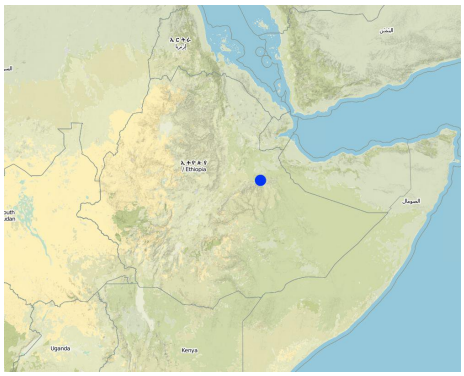
Daga (Oromifa)

## DESCRIPTION

**It is a structural measure constructed across the slope to control erosion and increase soil moisture.**

Sorghum terrace of Diredawa locally called as Daga is constructed by placing stone walls across a slope following contour lines. The development of Sorghum terrace involves activities of creating an embankment at a given spacing, which depends on slope. Cultivation in the terrace is done by the use of Dengora (local name for spade like hand tool) if the land is sloping and by oxen if land slope is gentle (<8%). The purpose of developing Sorghum Terrace of Diredawa (STD) is to collect as much rainwater as possible for growing sorghum, which is planted by broad casting. Sorghum is the staple food in the area. Since rainfall is erratic, the STD allows more water to be stored in the soil. STD is maintained every year and also upgraded while performing different farm activities (Ploughing, Weeding, etc.,). Every time maintenance is made breaks in the terrace are repaired and additional height given to the terrace until it forms bench. STD is very suitable to areas with erratic rainfalls, sloping cultivated fields and land having abandant stones for construction. It is suitable to areas with semi-arid to arid climatic conditions and soils ranging from shallow depth to moderately deep.

## LOCATION



**Location:** Dire Dawa, Dire Dawa, Ethiopia

**No. of Technology sites analysed:**

**Geo-reference of selected sites**
- 41.85, 9.55

**Spread of the Technology:** evenly spread over an area (approx. 100-1,000 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

## 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

### Land use
Land use mixed within the same land unit: Yes - Agro-silvopastoralism

**Cropland**
- Annual cropping: cereals - sorghum, legumes and pulses - beans, root/tuber crops - potatoes, chat
- Tree and shrub cropping: mango, mangosteen, guava, papaya

- [ ] mitigate climate change and its impacts
- [ ] create beneficial economic impact
- [ ] create beneficial social impact

Number of growing seasons per year: 1
Is intercropping practiced? Yes

**Grazing land**

- Semi-nomadic pastoralism
- Cut-and-carry/ zero grazing

Animal type: goats

| Species | Count |
|---|---|
| goats | 2 |

**Forest/ woodlands**Products and services: Timber, Fuelwood, Grazing/ browsing, fodder

### 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

### SLM group

- improved ground/ vegetation cover
- cross-slope measure

### SLM measures

**agronomic measures** - A2: Organic matter/ soil fertility, A3: Soil surface treatment

## TECHNICAL DRAWING

**Technical specifications**

DireDawa

Technical knowledge required for field staff / advisors: moderate

Technical knowledge required for land users: moderate

Main technical functions: reduction of slope angle, increase of infiltration, increase / maintain water stored in soil

Secondary technical functions: water harvesting / increase water supply, sediment retention / trapping, sediment harvesting

Early planting
Material/ species: Sorghum + Chat
Quantity/ density: 17500 +400

Mixed cropping / intercropping
Material/ species: Sorghum + Potato

Contour planting / strip cropping
Material/ species: Sorghum + Chat

Mulching
Material/ species: Sorghu Stalk/residue

Green manure
Material/ species: Sorghum/Chat-beans

Manure / compost / residues
Material/ species: Sorghum/Chat

Contour tillage
Remarks: Ploughing along the contour

Aligned: -contour
Vegetative material: O : other
Number of plants per (ha): 17500-2000
Spacing between rows / strips / blocks (m): 0.2
Vertical interval within rows / strips / blocks (m): 0.2-0.3

Perennial crops species: Chat

Slope (which determines the spacing indicated above): 10.00%

If the original slope has changed as a result of the Technology, the slope today is (see figure below): 3.00%

Gradient along the rows / strips: 0.00%

Terrace: backward sloping
Vertical interval between structures (m): 1-2
Spacing between structures (m): 4-6
Height of bunds/banks/others (m): 1
Width of bunds/banks/others (m): 0.5-2
Length of bunds/banks/others (m): 50-300

Bund/ bank: level
Vertical interval between structures (m): 1-2
Height of bunds/banks/others (m): 1
Width of bunds/banks/others (m): 0.3-0.5
Length of bunds/banks/others (m): 50-300

Construction material (earth): earth is placed upslope of the stone wall to provide reinforcement

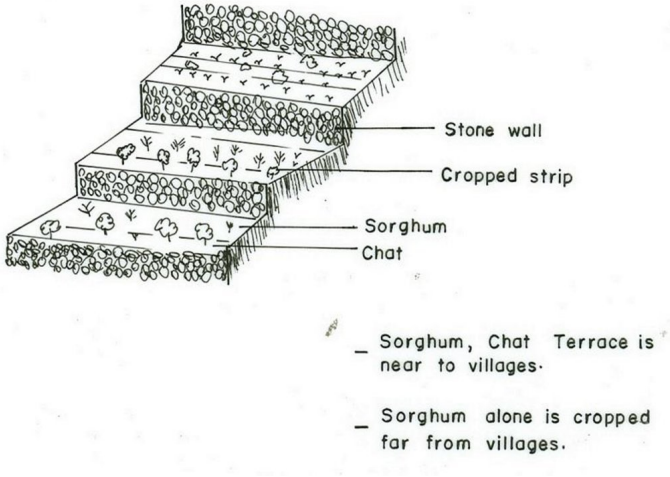
Construction material (stone): stone is used for the embankment

Slope (which determines the spacing indicated above): 12%

If the original slope has changed as a result of the Technology, the slope today is: 4%

Lateral gradient along the structure: 0%

Vegetation is used for stabilisation of structures.



Change of land use type: from grazing to cultivated land

Control / change of species composition: from mono-cropping to mixed cropping

## ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

**Calculation of inputs and costs**

- Costs are calculated:
- Currency used for cost calculation: **Birr**
- Exchange rate (to USD): 1 USD = 8.6 Birr
- Average wage cost of hired labour per day: 0.71

**Most important factors affecting the costs**

Slope:- As the slope increases cost of construction increases, Soil depth:- when the soil depth is shallow digging the foundation becomes more costly.

**Establishment activities**

1. Chat planting by cutting (Timing/ frequency: early rains)
2. Sorghum planting (Timing/ frequency: early rains)
3. Sowing (Timing/ frequency: with rains & withdrawal of rains)
4. Contour marking & layout (Timing/ frequency: dry period/after harvest)
5. Digging foundation (Timing/ frequency: after light rains/moist soil)
6. Stone collection (Timing/ frequency: dry season)
7. Stone wall placement (Timing/ frequency: after light rains/moist soil)
8. Earth support upslope (Timing/ frequency: after light rains/moist soil)
9. Clear vegetation (Timing/ frequency: dry period)
10. Construct Daga (Timing/ frequency: dry season)
11. Land preparation (Timing/ frequency: after the 1st rains)

**Establishment inputs and costs**

| Specify input | Unit | Quantity | Costs per Unit (Birr) | Total costs per input (Birr) | % of costs borne by land users |
|---|---|---|---|---|---|
| **Labour** | | | | | |
| Labour | ha | 1.0 | 272.0 | 272.0 | 50.0 |
| **Equipment** | | | | | |
| Animal traction | ha | 1.0 | 20.0 | 20.0 | 100.0 |
| Tools | ha | 1.0 | 4.0 | 4.0 | 100.0 |
| **Plant material** | | | | | |
| Seeds | ha | 1.0 | 5.0 | 5.0 | 100.0 |
| **Fertilizers and biocides** | | | | | |
| Compost manure | ha | 1.0 | | | 100.0 |
| **Total costs for establishment of the Technology** | | | | **301.0** | |
| *Total costs for establishment of the Technology in USD* | | | | *35.0* | |

**Maintenance activities**

1. Tillage (Timing/ frequency: dry season / 2-3)
2. Sowing (Timing/ frequency: dry season / each cropping season)
3. Cultivation (Timing/ frequency: early rains, after sawing, before flowering / each cropping season)
4. Weeding (Timing/ frequency: after flowrinf / each cropping season)
5. Harvest (Timing/ frequency: dry season, after crop matures / each cropping season)
6. Cultivation (Timing/ frequency: during rains /2)
7. Weeding (Timing/ frequency: withdrawal of rains /1)
8. Stone collection (Timing/ frequency: dry season/1)
9. Repairing breaks (Timing/ frequency: before planting/1)
10. Add stone wall height/upgrading (Timing/ frequency: before planting/1)
11. Plant stablizing/ trees/shrubs (Timing/ frequency: after rains/1)
12. Planting of useful trees & fruit trees (Timing/ frequency: after rains / annual)
13. Cultivation and weeding (Timing/ frequency: during rains / 2)

**Maintenance inputs and costs**

| Specify input | Unit | Quantity | Costs per Unit (Birr) | Total costs per input (Birr) | % of costs borne by land users |
|---|---|---|---|---|---|
| **Labour** | | | | | |
| Labour | ha | 1.0 | 40.7 | 40.7 | 100.0 |
| **Total costs for maintenance of the Technology** | | | | **40.7** | |
| *Total costs for maintenance of the Technology in USD* | | | | *4.73* | |

## NATURAL ENVIRONMENT

**Average annual rainfall**

- ☐ < 250 mm
- ☐ 251-500 mm
- ☑ 501-750 mm
- ☐ 751-1,000 mm
- ☐ 1,001-1,500 mm

**Agro-climatic zone**

- ☐ humid
- ☐ sub-humid
- ☑ semi-arid
- ☐ arid

**Specifications on climate**

Average annual rainfall in mm: 600.0

- [ ] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

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

**Landforms**
- [ ] plateau/plains
- [x] 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.
- [x] 1,001-1,500 m a.s.l.
- [ ] 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**
- [ ] very shallow (0-20 cm)
- [x] shallow (21-50 cm)
- [x] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [ ] very deep (> 120 cm)

**Soil texture (topsoil)**
- [x] coarse/ light (sandy)
- [x] 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
- [ ] > 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)
- [x] 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
- [x] animal traction
- [ ] mechanized/ motorized

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

**Individuals or groups**
- [ ] 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**
- [ ] small-scale
- [ ] medium-scale
- [ ] large-scale

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

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

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

**Access to services and infrastructure**

## IMPACTS

**Socio-economic impacts**

Crop production

decreased  increased

Because of high moisture in the soil

fodder production

decreased  increased

multipurpose tree species with good production potential are planted.

fodder quality

decreased ✓ increased

multipurpose tree species with good production potential are planted.

production area (new land under cultivation/ use)

decreased ✓ increased

due to structures occupying land

land management

hindered ✓ simplified

due to structural obstraction

farm income

decreased ✓ increased

### Socio-cultural impacts

community institutions: weakened ✓ strengthened

national institutions: weakened ✓ strengthened

conflict mitigation: worsened ✓ improved

### Ecological impacts

surface runoff

increased ✓ decreased

Quantity before SLM: 50
Quantity after SLM: 0

soil moisture

decreased ✓ increased

soil loss

increased ✓ decreased

Quantity before SLM: 100
Quantity after SLM: 5

Soil fertility

decreased ✓ increased

### 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

## CLIMATE CHANGE

-

## 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

- Production increased

  How can they be sustained / enhanced? external support with incentives such as tools, material for constructing structures for flood and runoff diversion.
- more soil moisture

  How can they be sustained / enhanced? integration of measures that reduces evapotranspiration

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

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

- hindering movement provide path way for humans and oxen during farm operation

- Soil erosion controlled

  How can they be sustained / enhanced? exercise effective maintenance

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

- have higher efficiency for retaining water in the soil

  How can they be sustained / enhanced? Strengthening maintenance, avoid livestock,exercise stall feeding, enhancing runoff and flood farming
- mantenance is simple because material is available
- Forms bench terrace easily
- Soil loss is remarkably reduced
- Production doubled and even increased by 150-200%

## REFERENCES

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**Date of documentation**: May 30, 2011

**Last update**: Sept. 10, 2019

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**Full description in the WOCAT database**
https://qcat.wocat.net/en/wocat/technologies/view/technologies_1067/

**Linked SLM data**
n.a.

**Documentation was faciliated by**

Institution
- Food and Agriculture Organization of the United Nations (FAO) - Italy
- Ministry of Agriculture and Rural Development of Ethiopia (Ministry of Agriculture and Rural Development) - Ethiopia

Project
- n.a.