Stone lines

Uganda - Ennyiriri z'amayinja eziziyiza ettaka okutwalibwa enkuba (Luganda)

Stone lines are built along a contour to control soil erosion on a degraded steep slope.

Most of the traditional cropland in Rakai District is fairly flat. However, there are many hectares of very steep, stony, wind-swept slopes facing the Kagera River Valley and Lake Victoria. These slopes have been degraded for a long time because when it rains the runoff is very fast and carries away soil and crops. The swampy Kagera river flood plains below the slopes are fertile because of the deposits of top soil carried from the slopes. Over the last 3 years, farmers have changed from the traditional farming practice where cultivation was done with little or no protection of soil and water movement on the steep slopes to using stone lines along a contour. The stone lines are arranged along the contour to act as a barrier that slows down the speed of water and soil, improve infiltration, mitigate land slides and trap sediment thereby reducing the extent of erosion.
The technical objective of stone lines is to minimize water and soil movement down the slope and, over time, enable the building of a terrace from the accumulation of soil on the upper side of the barrier.
The stones are arranged along the contour, guided by a rope. The contour is determined using an A-Frame. The other tools required to establish stone lines are hand hoes, pick axes, and pangas. Establishment requires a lot of labor by which the following activities are accomplished: (i) stones exposed by decades of runoff on hillsides are dug up, collected and placed along contours in a field 200 m by 300 m. The width of each stone line is 0.4 m to 0.6 m and 0.5 m high. The length is dependent on the size of the field across the slope. The spacing from one line to another is 8 m to 12 m, depending on the steepness of the slope. (ii) The exposed sandy loam top soil is very dry and dusty even in the rainy season. Digging with hand hoes loosens the soil. (iii) Following the contour, circular pits of 0.45 m diameter and 0.3 m depth are dug 1.50 m apart, in the middle of every 2 stone lines. In these holes, robusta coffee seedlings are planted. (iv) Beans may be planted throughout the field as a cover crop. The farmer field school (FFS) approach is used because many farmers participate together in completing the establishment tasks. The stone lines are maintained by ensuring that stones which move off the main line are put back and the weeds which grow among the stones are removed to avoid competition with the main crops.
There is no known threat to stone lines once they have been established. The runoff cannot gather enough speed between the lines to sweep the stones away because of the short distance. The main offsite benefit is that sediment deposits and water runoff do not destroy crops in the valley below and the Kagera River is protected from silting.

left: Stone lines established on a steep slope (upper section facing the Kagera River watershed) (Photo: Charles L Malingu)
right: The stone lines effectively stabilize the soil on very steep slopes. (Photo: Charles L Malingu)

Location: Uganda
Region: Rakai District
Technology area: 0.06 km^2
Conservation measure: structural
Stage of intervention: mitigation / reduction of land degradation
Origin: Developed externally / introduced through project, recent (<10 years ago)
Land use type:
Cropland: Perennial (non-woody) cropping
Cropland: Tree and shrub cropping
Climate: humid, tropics
WOCAT database reference: T_UGA028en
Related approach: FFS/SLM community initiative (A_UGA018en)
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Classification

Land use problems:

- Surface soil erosion is rampant, carrying away all the top soil with valuable nutrients towards to the marshes below. (expert's point of view)
The land is infertile and no crops can grow in that area. (land user's point of view)

Land use

Perennial (non-woody) cropping
Tree and shrub cropping

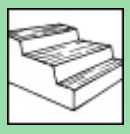
Climate

humid

Degradation

Soil erosion by water: loss of topsoil / surface erosion

Conservation measure



structural: Walls / barriers / palisades

Stage of intervention

- Prevention
- Mitigation / Reduction
- Rehabilitation

Origin

- Land users initiative
- Experiments / Research
- Externally introduced: recent (<10 years ago)

Level of technical knowledge

- Agricultural advisor
- Land user

Main causes of land degradation:
Direct causes - Human induced: deforestation / removal of natural vegetation (incl. forest fires)
Indirect causes: education, access to knowledge and support services

Main technical functions:
- control of dispersed runoff: impede / retard
- increase of infiltration
- sediment retention / trapping, sediment harvesting

Secondary technical functions:
- reduction of slope length
- water harvesting / increase water supply

Environment

Natural Environment

Average annual rainfall (mm)

- > 4000 mm
- 3000-4000 mm
- 2000-3000 mm
- 1500-2000 mm
- 1000-1500 mm
- 750-1000 mm
- 500-750 mm
- 250-500 mm
- < 250 mm

Altitude (m a.s.l.)

- > 4000
- 3000-4000
- 2500-3000
- 2000-2500
- 1500-2000
- 1000-1500
- 500-1000
- 100-500
- <100

Landform

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

Slope (%)

- flat
- gentle
- moderate
- rolling
- hilly
- steep
- very steep

Soil depth (cm)

- 0-20
- 20-50
- 50-80
- 80-120
- >120

Growing season(s): 150 days (February to June), 120 days (September to November)
Soil texture: medium (loam)
Soil fertility: medium
Topsoil organic matter: low (<1%)
Soil drainage/infiltration: good

Soil water storage capacity: low
Ground water table: > 50 m
Availability of surface water: medium
Water quality: poor drinking water
Biodiversity: low

Tolerant of climatic extremes: temperature increase, seasonal rainfall increase, seasonal rainfall decrease, heavy rainfall events (intensities and amount), droughts / dry spells, decreasing length of growing period
If sensitive, what modifications were made / are possible: n/a

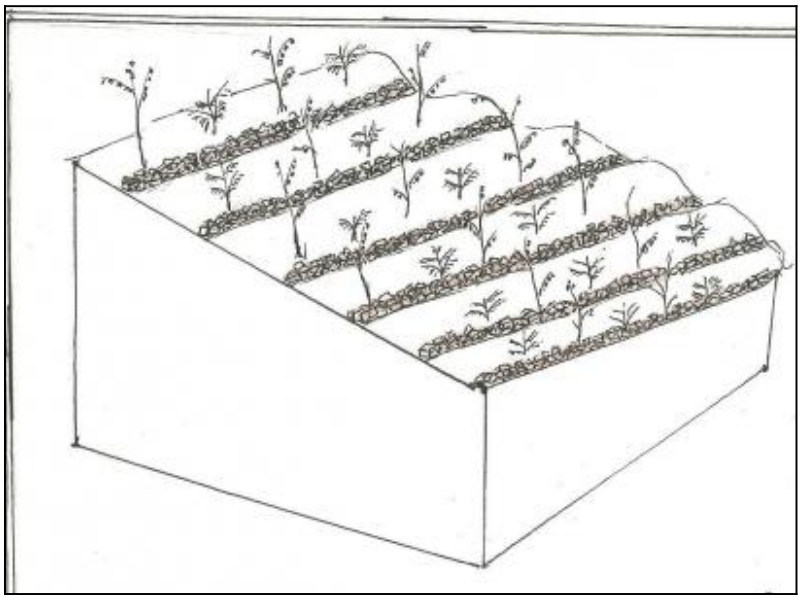
Human Environment

Cropland per household (ha)

- <0.5
- 0.5-1
- 1-2
- 2-5
- 5-15
- 15-50
- 50-100
- 100-500
- 500-1,000
- 1,000-10,000
- >10,000

Land user: Individual / household, Small scale land users, common / average land users, men and women
Population density: 50-100 persons/km2
Annual population growth: 2% - 3%
Land ownership: individual, not titled
Land use rights: individual
Water use rights: open access (unorganised)
Relative level of wealth: average, which represents 70% of the land users; 50% of the total area is owned by average land users

Importance of off-farm income: less than 10% of all income: Farming is mostly subsistence
Access to service and infrastructure: low: health, technical assistance, employment (eg off-farm), market, energy, financial services; moderate: education, roads & transport, drinking water and sanitation
Market orientation: subsistence (self-supply)



Technical drawing

Stone lines on a steep slope. In between is a young coffee plantation. (Byonabye Proscovia)

Implementation activities, inputs and costs

Establishment activities

- Collection and laying of stones

Establishment inputs and costs per ha

Inputs	Costs (US$)	% met by land user
Labour	1200.00	100%
Equipment		
- tools	60.00	100%
TOTAL	**1260.00**	**100.00%**

Maintenance/recurrent activities

- Repair of lines

Maintenance/recurrent inputs and costs per ha per year

Inputs	Costs (US$)	% met by land user
Labour	120.00	100%
Equipment		
- tools	0.00	0%
TOTAL	**120.00**	**100.00%**

Remarks:
Labor is the factor that influences costs. Digging up and carrying stones up and across slopes is a labor intensive activity. The calculations reflect costs of establishing the technology on a steep slope (38% to 45%) in December of 2013.

Assessment

Impacts of the Technology

Production and socio-economic benefits

++ increased crop yield
++ increased farm income
+ increased production area

Production and socio-economic disadvantages

+++ increased labour constraints

Socio-cultural benefits

++ community institution strengthening
++ improved conservation / erosion knowledge

Socio-cultural disadvantages

+ The hard labor is a challenge to women and children who play a major role in cultivation

Ecological benefits

+++ reduced surface runoff
+++ reduced soil loss
++ increased soil moisture
++ increased biomass above ground C
++ increased soil organic matter / below ground C

Ecological disadvantages

+ increased niches for pests

Off-site benefits

++ reduced downstream siltation
++ reduced groundwater river pollution
+ reduced downstream flooding

Off-site disadvantages

+ increased possibility of damage to cropland in the valley by stones rolling off the lines

Contribution to human well-being / livelihoods

++ There is more arable land, reducing pressure on land and generally improving productivity.

Benefits /costs according to land user

Benefits compared with costs	short-term:	long-term:
Establishment	not specified	very positive
Maintenance / recurrent	not specified	very positive

Acceptance / adoption:

100% of land user families (15 families; 100% of area) have implemented the technology voluntary. Adoption has been spontaneous, through farmer to farmer learning
There is moderate trend towards (growing) spontaneous adoption of the technology. The technology has been mainly taken up by members of Farmer Field School. The labor cost makes it too demanding for an individual but some households with several members in the family have adopted outside the FFS method.

Concluding statements

Strengths and → how to sustain/improve	Weaknesses and → how to overcome
Increases cropland available for cultivation → Sustain adoption through farmer-to-farmer visits	Expensive to the farmer → Help government and the private sector to subsidize cost to the farmer
Increases rain water infiltration, reducing flooding offsite → Encourage government to scale up the technology	Labor to dig up and transport stones is very heavy → Encourage community level approach like Farmer field School
Stone lines are robust and require little maintenance once established → Help farmers adopt because sustainability is easy	It has become more expensive to hire labor for other farm activities → Work in groups, one farm at a time
Offsite benefits are as important as they are onsite → Encourage catchment level participation including downstream farmers	
Having more land means more options for crop diversity → Scale up the technology	
There is improved food security → Establish stone lines on more disused land	