


Trenches combined with living hedges or grass lines
Rwanda - Imiringoti

left: Landscape view of the anti-erosion trenches and grass lines (Photo: Ngenzi Guy)
right: Detailed view of trench combined with grass line (Photo: Kagabo Desire and Ngenzi Guy)

Trenches combined with living hedges or grass lines are slow-forming terraces to control soil erosion by changing the length of the slope and progressively reducing the slope gradient; he slope steepness decreases progressively by hydric and tillage erosion.

Trenches combined with living hedges or grassed lines are less labour-intensive method that is practiced in the highlands of Rwanda. The method involves digging trenches which have grass-stabilized banks, or simply planting grass strips and vegetative barriers across the slope to reduce runoff. This method, locally referred to as 'progressive terracing', is more adaptable by individual farmers across the country. In the study conducted by Kagabo et al. (2013) in the highlands of Buberuka Region of Rwanda, it was noted that net increment in yields and returns on investment increased with the age of terraces, since the capital costs of terracing were easily recovered. These terraces also showed more resilience, some being over 30 years old and still effective. Along the contour band, soil from the upper parts of the slope is removed and deposited above by creating a series of discontinuous trenches in order to extend the flat terrain. Over 5-10 years, the terraces become enlarged and form a terrace along the contour, such that the slopes are transformed over time into level bench terraces (but never %).
The main purpose of this technology is to reduce runoff and soil erosion on the slope and to improve soil quality and soil moisture retention. Grass strips or living hedgerows are intended to both trap sediments and facilitate the slow formation of terraces.
The establishment of trenches combined with living hedges or grassed lines is less labor intensive and requires less skilled labor. Regular maintenance banks on which living hedges are planted, to seasonally stream living hedges to minimize the competition of nutrients and water with plants. To efficiently use these terraces it is advisable to introduce intensive and rentable cropping systems or agroforestry with fruits and forage trees.
This technology was reported to be very resilient as trenches combined with living hedges or grassed lines of 20+ year old are still effective in controlling soil erosion. However, the soil quality on these formed terraces between alleys does not homogenize 100% over the course of time. Large soil fertility gradients with marked spatial difference in both soil quality and crop yield from their upper parts downwards of the terraces is observed. The soil in the lower parts of the terraces showed as much as 57% more organic carbon content and 31% more available phosphorous than the soil in the upper parts of the terraces (Kagabo et al. 2013).

Location: Rwanda
Region: Kamonyi District (Southern Province)
Technology area: 10 - 100 km2
Conservation measure: vegetative, structural
Stage of intervention: mitigation / reduction of land degradation
Origin: Developed Government, 10-50 years ago
Land use type:
Cropland: Annual cropping
Cropland: Tree and shrub cropping
Land use:
Grazing land: Extensive grazing land (before), Cropland: Annual cropping (after)
Climate: subhumid, tropics
WOCAT database reference: T_RWA002en
Related approach: Top down approach (A_RWA001en)
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Classification

Land use problems:
- Soil erosion, water contamination due to sediment loads, decrease of soil fertility and soil depth, loss of vegetation cover (expert's point of view)
Soil erosion, contamination of water (the turbidity of water is high) therefore the domestic use of water is a problem. (land user's point of view)

Land use

Annual cropping
Tree and shrub cropping
Grazing land: Extensive grazing land (before)
Cropland: Annual cropping (after)
rainfed
rainfed

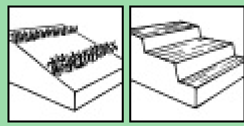
Climate

subhumid

Degradation

Soil erosion by water: loss of topsoil / surface erosion

Conservation measure



vegetative: Grasses and perennial herbaceous plants
structural: Graded ditches / waterways (to drain and convey water)

Stage of intervention

- Prevention
- Mitigation / Reduction
- Rehabilitation

Origin

- Land users initiative
- Experiments / Research
- Externally introduced
- Other: Government: 10-50 years ago

Level of technical knowledge

- Agricultural advisor
- Land user
- Farmer representive

Main causes of land degradation:
Direct causes - Human induced: deforestation / removal of natural vegetation (incl. forest fires)
Direct causes - Natural: other natural causes, Steep slopes in many cases are over 60%
Indirect causes: population pressure

Main technical functions:
- control of concentrated runoff: retain / trap
- reduction of slope length
- improvement of topsoil structure (compaction)
- increase of infiltration
- sediment retention / trapping, sediment harvesting

Secondary technical functions:
- control of concentrated runoff: impede / retard
- reduction of slope angle

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 (September – February), 120 days (March – July)
Soil texture: medium (loam)
Soil fertility: medium
Topsoil organic matter: medium (1-3%)
Soil drainage/infiltration: good

Soil water storage capacity: medium
Ground water table: 5 - 50 m
Availability of surface water: poor / none
Water quality: poor drinking water
Biodiversity: medium

Tolerant of climatic extremes: temperature increase, seasonal rainfall decrease, wind storms / dust storms, droughts / dry spells, decreasing length of growing period
Sensitive to climatic extremes: seasonal rainfall increase, heavy rainfall events (intensities and amount), floods

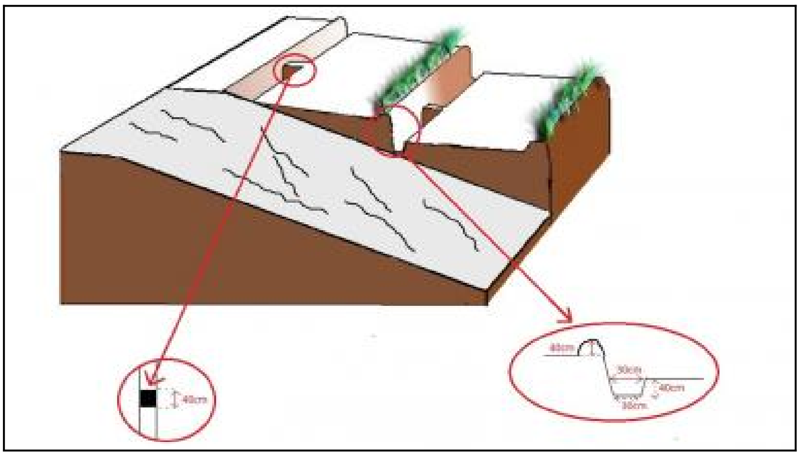
Human Environment

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, titled
Land use rights: individual
Water use rights: open access (unorganised)
Relative level of wealth: poor, which represents 75% of the land users; 75% of the total area is owned by poor land users

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



Technical drawing

Trenches are dug in trapezoidal shape with 40 cm of height, 30 cm of base length and 50 cm of top lengths. An empty space of 40 cm is left between two consecutive trenches along a contour line. (Kagabo Desire and Guy Ngenzi)

Implementation activities, inputs and costs

Establishment activities

- Cuttings
- Transport
- Planting
- Identification of contour lines, digging of trenches and grass planting on risers

Establishment inputs and costs per ha

Inputs	Costs (US$)	% met by land user
Labour	381.25	100%
Equipment		
- Hand hoe	125.00	100%
TOTAL	**506.25**	**100.00%**

Maintenance/recurrent activities

- Weeding
- Manure application and transportation
- Grass streaming
- Clearing the ditches by removing piled up sediments.

Maintenance/recurrent inputs and costs per ha per year

Inputs	Costs (US$)	% met by land user
Labour	33.00	100%
Equipment		
- Hand hoe	5.00	100%
TOTAL	**38.00**	**100.00%**

Remarks:
The most determining factor affecting the cost is labor (the cost of labor increases with the nature of the soil structure as well as with the land steepness.
The cost of labor is estimated based on land steepness, soil structure (deep, gravel or shallow soils). Land steepness defines the spacing between anti-erosion ditches hence affecting the cost of labor. Similarly, the soil structure (deep, gravel or shallow soils) defines the size of labor to be used per hectare.

Assessment

Impacts of the Technology

Production and socio-economic benefits	Production and socio-economic disadvantages
++ increased crop yield	++ increased labour constraints
++ increased fodder production	+ loss of land

Socio-cultural benefits	Socio-cultural disadvantages
++ conflict mitigation	
+ improved conservation / erosion knowledge	

Ecological benefits	Ecological disadvantages
++ reduced surface runoff	
++ reduced soil loss	
+ improved harvesting / collection of water	
+ increased soil moisture	
+ reduced hazard towards adverse events	
+ improved soil cover	

Off-site benefits	Off-site disadvantages
++ reduced downstream siltation	
++ reduced damage on neighbours fields	

Contribution to human well-being / livelihoods

++ Increase in agricultural production has contributed to income generation and provide needed school fees

Benefits /costs according to land user

Benefits compared with costs	short-term:	long-term:
Establishment	neutral / balanced	very positive
Maintenance / recurrent	slightly negative	very positive

Acceptance / adoption:

100% of land user families (207 families; 100% of area) have implemented the technology voluntary.
There is strong trend towards (growing) spontaneous adoption of the technology. 100% of farmers has adopted the technology

Concluding statements

Strengths and → how to sustain/improve	Weaknesses and → how to overcome
Mitigation of land degradation due to soil erosion → Continuous sensitization and enforcement by government to land users to stabilize the technology.	It requires a lot of physical energy, elderly people can't afford → Help each other through communal work (umuganda)
Increased crop productivity → Continuous training from government and give all basic necessary support services to land users	Labor costs → Land users with less financial means should join their efforts by working together
Increased fodder production → Proper maintenance of the technology by land users	It is hard to implement mainly by older and poor land users → It is required to offer communal support or financial support from development partners
To prevent soil erosion → Maintenance of contour lines	
Grasses provide mulching → Proper maintenance of grasses on contour lines	