Examples of terraced cotton, soy, and corn fields. (Hohnwald (Rotdornweg 9, 37120 Bovenden))

Terracing for soil erosion protection (Brazil)

Terraços contra erosão

DESCRIPTION

Terracing of landscapes against soil erosion for soy, corn, cotton, and sugar cane production of large enterprises in Central Brazil

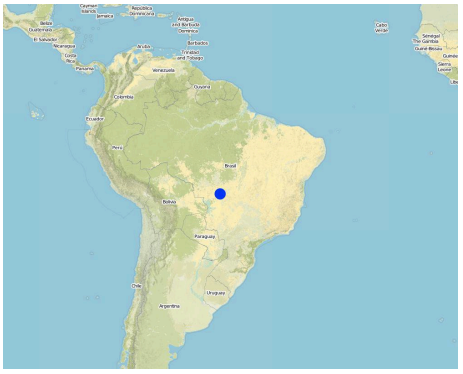
Medium to slightly inclined tablelands in the cerrados are protected by soil terraces against soil erosion, building kilometer long and up to 1m high terraces.

Purpose of the Technology: The purpose of the terraces is to protect the cotton, corn, and soy bean fields against top-soil losses due to heavy tropical rain events that occur during the starting rainy season. It is predicted and modeled for the future that heavy rain events will increase in the following decades.

Establishment / maintenance activities and inputs: High-input machinery like tractors are used to install the terraces. These terraces have to be repaired and improved periodically, e.g. every 5 years.

Natural / human environment: The terraces are necessary because the potential natural vegetation, the cerrado forests that protected the soils before, have been converted to huge farmlands that are now directly exposed to heavy tropical rainfalls and soil erosion.

LOCATION



Location: Campo Verde, Primavera do Leste, Mato Grosso, Brazil

No. of Technology sites analysed:

Geo-reference of selected sites
- -55.17105, -15.58398

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

In a permanently protected area?:

Date of implementation: 10-50 years ago

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

Aerial view on terraced soy bean fields (left upper corner: rain forest, line on the right site- dirt road (Hohnwald (Rotdornweg 9, 37120 Bovenden))

Close-up of a recently improved terrace of a slightly inclined corn field. (Hohnwald (Rotdornweg 9, 37120 Bovenden))

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

Land use

Cropland

- Annual cropping: cereals - maize, fibre crops - cotton, legumes and pulses - soya
- Perennial (non-woody) cropping: sugar cane

Number of growing seasons per year: 2

Water supply

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

Purpose related to land degradation

- [ ] prevent land degradation
- [ ] 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, Wg: gully erosion/ gullying, Wm: mass movements/ landslides

soil erosion by wind - Ed: deflation and deposition

SLM group

- cross-slope measure
- terracing

SLM measures

agronomic measures - A3: Soil surface treatment

vegetative measures - V2: Grasses and perennial herbaceous plants

structural measures - S1: Terraces

management measures - M1: Change of land use type

TECHNICAL DRAWING

Technical specifications

Terraces are planned at the desk and implemented by bull-dozers. Close-up of a recently improved terrace of a slightly inclined corn field.

Location: Campo Verde. Mato Grosso

Date: 30.09.2011

Technical knowledge required for field staff / advisors: high (precision farming)

Technical knowledge required for land users: high (precision farming)

Main technical functions: control of dispersed runoff: retain / trap, control of concentrated runoff: retain / trap, sediment retention / trapping, sediment harvesting

Secondary technical functions: control of dispersed runoff: impede / retard, control of concentrated runoff: impede / retard, control of concentrated runoff: drain / divert, reduction of slope angle, reduction of slope length, improvement of ground cover, increase of surface roughness, improvement of surface structure (crusting, sealing), improvement of topsoil structure (compaction), improvement of subsoil structure (hardpan), stabilisation of soil (eg by tree roots against land slides), increase in organic matter, increase in nutrient availability (supply, recycling,...), increase of infiltration, increase / maintain water stored in soil, increase of groundwater level / recharge of groundwater, water harvesting / increase water supply, water spreading, improvement of water quality, buffering / filtering water, reduction in wind speed, increase of biomass (quantity), promotion of vegetation species and varieties (quality, eg palatable fodder), control of fires, reduction of dry material (fuel for wildfires), spatial arrangement and diversification of land use

Terrace: forward sloping
Vertical interval between structures (m): 5
Spacing between structures (m): 50

Terrace: bench level
Vertical interval between structures (m): 5
Spacing between structures (m): 50

Construction material (earth): 90%

Construction material (stone): 10%

Slope (which determines the spacing indicated above): 3%

If the original slope has changed as a result of the Technology, the slope today is: 2%

Lateral gradient along the structure: 1%

Author: Hohnwald, Rotdornweg 9, 37120 Bovenden

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated:
- Currency used for cost calculation: **Reais**
- Exchange rate (to USD): 1 USD = 3.2 Reais
- Average wage cost of hired labour per day: 16.00

Most important factors affecting the costs

The costs are determined by labour time, gas costs, machinery maintenance

Establishment activities

1. Establishment (Timing/ frequency: 3)

Establishment inputs and costs

Specify input	Unit	Quantity	Costs per Unit (Reais)	Total costs per input (Reais)	% of costs borne by land users
Labour					
Labour	ha	1.0	160.0	160.0	100.0
Equipment					
Machine use	ha	1.0	100.0	100.0	100.0
Total costs for establishment of the Technology				**260.0**	
Total costs for establishment of the Technology in USD				*81.25*	

Maintenance activities

1. repairing (Timing/ frequency: 3)
2. repairing (Timing/ frequency: 1)

Maintenance inputs and costs

Specify input	Unit	Quantity	Costs per Unit (Reais)	Total costs per input (Reais)	% of costs borne by land users
Labour					
Labour	ha	1.0	50.0	50.0	100.0
Equipment					
Machine use	ha	1.0	100.0	100.0	100.0
Total costs for maintenance of the Technology				**150.0**	
Total costs for maintenance of the Technology in USD				*46.88*	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [x] 1,001-1,500 mm
- [x] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

Agro-climatic zone
- [ ] humid
- [x] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate
Thermal climate class: tropics

Thermal climate class: subtropics

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

Landforms
- [x] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [ ] footslopes
- [x] valley floors

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [x] 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.
- [ ] 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)
- [ ] shallow (21-50 cm)
- [ ] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [x] 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%)
- [x] medium (1-3%)
- [ ] low (<1%)

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

Availability of surface water
- [ ] excess
- [x] good
- [ ] medium
- [ ] 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
- [x] high
- [ ] medium
- [ ] low

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [ ] mixed (subsistence/ commercial)
- [x] 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
- [ ] poor
- [ ] average
- [x] rich
- [x] very rich

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

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

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

Gender
- [ ] women
- [x] men

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

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

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

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

health	poor	good
education	poor	good
technical assistance	poor	good
employment (e.g. off-farm)	poor	good
markets	poor	good
energy	poor	good
roads and transport	poor	good
drinking water and sanitation	poor	good
financial services	poor	good

IMPACTS

Socio-economic impacts

Crop production	decreased	increased
land management	hindered	simplified

Socio-cultural impacts

SLM/ land degradation knowledge	reduced	improved
conflict mitigation	worsened	improved

Ecological impacts

water quantity	decreased	increased
surface runoff	increased	decreased
groundwater table/ aquifer	lowered	recharge
soil moisture	decreased	increased
soil loss	increased	decreased
fire risk	increased	decreased
wind velocity	increased	decreased

Off-site impacts

reliable and stable stream flows in dry season (incl. low flows)	reduced	increased
downstream flooding (undesired)	increased	reduced
damage on neighbours' fields	increased	reduced

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

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
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%
- [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

- Long-term soil conservation against prognosticated heavy rain fall with climate change.

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

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

- In some cases the terraces are even exaggerated.

REFERENCES

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Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_1275/

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n.a.

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- n.a.