Planting pits and stone lines

Niger - Tassa avec cordon pierreux (french)

Rehabilitation of degraded land through manured planting pits, in combination with contour stone lines. The planting pits are used for millet and sorghum production on gentle slopes.

The combination of planting pits (tassa) with stone lines is used for the rehabilitation of degraded, crusted land. This technology is mainly applied in semi-arid areas on sandy/loamy plains, often covered with a hard pan, and with slopes below 5%. These denuded plains are brought into crop cultivation by the combination of tassa and stone lines. Planting pits are holes of 20-30 cm diameter and 20-25 cm depth, spaced about 1 m apart in each direction. The excavated earth is formed into a small ridge downslope of the pit. Manure is added to each pit, but its availability is sometimes a problem. At the start of the rainy season, millet or sorghum is sown in these pits. The overall aim of the system is to capture and hold rainfall and runoff, and thereby improve water infiltration, while increasing nutrient availability. Stone lines are small structures, at most three stones wide and sometimes only one stone high. The distance between the lines is a function of the slope and availability of stone. Typically they are sited 25-50 m apart on 2-5% slopes. Stones are usually collected from nearby sites - though sometimes up to 5-10 km away and brought to the fields by donkey carts or lorries (when a project is involved). They are positioned manually, along the contour. Stone lines are intended to slow down runoff. They thereby increase the rate of infiltration, while simultaneously protecting the planting pits from sedimentation. Often grass establishes between the stones, which helps increase infiltration further and accelerates the accumulation of fertile sediment. Wind-blown particles may also build up along the stone lines due to a local reduction in wind velocity. The accumulation of sediment along the stone lines in turn favours water infiltration on the upslope side. This then improves plant growth, which further enhances the effect of the system. Construction does not require heavy machinery (unless the stones need to be brought from afar by lorry). The technique is therefore favourable to spontaneous adoption. Stone lines may need to be repaired annually, especially if heavy rains have occurred. Manure is placed every second (or third) year into the previously dug pits and sand is removed annually: normally the highest plant production is during the second year after manure application.

left: Adding manure to the pits (tassa) before planting. (Photo: William Critchley)
right: Stone lines in combination with tassa: the two measures act together to capture runoff and improve plant performance. (Photo: Charles Bielders)

Location: Niger, Tahoua
Technology area: 40 km^2
Conservation measure: agronomic, structural
Stage of intervention: rehabilitation / reclamation of denuded land
Origin: Developed externally / introduced through project,
Land use type:
Cropland: Annual cropping
Climate: semi-arid
WOCAT database reference: T_NIG002en
Related approach: Approche participative de récupération des terres (NIG01f), Participatory land rehabilitation (NIG01e)
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Classification

Land use problems:

- Soil fertility decline is the basic problem: this is due to degradation and nutrient mining. Loss of limited rainwater by runoff and loss of soil cover result in low crop production and food insufficiency. This occurs in combination with lack of pasture, resulting in shortage of manure. (expert's point of view)

Land use

Annual cropping
rainfed

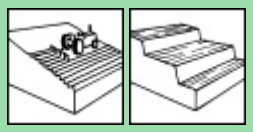
Climate

semi-arid

Degradation

Soil erosion by water: loss of topsoil / surface erosion, Soil erosion by wind: loss of topsoil, Chemical soil deterioration: fertility decline and reduced organic matter content, Physical soil deterioration: compaction, sealing and crusting

Conservation measure



Agronomic: Others (Manure application (supplementary))
Structural: Others (stone lines, planting pits)

Stage of intervention

- Prevention
- Mitigation / Reduction
- Rehabilitation

Origin

- Land users initiative
- Experiments / Research
- Externally introduced

Level of technical knowledge

- Agricultural advisor
- Land user

Main causes of land degradation:

Main technical functions:

- increase in organic matter
- increase of infiltration
- increase / maintain water stored in soil
- water harvesting / increase water supply
- increase in soil fertility
- increases natural regeneration of trees

Secondary technical functions:

- reduction of slope length
- improvement of ground cover
- improvement of soil structure

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

Soil texture: coarse / light (sandy)
Soil fertility: low
Topsoil organic matter: low (<1%)
Soil drainage/infiltration: good

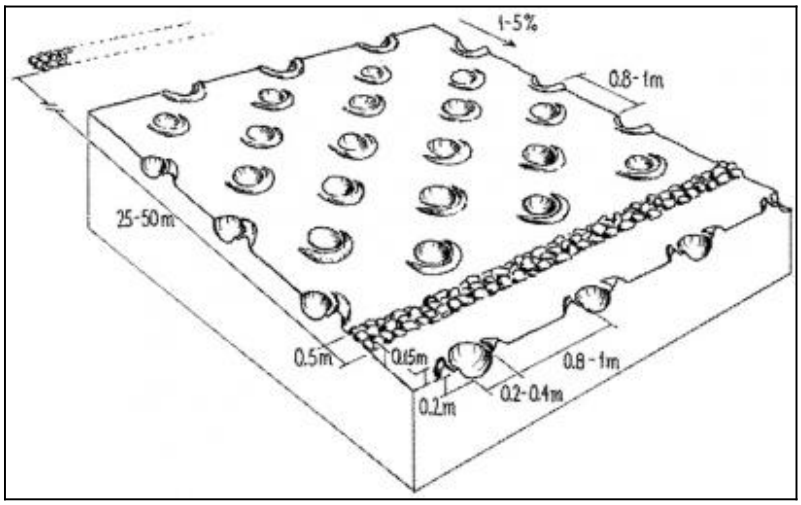
Human Environment

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 ownership: individual, titled
Land use rights: individual

Importance of off-farm income: > 50% of all income: remittances from out-migration of labour, commerce and crafts
Access to service and infrastructure:
Market orientation: subsistence (self-supply)
Mechanization:
Livestock grazing on cropland:



Technical drawing

Planting pits (tassa) capture rainfall runoff for cultivation of annual crops, and the stone lines - spaced at 25-50 metres apart - help hold back moisture and eroded soil. (Mats Gurtner)

Implementation activities, inputs and costs

Establishment activities

- Aligning the stones along the contour with the help of a 'water tube
- Digging pits (tassa): the excavated earth
- Digging out stones from nearby sites
- Transporting stones

Establishment inputs and costs per ha

Inputs	Costs (US$)	% met by land user
Equipment		
- Transporting stones with lorri	40.00	0%
- tools for tassa	5.00	100%
- tools for stone lines	5.00	75%
Construction material		
- stone	0.00	%
Agricultural		
- compost/manure	5.00	100%
Other		
- person days (for digging tassa	150.00	100%
- person days (stone lines)	40.00	100%
TOTAL	**245.00**	**83.16%**

Maintenance/recurrent activities

- Manuring the pits with about 250 g per pit (2.5 t/ha)
- Manuring the pits with approx 250 g per pit
- Removing sand from the tassa
- Check and repair stone lines

Maintenance/recurrent inputs and costs per ha per year

Inputs	Costs (US$)	% met by land user
Equipment		
- tools for tassa	1.00	100%
Agricultural		
- compost/manure	2.50	100%
Other		
- person days (for digging tassa	30.00	100%
- person days (stone lines)	1.50	100%
TOTAL	**35.00**	**100.00%**

Remarks:

The costs are based on 300 m of stone lines per hectare (on a 3-4% slope). Maintenance costs refer to removing sand from the pits from the second year onwards, and to the application of manure every second year (costs are spread on an annual basis). If applicable, costs for transporting the manure need to be added. The general assumption in these calculations is that adequate manure is readily available close by. The availability of stones is the main factor in determining costs - though labour availability can affect prices also. If stones are not available in the field or nearby (from where they can be transported by donkey cart), they have to be carried by lorries, which is much more expensive. The costs here refer to fuel costs only, paid by a project: they do not include depreciation of lorries.

Assessment

Impacts of the Technology

Production and socio-economic benefits

+++ increased crop yield
++ increased farm income

Production and socio-economic disadvantages

++ increased labour constraints
++ increased input constraints

Socio-cultural benefits

++ improved conservation / erosion knowledge
+ community institution strengthening

Socio-cultural disadvantages

+ land use rights conflicts of rehabilitated land
+ conflicts between farmers and pastoralists

Ecological benefits

++ increased soil moisture
++ increased soil organic matter / below ground C
++ reduced soil loss
++ long-term soil cover improvement
++ increase in soil fertility

Ecological disadvantages

+ waterlogging in planting pits after heavy rains

Off-site benefits

+ reduced downstream flooding
+ reduced downstream siltation

Off-site disadvantages

Contribution to human well-being / livelihoods

Benefits /costs according to land user

Benefits compared with costs	short-term:	long-term:
Establishment	positive	very positive
Maintenance / recurrent	positive	very positive

Acceptance / adoption:

100% of land user families have implemented the technology with external material support.
There is moderate trend towards (growing) spontaneous adoption of the technology. There is moderate growing spontaneous adoption (for rehabilitation of the plains), but there are no estimates available regarding the extent.

Concluding statements

Strengths and → how to sustain/improve	Weaknesses and → how to overcome
Simple technology, individually applicable in the dry season, requiring only very little training/knowledge and no special equipment. →	Labour demanding technology for implementation and maintenance → Mechanisation of tasks: transportation of stones and manure. However, this would raise the cost.
Making best use of manure, which is a limiting resource. →	Instability of planting pits in loose soil, increased erosion on steeper slopes and with heavier rains → Avoid loose sandy soils and steep slopes.
Increase in agricultural production. →	
Rehabilitation of degraded and denuded land: bringing back into production formerly uncultivated land; extension of farm land to the plateaus. →	The effectiveness can be compromised if the various geo-morphological units (plateaus, slopes) are not treated simultaneously → Catchment area approach if downstream flooding is an issue.
	Possibility of land use conflicts concerning rehabilitated land, in particular with pastoralists → Better coordination/consultation before implementing the technology in an area.
	Implementation constraint: availability of manure and/or stones and transporting manure/stones to the plateaus and slopes → Subsidise transport means (or supply donkey carts) or/and apply stone lines only in areas where there are stones available close to the fields.