Left: Newly planted Salix cuttings along the stream bank are protected by biofencing. (Indira Mulepati)
Right: Well-established Salix rows along a stream bank. (Indira Mulepati)

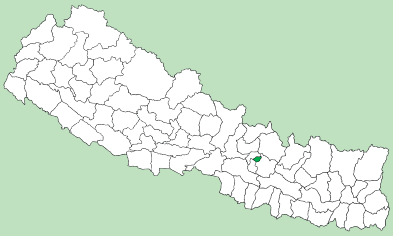
Using Salix plants to protect stream banks

Nepal: बैंस रोपी खोला किनार संरक्षण

Stream banks can be protected by planting them with Salix (*Salix babylonica*); this is a traditional practice that has been used for streams that flow through agricultural lands.

The erosion of stream banks is a natural geomorphic process, but when the streams flow through agricultural land there is a danger that they can overrun their banks and damage crops or erode land used for cultivation. The degree of erosion can be reduced by using structural measures such as lining the banks with concrete or large boulders or by planting trees along the edges. The Salix plant (*Salix babylonica*) has been found to be particularly useful for preventing erosion because its roots extend deep into the soil and help to anchor the bank. Following age-old tradition, land users in Bhaktapur district have planted Salix along the Bramayaeni khola (stream). It is a low-cost technology that is simple to implement.

Salix does best in moist soils, such as those found along irrigation channels and along the banks of rivers and streams. Salix saplings are most commonly planted in single rows but sometimes in double rows. After the saplings are planted, the entire area is fenced off using a biofence to protect them from being eaten or trampled by wild animals. Land users keep an eye on the Salix and prune or thin them as needed, for example when it is shading crops, or when they need firewood or can sell the branches.



WOCAT database reference: QT NEP 29
Location: Bhaktapur Municipality-2, Nantukucha, Bhaktapur District, Nepal
Technology area: 0.026 km^2
Conservation measure(s): Vegetative
Land Use: Annual cropping, irrigated land
Stage of intervention: Prevention of land degradation
Origin: Traditional
Climate: Sub humid/temperate
Related approach: Not described
Other related technology: Landslip and stream bank stabilization (QT NEP 11)
Compiled by: Indira Mulepati, Department of Soil Conservation and Watershed Management (DSCWM), Kathmandu
Date: April 2011, updated March 2013

The technology was documented using the WOCAT (www.wocat.org) tool.

ICIMOD

WOCAT

Classification

Land use problems

When streams overflow their banks, agricultural land can be flooded and eroded.

Land use

Annual cropping (mixed rainfed and irrigated)

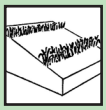
Climate

Subhumid/ temperate

Degradation

Water erosion: streambank erosion

Conservation measures



Vegetative measure

Stage of intervention

- [x] Prevention
- [ ] Mitigation/reduction
- [ ] Rehabilitation

Origin

- [x] Land users' initiative traditional
- [ ] Experiment/research
- [ ] Externally introduced
- [ ] Other (specify)

Level of technical knowledge

- [ ] Low
- [x] Medium: land user
- [ ] High

Main causes of land degradation: stream bank cutting during flood events

Technical function/impact

Main:
- The Salix roots reinforce the soil and support it by buttressing and arching.
- Salix armours the slope against surface erosion.

Secondary:
- Floodwater is safely channelled downstream.

Environment

Natural environment

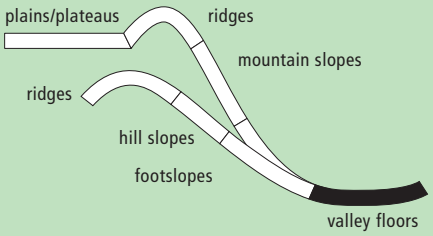
Average annual rainfall (mm)

- [ ] >4000
- [ ] 3000–4000
- [ ] 2000–3000
- [ ] 1500–2000
- [x] 1000–1500
- [ ] 750–1000
- [ ] 500–750
- [ ] 250–500
- [ ] <250

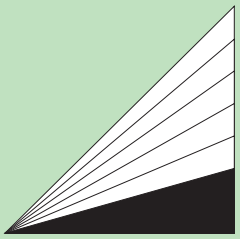
Altitude (masl)

- [ ] >4000
- [ ] 3000–4000
- [ ] 2500–3000
- [ ] 2000–2500
- [ ] 1500–2000
- [x] 1000–1500
- [ ] 500–1000
- [ ] 100–500
- [ ] <100

Landform



Slope (%)



Soil depth (cm)

- [ ] 0–20
- [ ] 20–50
- [ ] 50–80
- [ ] 80–120
- [x] >20

Growing season(s): two
Soil texture: loam
Soil fertility: high
Topsoil organic matter: high
Soil drainage/infiltration: good

Soil water storage capacity: medium
Groundwater table: <50 m
Availability of surface water: good
Water quality: good for agricultural use only
Biodiversity: medium

Tolerant of climatic extremes: increases in temperature and seasonal rainfall, floods
Sensitive to climatic extremes: dry spells and droughts
If sensitive, what modifications were made/are possible: Plant Salix lower down the stream banks so that plants can access seepage water from the stream.

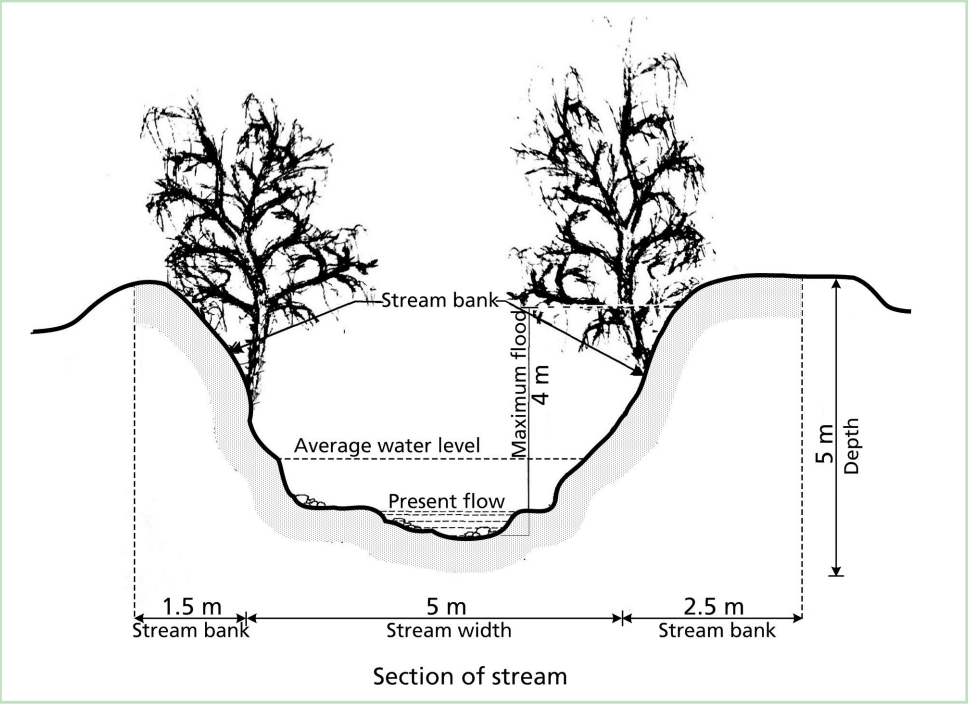
Human environment

Crop land per household (ha)

- [x] <0.5
- [ ] 0.5–1
- [ ] 1–2
- [ ] 2–5
- [ ] 5–15
- [ ] 15–50
- [ ] 50–100
- [ ] 100–500
- [ ] 500–1000
- [ ] 1000–10000
- [ ] >10000

Land user: individual and households
Population density: 1,895 per km^2
Annual population growth: 2.7%
Land ownership: individual, titled
Land/water use rights: land rights are individual, but water rights are communal (i.e. organized)
Relative level of wealth: well off
Importance of off-farm income: >50% of all households
Access to service and infrastructure: high

Market orientation: mixed (subsistence and commercial)
Mechanization: manual labour
Livestock grazing on cropland: not applicable
Livestock density: not applicable
Purpose of forest/woodland use: not applicable
Types of other land: not applicable



Technical drawing
Schematic diagram of a low cost riverbank protection scheme that can be implemented using mostly local materials.
(Bhojdeo Mandal, AK Thaku)

Implementation activities, inputs and costs

Establishment activities

Establishment activities are carried out in January and February

1. The planting site is cleared.
2. Cuttings are taken from 3–5 year-old trees: average length: 2–2.5 m; average diameter: 5–7 mm.
3. Planting pits approximately 30 cm in diameter and 90 cm deep are dug into the stream bank approximately 1–2 m apart.
4. The Salix cuttings are planted so that one-third of their length is below the surface of the soil.
5. After planting, the soil is compacted around the base of the cuttings.
6. The cuttings are watered soon after planning and again at least three times per month

In June and July, six months after planting, the cuttings that have survived and taken hold should show new shoots.

Establishment inputs and costs per ha

Inputs	Cost (USD)	% met by land user
Labour for pitting, branch cutting, transport, and planting (150 person days)	584	100%
Materials - Salix cuttings	186	100%
TOTAL	**770**	**100%**

Maintenance/recurrent activities

The established Salix is thinned or pruned if it is found to be shading crops. New cuttings are planted in areas where cuttings have failed to take root.

Maintenance/recurrent inputs and costs per ha per year

Inputs	Cost (USD)	% met by land user
Labour for replanting and pruning (10 person days)	39	100%
Agricultural - Salix cuttings	35	100%
TOTAL	**74**	**100%**

Remarks:

- The labour cost is very high in Bhaktapur District; when compared to other parts of the country it is probably the highest.
- All costs and amounts are rough estimates by the technicians and authors. Exchange rate USD 1 = NPR 71 in April 2011

Assessment

Impacts of the technology

Production and socioeconomic benefits

- + + + Reduced risk of production failure
- + + New land can be brought under cultivation/use
- + + Increased fodder production
- + Diversification of income sources

Production and socioeconomic disadvantages

none

Socio-cultural benefits

- + + + Improved understanding of conservation measures
- + + Strengthening community institutions

Socio-cultural disadvantages

none

Ecological benefits

- + + + Reduced susceptibility to adverse events such as floods
- + + + Reduced soil loss
- + + + Increased biomass available
- + + Improved drainage of excess water
- + Reduced evaporation

Ecological disadvantages

- – Salix can shade crops

Off-site benefit

- + + Reduced probability of flooding that can damage both public and private infrastructure
- + Improved water availability downstream because water remains contained in the stream

Off-site disadvantages

none

Contribution to human wellbeing/livelihood

- + Farm income is increased when more land is available for cultivation and when more fodder and fuelwood are available.

Benefits/costs according to the land user

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

Acceptance/adoption:
All of the 148 households studied implement this technology voluntarily without external support.

Concluding statements

Strengths and ➔how to sustain/improve	**Weaknesses** and ➔how to overcome
It is a successful example of sustainable land management that has been very effective in Nepal. ➔ An awareness programme on the importance of stream bank protection would help to validate and reconfirm this age-old practice.	There are no funds to help extend the technology to other areas. ➔ More funding should be made available for stream bank protection either from the District Soil Conservation Office or private organizations.
This low-cost technology is applied using indigenous knowledge. ➔ Scientific and technical input might help to make this technology more effective.	When newly planted Salix cuttings are overrun by khosima, a new invasive species, they gradually die. ➔ Technical backstopping is needed for the removal of unwanted species.

Key reference(s): None

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