Left: Hedgerow terraces are slowly formed when fodder and forage plants are cultivated along the bunds. (Gyanbandhu Sharma)
Right: Initial stage of establishing hedgerow technology on sloping land (Gyanbandhu Sharma)

Hedgerow technology

Nepal: घाँसेहार प्रबिधि

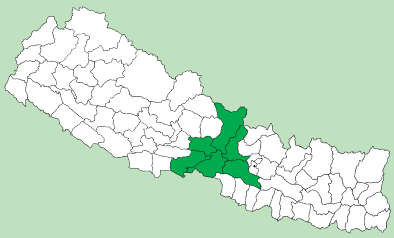
A technology that uses hedgerows to help establish terraces on sloping land; farmers learn improved methods to manage a cultivation practice that stabilizes the soil, enhances food production, and adds to on-farm cash income.

Hedgerow technology provides options and opportunities for farmers working on sloping land. These hedgerows are a soil conservation measure but they also help to generate additional biomass and fodder and/or income for marginal farmers; in addition, they offer the added benefit of helping to balance the ecosystem and to address climate change by encouraging biodiversity. This improved version of a local technology makes maximum use of indigenous knowledge and adds to it by making available the latest scientific knowledge.

Farmers have traditionally selected plants for hedgerow cultivation based on practical considerations such as the availability of seeds and seedlings, how well seeds germinate, how well the plants grow and how well they can be coppiced, their branching habit, the amount of biomass they can produce, and how much cash the crop can generate. They made these choices without the benefit of any external input or scientific knowledge, relying solely on what they have been able to observe locally over the years. The participatory technology development process aims to help farmers by providing them with scientific input to augment their traditional knowledge on the selection, plan, and design of hedgerows. Over a very short time, the farmers learn to make good use of the new information and start enjoying the benefits that the improved agriculture yields in terms of social, economic, and environmental benefits.

The following steps outline how hedgerows can be established on sloping land:

- A participatory designing and planning process is used to choose which sloping lands will be cultivated and to select which hedgerow species are to be planted. Trained manpower is recruited with the help of farmers and other related stakeholders.
- The necessary materials such as A-frames, seeds, and seedlings are prepared.
- The technology is implemented in the field by trained manpower.
- The hedgerow seedlings are regularly maintained.
- The land users participate in periodic monitoring and evaluation of the technology. They report on progress and provide feedback.



WOCAT database reference: QT NEP 27
Location: Gorkha, Tanhun, Chitwan, Makwanpur, Nawalparasi, Dhading Districts, Nepal
Technology area: 1–10 km^2
Conservation measure(s): Vegetative and land management
Land Use: Mixed cropping and agroforestry
Stage of intervention: Preventing land degradation
Origin: Experimental/research
Climate: Subhumid/subtropical
Related approach: Participatory hedgerow management (QA NEP 27)
Other related technology: Gully plugging using check dams (QT NEP 14)
Compiled by: Gyanbandhu Sharma (LI-BIRD)
Date: : October 2009, updated March 2013

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

ICIMOD LI-BIRD WOCAT

Classification

Land use problems

Noticeable soil erosion, decreased soil fertility, diminished productivity, and lower moisture content in areas that have sloping lands and in areas where shifting cultivation is or was practised. Plots that had previously been farmed by the method of shifting cultivation, where plots are allowed to lie fallow for a number of years, are now cultivated annually. This land use change is worrying because shifting cultivation has traditionally been practised in areas where the quality of the soil is poor and cannot support annual crop production year on year.

Land use

Mixed cropping and agroforestry (rainfed)

Climate

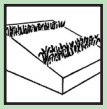
Subhumid/ subtropical

Degradation

Water erosion; loss of topsoil by water, gully erosion, and landslides

Nutrient depletion and reduced fertility by overuse of chemical fertilizers; reduced organic matter content in soil

Conservation measures



Vegetative measure

Management measure

Stage of intervention

- Prevention
- Mitigation/reduction
- Rehabilitation

Origin

- Land users' initiative
- Experiment/research: LI-BIRD
- Externally introduced
- Other (specify)

Level of technical knowledge

- Low
- Medium: land user, field staff
- High

Main causes of land degradation: heavy/extreme rainfall, droughts, poor soil management, deforestation

Technical function/impact

Main:
- Prevents soil erosion
- Controls dispersed runoff; hedgerows help to trap and retain water

Secondary:
- Where the soil is stabilized by vegetation landslides occur less frequently
- Increases nutrient content in the soil (supply, recycling)
- Reduces slope gradient

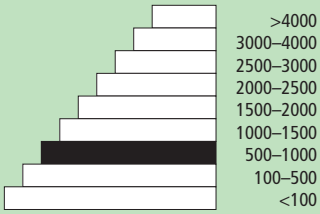
Environment

Natural environment

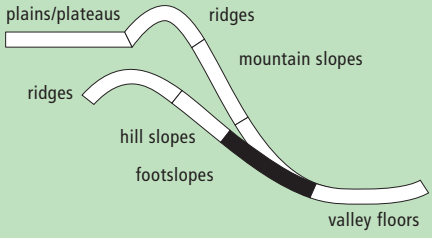
Average annual rainfall (mm)

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

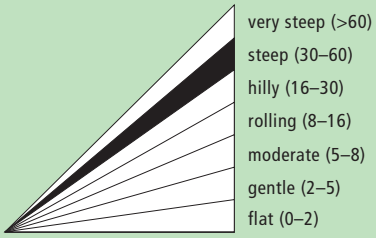
Altitude (masl)



Landform



Slope (%)



Soil depth (cm)

- 0–20
- 20–50
- 50–80
- 80–120
- >20

Growing season(s): two
Soil texture: coarse/light (sandy)
Soil fertility: low
Topsoil organic matter: medium (1–3%)
Soil drainage/infiltration: poor

Soil water storage capacity: low
Ground water table: >50 m
Availability of surface water: poor/none
Water quality: poor
Biodiversity: low

Tolerant of climatic extremes: droughts, decrease in seasonal rainfall
Sensitive to climatic extremes: heavy rainfall events
If sensitive, what modifications were made/are possible: farmers select species with deep roots to adapt to climate extremes

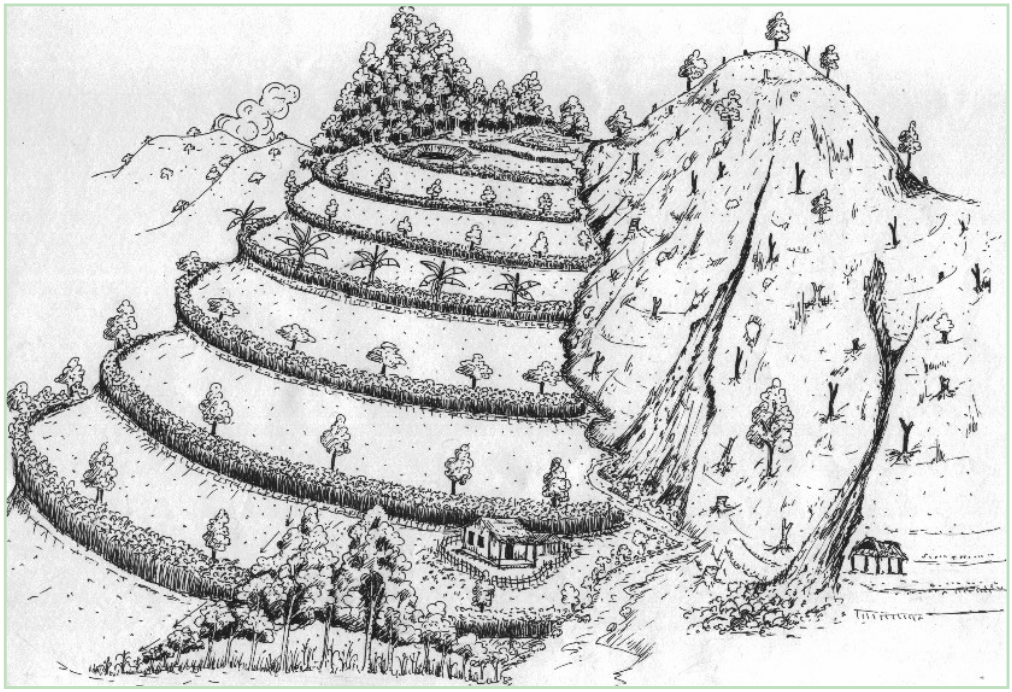
Human environment

Crop land per household (ha)

- <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 or household
Population density: 10–50 persons per km^2
Annual population growth: 3–4%
Land ownership: individual, titled
Land/water use rights: : poor
Relative level of wealth: poor
Importance of off-farm income: 10–50% of all income

Access to services and infrastructure: moderate
Market orientation: subsistence
Mechanization: manual labour, animal traction
Livestock grazing on cropland: limited
Livestock density: low
Purpose of forest/woodland use: not applicable



Technical drawing
Hedgerow technology on sloping land; note that the hedgerows help to stabilize the land and to control soil erosion and runoff. (Bir Bahadur Tamang)

Implementation activities, inputs and costs

Establishment activities

- The equipment that is needed for planting is collected and prepared; this can include such things as A-frames, spades, and sickles.
- The hillside where the technology is to be implemented is first cleaned and groomed to make way for the new hedgerows.
- Contour lines are demarcated.
- The seeds and/or seedlings are planted along the contour lines.

Establishment inputs and costs per ha (average)

Inputs	Cost (USD)	% met by land user
Labour (10 person days)	27	100%
Equipment	32	100%
Agricultural		
– seeds, seedlings	68	100%
TOTAL	**127**	**100%**

Maintenance/recurrent activities

- The hedgerows are weeded and cleaned to discourage unwanted plants and pests.
- Enrichment planting
- The hedgerows are pruned and the clippings are mulched.
- Manuring

Maintenance/recurrent inputs and costs per ha per year

Inputs	Cost (USD)	% met by land user
Labour (26 person days)	71	100%
Agricultural		100%
– seed, seedlings	34	
– manure	20	100%
TOTAL	**125**	**100%**

Remarks:

- The cost of implementing this technology is dependent on the gradient of the slope (and other geographical features), the local cost of the seeds or seedlings, and the availability of labour.
- All costs and amounts are rough estimates by the technicians and authors. Exchange rate USD 1 = NPR 75 in October 2009
- The technology has a low to average cost for implementation. Locally available seeds and seedlings and locally trained manpower and resources are valuable low-cost inputs for implementation. The technology has a higher likelihood of adoption in some social and physiographic areas, especially where land users can integrate their own expertise with scientific knowledge. Many factors play a role in determining whether the technology is effective and sustainable and whether farmers are willing to adopt it; these include that if the technology is demand driven, it is more likely to be adopted, and if land users can use inexpensive local resources they are more likely to try it.

Assessment

Impacts of the technology

Production and socioeconomic benefits

+ + + Increased fodder production
+ + + Increased crop yield
+ + Reduced need for external agricultural inputs
+ + Diversification of income sources
+ + Increased product diversification

Production and socioeconomic disadvantages

− − − Not suitable for very steep slopes (>30°)
− − Increased demand for irrigation water
− − High initial cost
− − Hedgerows require a long time to become well established

Socio-cultural benefits

+ + + Improved knowledge of conservation/erosion
+ + Strengthening of community institutions
+ + Empowerment of the community
+ + Improved food security and self-sufficiency (reduced dependence on external inputs)

Socio-cultural disadvantages

none

Ecological benefits

+ + + Reduced surface runoff
+ + + Increased biomass and ground cover
+ + + Increased organic matter in the soil
+ + Increased moisture in the soil
+ + Increased plant diversity

Ecological disadvantages

− Increased competition for water, sunlight, and nutrients
− Hedgerows provide niches that can harbour pests such as birds, slugs, and rodents.

Off-site benefit

+ Reduced siltation downstream
+ Improved buffering/filtering capacity (by soil, vegetation, wetlands)

Off-site disadvantages

none

Contribution to human wellbeing/livelihood

+ + The hedgerows provide fodder and forage for animals; selling or bartering fodder helps to diversify food sources for humans and can also be a significant source of income.

Benefits/costs according to the land user

This technology provides diverse benefits in the long run.

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

Acceptance/adoption:
One quarter of the total land users (about 450 families) in the areas studied adopted this technology voluntarily without any external support.

Concluding statements

Strengths and →how to sustain/improve	**Weaknesses** and →how to overcome
Effective control of soil erosion on sloping land → This vegetative measure of planting along contour lines can be sustained in the long run by initially selecting species preferred by farmers and by continuing to maintain them.	Hedgerows are difficult to establish on steep slopes and in areas where the soil is dry and degraded → Increase moisture in the soil by mulching the hedges
Improved soil fertility → Hedgerows help to increase soil fertility because they trap water and sediment on the terraces; leguminous hedgerow plants fix nitrogen in the soil and when they are mulched their residues increase organic matter in the soil.	Hedgerows take a long time to establish → Increase the amount of manure (compost, crop residue) added to the hedgerows and add more frequently. Increase the frequency of weeding and cleaning.
Quality fodder and forage production → Hedgerows produce fodder and forage for livestock	It is difficult to establish bio-terraces on steep land → Reduce the spacing between hedgerows and grow tree species. Remember that that this technology is not recommend for very steep slopes
Bioterracing → When leguminous plants with deep roots are used in the hedgerows they help to anchor the edges and over time, as the soil accumulates, bioterraces are established.	High initial cost → Make maximum use of local resources and local labour
High adoption potential → This technology is simple to implement using only local resources and is assured of replication since it was demand driven.	Hedgerows threatened by free grazing of animals → Control grazing in the area

Key reference(s): Regmi, BR; et al. (2004) *Factors responsible for acceptance or rejection of SALT and other technological options suitable for shifting and sloping land cultivation areas*, Technical Paper submitted to Hill Agriculture Research Project (HARP), NARC, Kathmandu, Nepal
Sharma, G; Regmi, BR; Tamang, BB; Shrestha, PK (2008) *A resource book: Integrated hedgerow technology* (in Nepali). Pokhara, Nepal: LI-BIRD
ICIMOD (1999) *Manual on contour hedgerow inter-cropping technology.* Kathmandu, Nepal: ICIMOD
Ya, T; Murray, AB (eds) (2004) *Impact of contour hedgerows: A case study,* Focus on Godavari No 3. Kathmandu, Nepal: ICIMOD
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