View of the case study gullies with check dams (PARDYP, ICIMOD)

Gully plugging using check dams (Nepal)

Galchhi niyantran - Nepali

DESCRIPTION

Small dam structures constructed across erosion gullies

Check dams are small low structures built across a gully or a channel to prevent them from deepening further. These small dams reduce the speed of water flow and minimise the erosive power of runoff. They also promote the deposition of eroded materials to further stabilise the gullies.
Two gullies adjacent to a degraded area of communal grazing land were controlled by constructing check dams and with vegetative measures including planting bamboo. The main purpose was to control the further development of the gullies, which were affecting the adjacent grazing land and blocking a downstream irrigation channel. The site is community land used by the 40 households (240 people) of Dhotra village in the intensively used Jhikhu Khola watershed. Irrigated cropland lies downstream from the site, whilst the site itself is bordered by grazing land, degraded sal-dominated forest, and rainfed forward-sloping terraces.
The check dams were made of old cement bags filed with soil and were 1m high with 0.5m deep foundations. The check dams were spaced so that a line joining the top of two adjacent dams had about a 3% slope gradient. Twenty-four check dams were built in the two gullies using a total of 2400 filled cement bags. Forty clumps of bamboo were planted between the dams for stabilisation.
All that is needed to maintain this technology is to inspect the condition of the check dams occasionally, especially before and after the monsoon. Displaced bags should be replaced and the water courses cleared of branches and big stones. Further planting should be carried out if needed.
The case study area has a distinct dry season from November to May and a wet monsoon period from June to October. Annual rainfall is around 1200 mm. The site has red soils that are highly weathered and, if not properly managed, are very susceptible to erosion.

LOCATION

Location: Kavre Palanchok/ Dhotra village, Jhikhu Khola watershed, Nepal

No. of Technology sites analysed:

Geo-reference of selected sites
- 85.68449, 27.68362

Spread of the Technology: evenly spread over an area (0.006 km²)

In a permanently protected area?:

Date of implementation: 10-50 years ago

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

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

Land use

Grazing land
- Ranching

Water supply
- ☑ rainfed

- [ ] adapt to climate change/ extremes and its impacts
- [ ] mitigate climate change and its impacts
- [ ] create beneficial economic impact
- [ ] create beneficial social impact
- [x] reduce land loss

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

Purpose related to land degradation

- [ ] prevent land degradation
- [x] reduce land degradation
- [ ] restore/ rehabilitate severely degraded land
- [ ] adapt to land degradation
- [ ] not applicable

Degradation addressed

soil erosion by water - Wg: gully erosion/ gullying, Wo: offsite degradation effects

SLM group

- improved ground/ vegetation cover
- cross-slope measure

SLM measures

vegetative measures - V1: Tree and shrub cover

structural measures - S5: Dams, pans, ponds

TECHNICAL DRAWING

Technical specifications

Schematic drawing of two gullies with 24 check dams and bamboo planted below the check dams for stabilisation

Location: Dhotra. Khabre

Date: 22.6.06

Technical knowledge required for field staff / advisors: low

Technical knowledge required for land users: low

Main technical functions: control of dispersed runoff: impede / retard, sediment retention / trapping, sediment harvesting

Secondary technical functions: reduction of slope angle, increase of infiltration

Scattered / dispersed
Vegetative material: T : trees / shrubs
Number of plants per (ha): 40
Vertical interval between rows / strips / blocks (m): 4 m

Trees/ shrubs species: Bamboo

Slope (which determines the spacing indicated above): 30.00%

If the original slope has changed as a result of the Technology, the slope today is (see figure below): 25.00%

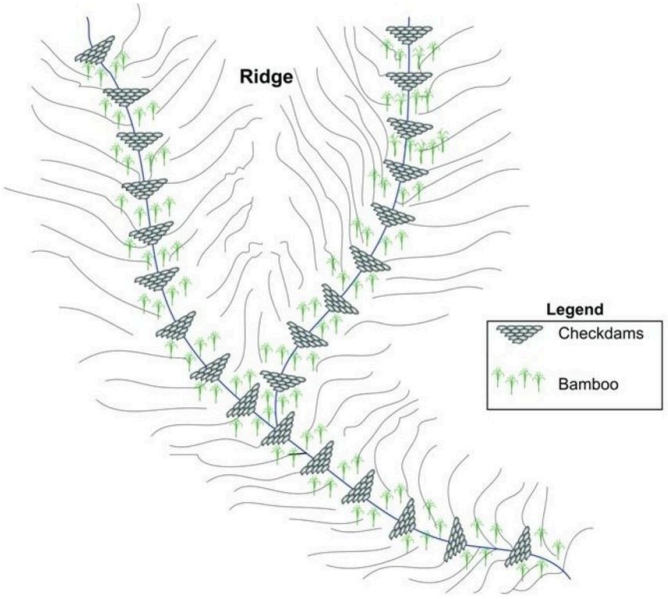
Dam/ pan/ pond
Vertical interval between structures (m): 4 m

Construction material (earth): soil resulting from digging activities from the adjacent grassland was used to fill cement bags for

Slope (which determines the spacing indicated above): 30%

If the original slope has changed as a result of the Technology, the slope today is: 25%

Vegetation is used for stabilisation of structures.



Author: I. Providoli, A.K.Thaku ICIMOD

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated:
- Currency used for cost calculation: **Nepali Rupee**
- Exchange rate (to USD): 1 USD = 73.0 Nepali Rupee
- Average wage cost of hired labour per day: 2.00

Most important factors affecting the costs

n.a.

Establishment activities

1. Plantating of bamboo plants (clumps) below the check dams (Timing/ frequency: before onset of monsoon (June))

2. Placing filled cement bags across gullies to form checkdams (Timing/ frequency: before onset of monsoon (June))
3. Filling cement bag with soil (Timing/ frequency: before onset of monsoon (June))
4. Digging trenches for dam foundations (Timing/ frequency: before onset of monsoon (June))

Establishment inputs and costs

Specify input	Unit	Quantity	Costs per Unit (Nepali Rupee)	Total costs per input (Nepali Rupee)	% of costs borne by land users
Labour					
Building dams and planting bamboo	Persons/day	18.0	2.0	36.0	100.0
Construction material					
Cement bags	ha	1.0	73.0	73.0	
Other					
Lunch, tea for farmers	ha	1.0	16.0	16.0	
Transportation	ha	1.0	14.0	14.0	
Total costs for establishment of the Technology				**139.0**	
Total costs for establishment of the Technology in USD				*1.9*	

Maintenance activities
1. Maintaining gullies: repair or replace damaged check dams, plant (Timing/ frequency: before onset of monsoon (June))
2. Ensuring good drainage for bamboo (Timing/ frequency: before onset of monsoon (June))
3. Maintaining gullies: repair or replace damaged check dams,plant more grassesor trees if needed (Timing/ frequency: before onset of monsoon (June)/once a year)

NATURAL ENVIRONMENT

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

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

Specifications on climate
Thermal climate class: subtropics

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

Landforms
- [ ] plateau/plains
- [x] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [x] footslopes
- [ ] 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
- [x] very shallow (0-20 cm)
- [x] shallow (21-50 cm)
- [ ] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [ ] very deep (> 120 cm)

Soil texture (topsoil)
- [ ] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [x] fine/ heavy (clay)

Soil texture (> 20 cm below surface)
- [ ] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Topsoil organic matter content
- [ ] high (>3%)
- [ ] medium (1-3%)
- [x] low (<1%)

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

Availability of surface water
- [ ] excess
- [ ] good
- [ ] medium
- [ ] poor/ none

Water quality (untreated)
- [ ] good drinking water
- [x] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [ ] unusable

Water quality refers to:

Is salinity a problem?
- [ ] Yes
- [ ] No

Occurrence of flooding
- [ ] Yes
- [ ] No

Species diversity
- [ ] high
- [ ] medium
- [ ] low

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [x] subsistence (self-supply)
- [ ] mixed (subsistence/ commercial)

Off-farm income
- [ ] less than 10% of all income
- [x] 10-50% of all income
- [ ] > 50% of all income

Relative level of wealth
- [ ] very poor
- [x] poor
- [ ] average

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

- [ ] commercial/ market
- [ ] rich
- [ ] very rich

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

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

Gender
- [x] women
- [x] men

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

Area used per household
- [ ] < 0.5 ha
- [x] 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
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

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

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

Land use rights
- [ ] open access (unorganized)
- [x] communal (organized)
- [ ] leased
- [ ] individual

Water use rights
- [ ] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [ ] individual

Access to services and infrastructure

IMPACTS

Socio-economic impacts

Socio-cultural impacts

community institutions	weakened	strengthened ✓
SLM/ land degradation knowledge	reduced	improved ✓
conflict mitigation	worsened ✓	improved

At the beginning a few people opposed the activities.

Ecological impacts

excess water drainage	reduced	improved ✓
soil cover	reduced	improved ✓
soil loss	increased	decreased ✓

Off-site impacts

downstream siltation	increased	decreased ✓

into irrigation canal

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

Due to the high establishment costs, the short term benefit for the community only matches the costs. However, in the long-term the environmental benefit of rehabilitated land is high, and economic benefit is 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%
- [x] > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?

- [x] 0-10%
- [ ] 11-50%
- [ ] 51-90%
- [ ] 91-100%

Number of households and/ or area covered

40 households in an area of 0.006 sq km

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

- Reduced soil erosion, rill erosion, and top soil loss

  How can they be sustained / enhanced? Regular maintenance of the structure and grasses is required
- The technology is easy to maintain.

  How can they be sustained / enhanced? As above

Strengths: compiler's or other key resource person's view

- It's a low cost technology , easy to apply, little knowledge needed.

  How can they be sustained / enhanced? Regular maintenance of the structure and grasses is required
- The effect of the technology can be seen easily.

  How can they be sustained / enhanced? As above

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

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

REFERENCES

Compiler
Nicole Guedel

Editors

Reviewer
David Streiff
Alexandra Gavilano

Date of documentation: June 6, 2011

Last update: June 3, 2019

Resource persons
Nicole Guedel - SLM specialist
Madhav Dhakal - SLM specialist
Isabelle Providoli - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_1493/

Linked SLM data
Approaches: Local initiatives for rehabilitating degraded communal grazing land
https://qcat.wocat.net/en/wocat/approaches/view/approaches_2353/

Documentation was faciliated by

Institution
- ICIMOD International Centre for Integrated Mountain Development (ICIMOD) - Nepal

Project
- People and Resource Dynamics Project, Nepal (PARDYP)

Key references

- Nakarmi, G. (2000) Soil Erosion Dynamics in the Middle Mountains of Nepal, a report submitted to PARDYP, ICIMOD, Kathmandu: ICIMOD
- Schreier, H.; Brown, S.; Shah, P. B.; Shrestha, B.; Merz, J. (2002) Jhikhu Khola Watershed – Nepal, CD ROM. Vancouver: Institute for Resources and Environment, University of British Columbia.: ICIMOD
- Shrestha, B. (2004) Progress Report PARDYP- Nepal. Paper presented at the PARDYP Access Mid Year Meeting, 19-22 July 2004, ICIMOD, Kathmandu: ICIMOD