Left: Brick-cement walled spring box (check dams were established to prevent surface water flowing directly into the spring and contaminating it) (Sanjeev Bhuchar)
Right: Grass seedlings planted around the spring box (Madhav Dhakal)

Drinking water quality improvement through conservation measures

Nepal: संरक्षण विधिद्वारा पिउने पानीको गुणस्तर सुधार

Structural and vegetative measures to improve the quality of drinking water contaminated due to poor sanitation and seepage

This technology combines structural and vegetative measures to improve the quality of drinking water in an open spring. The quality of water was deteriorating due to poor sanitation and seepage around the spring. The spring was located near to Dhotra village at Barbot sub-settlement, Kabhrepalanchok district. About five households depended on the spring for their drinking water supplies with a further 10 using it regularly and 10-15 using it occasionally during the dry season.

The main purpose of implementing the technology was to improve the quality of drinking water in the spring by preventing it from being contaminated by surface runoff during the rainy season. This technology has long been implemented across Nepal's midhills. In this case a development project (PARDYP) mobilised the users and provided them with technical and material support to make the improvements.

A spring user group was formed. With project help, it built a walled structure (a spring box) over the spring and check dams around the spring, and planted grasses around the spring box and trees in the catchment. These measures prevented the direct flow of surface water into the spring thus reducing contamination and turbidity. Users built a 1.8m long, 1m wide and 1.5m high spring box with a zinc sheeted roof. Check dams were built across the surrounding gullies and rills. A main 2.5m long, 0.5m wide, and 1m high check dam was constructed near the source to prevent surface runoff from entering the spring. A drainage channel was made to drain off wastewater. Vetiver grass seedlings were planted around the spring box and trees were planted in the adjoining catchment. These activities were carried out at the beginning of the rainy season.

This technology is simple and durable and the only maintenance needed is to keep the surroundings clean and to repair any damage.

The case study area receives about 1200 mm of annual precipitation of which about 80% occurs during the monsoon season (June to September). The area mostly has red soils which are highly weathered and, if not managed properly, are very susceptible to erosive processes.

WOCAT database reference: QT NEP17
Location: Dhotra village, Jhikhu Khola watershed, Kabhrepalanchok district, Nepal
Technology area: < 0.1 km^2
SWC measure: Structural and vegetative
Land use: Extensive grazing
Climate: Humid subtropical
Related approach: Community effort for drinking water quality improvement, QA NEP17
Compiled by: Madhav Dhakal, ICIMOD
Date: : November 2006

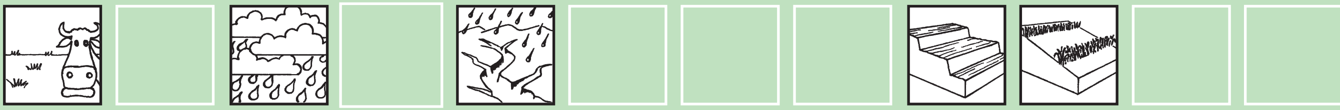
The technology was documented using the WOCAT (www.wocat.org) tool.

Classification

Land water use problems

High pressure on limited land resources due to overuse of crop, forest, and grazing lands; increased inputs of agro-chemicals which will lead to the deterioration of drinking water quantity and quality
Water quality deterioration resulting from poor sanitation

Land use | **Climate** | **Degradation** | **SWC measures**



Grazing land: extensive grazing | Humid subtropical | Water erosion: loss of top soil, and offsite degradation effects | Structural: walls, check dams | Vegetative: grasses around structures

Technical function/impact

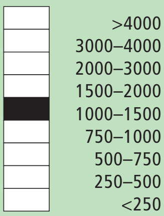
Main: - control of concentrated runoff (impedes/retards)
- improvement of ground cover

Secondary: - increase/maintain water stored in soil

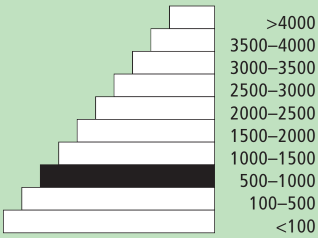
Environment

Natural environment

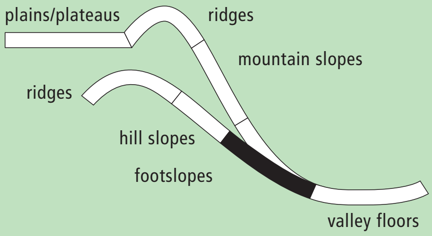
Average annual rainfall (mm)



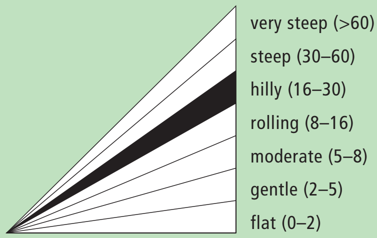
Altitude (masl)

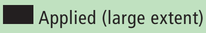


Landform

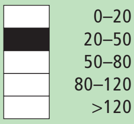


Slope (%)





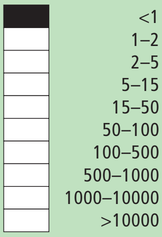
Soil depth (cm)



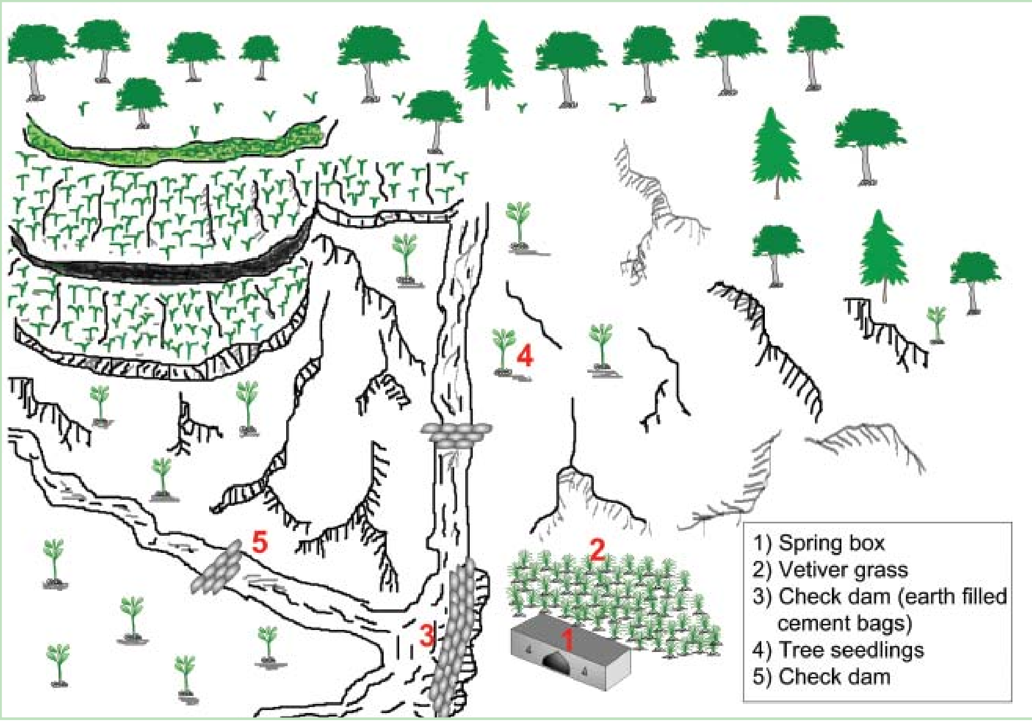
Growing season: 150 days (June to October) and 120 days (November to February)
Soil fertility: very low
Soil texture: mostly fine (clay)
Surface stoniness: some loose stone
Topsoil organic matter: low
Soil drainage: medium
Soil erodibility: very high

Human environment

Grazing land per household (ha)



Land use rights: individual
Land ownership: partly individually owned/titled and partly state owned
Market orientation: mostly subsistence (self-supply)
Level of technical knowledge required: field staff/extension worker: moderate, land user: moderate
Number of livestock: not relevant
Importance of off-farm income: in most farm households, off-farm income plays at least a minor and increasingly a major role. Occasional opportunities for off-farm income present themselves in the form of daily labour wages. Some households' members receive regular salaries, whilst an increasing number of Nepalis are working in India, the Middle East, Malaysia, and elsewhere and sending remittance incomes home.



Technical drawing
Structural and vegetative measures applied to improve water quality of spring

Implementation activities, inputs and costs

Establishment activities

The following tasks are carried out using manual labour and local agricultural tools (hoe, shovel, leveller, trowel nails, and a hammer). The work is usually done at the beginning of the rainy season.

1. Building of check dams to divert stream and gully runoff water
2. Building of the spring box
3. Construction of concrete floor in front of spring box
4. Construction of drainage channel
5. Planting vetiver grass around the spring box
6. Planting tree species in the catchment

Establishment inputs and costs per unit technology (2006)

Inputs	Cost (US$)	% met by land user
Labour (63 person days)	110	80%
Materials		
- Cement (400 kg)	44	0%
- Gravel and sand (2000 kg)	55	100%
- Bricks (2750 pieces)	188	0%
- Empty sacks (200 pieces)	5	0%
- Zinc sheet (4 pieces)	16	0%
- Steel wire	1	0%
Agricultural		
- Grass seedlings (250 pieces)	4	0%
Other		
- Transportation	10	15
TOTAL	**433**	**33%**

Maintenance/recurrent activities

Maintenance is carried out as needed using local agricultural tools.

- Cleaning spring box surroundings
- Maintenance of wall/floor against damage
- Maintenance of check dam against damage
- Replacement/gap filling with new tree seedlings
- Cutting planted grass

Maintenance/recurrent inputs and costs per year (2006)

Inputs	Cost (US$)	% met by land user
Labour (2 person days)	3.2	100%
TOTAL	**3.2**	**100%**

Remarks: Skilled labour was paid to build the spring box. Exchange rate US$1 = NRs 73 in 2006

Assessment

Acceptance/adoption

Fifteen families accepted the technology with incentives. Local people with inadequate access to drinking water or whose source is contaminated are likely to adopt the technology after raising the funds themselves.

Drivers for adoption

- Need for clean drinking water
- Fast impact visible, including improved water quality leading to improved health
- Easy to establish and no guidance is needed

Constraints to adoption

- Community has to get organized and collect enough money
- Too expensive for an ordinary single farmer

Benefits/costs according to land users

Clean water is available immediately after only a little investment. Government and PARDYP support meant that the short-term benefit was positive. Without this support the short-term costs would equal the benefits.

Benefits compared with costs	short-term	long-term
establishment	positive	very positive
maintenance/recurrent	very positive	very positive

Impacts of the technology

Production and socioeconomic benefits		Production and socioeconomic disadvantages	
none		none	
Socio-cultural benefits		**Socio-cultural disadvantages**	
+++	Strengthened community institution due to formation of a user group; less conflicts for drinking water	- - -	Socio-cultural conflicts due to insufficient water quantity especially during dry and pre-monsoon months
+++	Improved knowledge of soil and water conservation and erosion from group discussions and awareness raising activities		
	Improved health		
	Decreased women's workload for collecting water		
Ecological benefits		**Ecological disadvantages**	
+++	Improved drainage of excess water due to the drainage trench and check dams	none	
++	Reduced soil loss reduction due to the check dams		
+	Improved soil cover		
Off-site benefit		**Off-site disadvantages**	
none		none	

Concluding statements

Strengths and ➔how to sustain/improve	Weaknesses and ➔how to overcome
Water turbidity decreased from 23 nephelometric turbidity units (NTU) in August 2004 to 7 NTU in August 2005 ➔Encourage spring users to plant more multiple grasses and tree species around the catchment area	Coliform bacteria are still a problem ➔ Treat the water using SODIS, boiling, filters, chlorination or other methods before drinking
Faecal contamination decreased from 500 coliform formation units (CFU)/100 ml in August 2004 to 200 CFU/100 ml in August 2005. Similarly, the levels of ammonia (NH_3) and nitrate (NO_3 in the spring water have decreased (NH_3 from 0.5 to 0 mg/l; and NO_3 from 0.7 to 0.5 mg/l). Total hardness of spring water remained the same at 30 mg/l ➔ Regular maintenance, especially cleaning the surrounding area is needed; also need a clean pot for extracting the water	The water available during the pre-monsoon season is insufficient for the 15 households, leading to conflicts; the water source can be contaminated from unclean water fetching pots ➔The water in the spring box should be siphoned into a storage tank fitted with an overflow mechanism, cleaning outlet, lockable cover, and taps. This would protect the water source from contamination from open access and improve the quality and availability of water. The amount available could be increased by tapping other spring sources
Increased availability of drinking water has reduced women's workload during the dry season ➔ Improve the technology by building a closed storage tank	

Key reference(s): ICIMOD (2007) *Good Practices in Watershed Management: Lessons Learned in the Mid Hills of Nepal.* Kathmandu: ICIMOD

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