Left: A plastic-lined dug out pond holding household wastewater and runoff from the courtyard (K.M. Sthapit)
Right: The water from these ponds can be used to run micro-irrigation systems (drip as in picture and sprinkler) (PARDYP)

Plastic-lined conservation pond to store irrigation water

Nepal: प्लास्टिक बिछ्याइएको संरक्षण पोखरी

A plastic-lined dugout pond to store runoff and household wastewater for irrigation purposes during dry periods

Water harvesting technology is very useful in areas where there is limited rainfall for long periods of the year. These dry periods severely limit the growing of crops across Nepal's middle mountains especially on steep slopes where conventional irrigation can be difficult to arrange. Plastic-lined conservation ponds store water for irrigation more efficiently than the traditional earthen ponds which lose much water to seepage.

The ponds are dug out and the earthen walls lined with high density polyethylene (HDPE) sheet or SILPAULIN (multi-layered, cross laminated, UV stabilised) heavy duty plastic sheeting. The size of the pond will vary depending on the area available and the soil characteristics. The PARDYP project tested and demonstrated plastic-lined ponds with a capacity of 8,000-10,000 litres. These ponds were about 3m long, 2m wide and 1.5m deep and were located at shady sites to minimise evaporation losses.

The conservation ponds tested and demonstrated by the PARDYP project were used for irrigating high value off-season horticultural crops (vegetables, fruit, and spices). These crops were irrigated with drip irrigation and micro sprinklers (see sheets QT NEP6 and QT NEP21). The ponds were fed from rainwater, upland springs and taps, and household wastewater.

The ponds were established during the dry season in three days. They were prepared by selecting a suitable site with a sufficient catchment; mapping out the area and depth of the pond; digging out the soil; removing protruding stones and roots; and compacting and smoothing the sides and bottom of the pond. Then the sides and bottom of the pond were lined with sieved soil followed by plastic sheet, which was anchored by stones and soil.

The main maintenance activity is to prevent livestock and people from entering the pond to avoid damaging the sheet. The pond should not be allowed to dry up as this would let rats damage the sheet. The sediment that accumulates in the pond should be removed once a year carefully by hand only as the use of agricultural tools could puncture the sheet.

WOCAT database reference: QT NEP22
Location: Lamdihi, Patalekhet, Chiuribot villages of the Jhikhu Khola watershed, Kabhrepalanchok district, Nepal
Technology area: < 0.1 km^2
SWC measure: Structural
Land use: Annual cropping
Climate: Humid subtropical
Related approach: Not described
Compiled by: Madhav Dhakal, ICIMOD
Date: November 2006

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

ICIMOD

Swiss Agency for Development and Cooperation SDC

WOCAT

Classification

Land/water use problems

- Small landholdings which are mostly rainfed for cropping.
- Low soil fertility status and high susceptibility to erosion.
- Limited supplies of irrigation water and poor irrigation infrastructure.

Land use

Annual crops: vegetables

Climate

Humid subtropical

Degradation

Physical: excess harvesting of available water resources reduced

SWC measures

Management: from traditional to improved irrigation

Technical function/impact

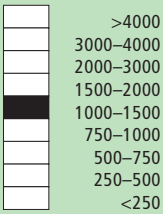
Main: - water harvesting

Secondary: - control of dispersed runoff (retain/trap)

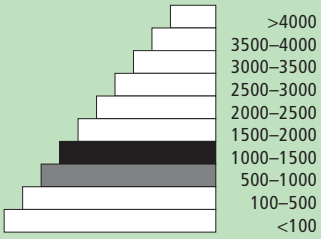
Environment

Natural environment

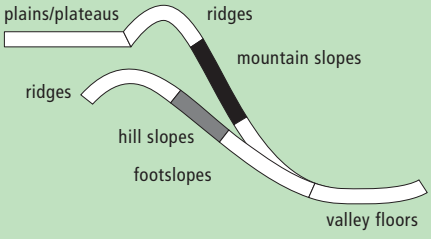
Average annual rainfall (mm)



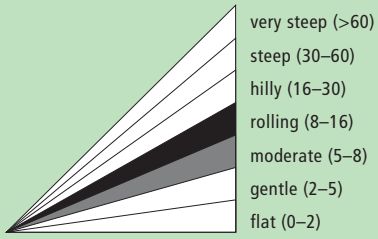
Altitude (masl)



Landform

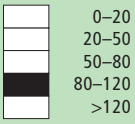


Slope (%)



Applied (large extent) Applied (medium extent)

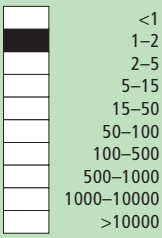
Soil depth (cm)



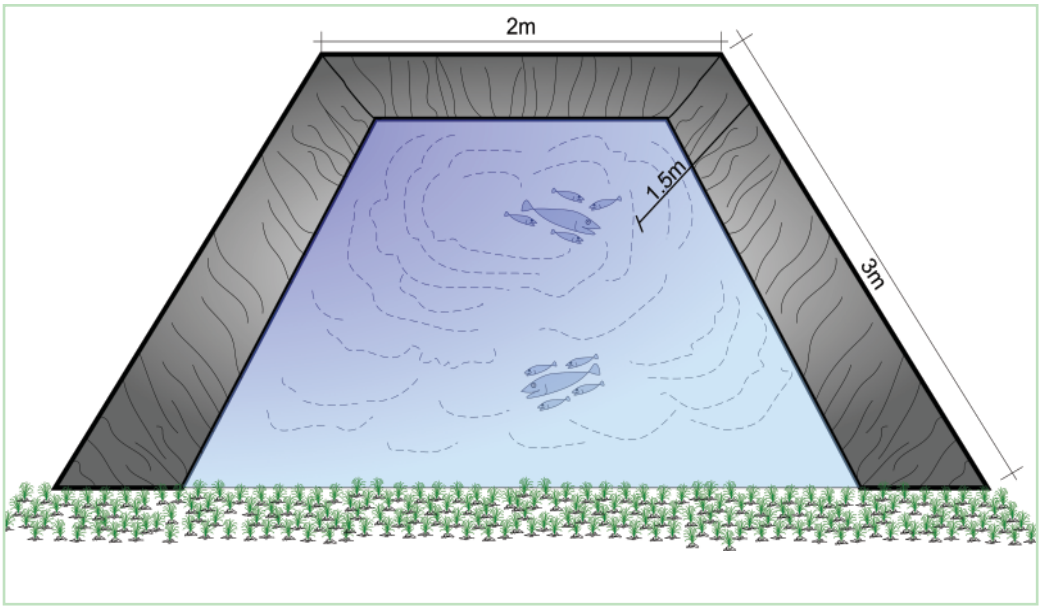
Growing season: 150 days (June to October) and 120 days (November to February)
Soil fertility: medium
Soil texture: mostly medium (loam) to fine (clay)
Surface stoniness: some loose stone
Topsoil organic matter: not appropriate
Soil drainage: good
Soil erodibility: good

Human environment

Cropland per household (ha)



Land use rights: individual
Land ownership: individually owned/titled
Market orientation: mixed (subsistence and commercial-only vegetables)
Level of technical knowledge required: field staff/extension worker: moderate, land user: moderate
Number of livestock: not appropriate
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
A plastic-lined conservation pond

Implementation activities, inputs and costs

Establishment activities

The establishment activities are performed with manual labour using local construction tools including a measuring tape, spade, shovel, knife, hoe, hammer, trowel, and pan. Establishment activities are done during the dry months and can be completed within three days. The major steps are as follow.

1. Select a preferably flat site with a sufficient catchment area
2. Measure the area to be irrigated and estimate the size of the pond
3. Measure and mark out the pond
4. Dig out the soil to the pre-determined depth
5. Remove protruding stones and roots
6. Compact and smooth the sides and bottom of the pond
7. Line the sides and bottom of the pond with sieved soil (preferably a clay and cow dung mixture) to make a smooth surface
8. Lay out the plastic sheets without any folds over the pond with overlapping of about 50 cm at any joints. Fold overlapped sections to reduce leakage
9. Overlay thick fine soil on the plastic sheet
10. Anchor the edges of the sheet at the rim of the pond with stones and soil.

Establishment inputs and costs per unit technology (2006)

Inputs	Cost (US$)	% met by land user
Labour (3 person days)	6.3	100%
Material		
- Plastic (6 kg)	29.2	0%
TOTAL	**35.5**	**18%**

Maintenance/recurrent activities

1. Prevent livestock and humans from entering the pond
2. Ensure that the pond is not allowed to dry out completely as this could allow rats to damage the plastic sheet
3. Removing accumulated sediment once a year carefully by hand (using agricultural tools may puncture the sheet)

Maintenance/recurrent inputs and costs per system per year (2006)

Inputs	Cost (US$)	% met by land user
Labour (3 person days)	6.3	100%
TOTAL	**6.3**	**100%**

Remarks: The costs given above are for a pond with a 9,000 litre capacity. Exchange rate US$1 = NRs 73 in 2006

Assessment

Acceptance/adoption

Five families accepted the technology with incentives. No known spontaneous adoption of the technology because of the expense of the plastic sheet and it not being locally available

Drivers for adoption

- Addresses water scarcity problem during dry months
- Reduces workload for collecting water
- Enables farmers to grow cash crops

Constraints to adoption

- The plastic sheet is not available locally
- The plastic sheet is expensive

Benefits/costs according to land users

Perception of land users who accepted the technology by getting incentives from the PARDYP project. If incentives are not available the short-term costs and benefits would be equal.

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

+ + Increased farm income due to availability of more water for irrigation

Production and socioeconomic disadvantages

- Loss of land
- Hindered farm operations

Socio-cultural benefits

+ + + Improved knowledge of soil and water conservation and erosion as farmers discussed and shared their experiences

+ + Strengthened community institution due to informal network of farmers with ponds

Socio-cultural disadvantages

none

Ecological benefits

+ + + Increased soil moisture

+ Improved soil cover as fallow land is turned into cropped land

Ecological disadvantages

none

Off-site benefit

+ Reduced downstream flooding due to trapped runoff

Off-site disadvantages

none

* All changes in technology may have gender and equity implications and potentially affect the members of disadvantaged groups differently. This has not been assessed here but should be considered when recommending technology use.

Concluding statements

Strengths and ➔how to sustain/improve	**Weaknesses** and ➔how to overcome
Good income from sales of vegetables in the dry season can be achieved even from a small piece of land ➔ Advantages of the technology should be more widely shared	SILPAULIN (multi-layered, cross laminated, UV stabilized) heavy duty plastic is not available in local markets and is expensive for poor farmers ➔ Make it available in the local market at a subsidised cost for poor farmers
These ponds are fed with rainwater and household wastewater and from springs and taps. The ponded water was mainly used for micro irrigation including drip irrigation and micro-sprinklers ➔ Promote the use of other water conserving techniques like mulching when using the harvested water	The ponds attract insects, mainly mosquitoes, that cause disease; and the ponds are unsafe for small children ➔ Regularly clean the pond and fence them in
Reduced the dependence on large scale water supply schemes ➔ Harvest all possible sources of water	
No seepage loss observed five years after building the ponds meaning that the plastic lasts at least five years ➔ Continue trials	

Key reference(s): ICIMOD (2007) *Good Practices in Watershed Management, Lessons Learned in the Mid Hills of Nepal.* Kathmandu: ICIMOD ■ SCWMC (2004) *Soil Conservation and Watershed Management Measures and Low Cost Techniques.* Kathmandu: Government of Nepal, Soil Conservation and Watershed Management Component - Department of Soil Conservation and Watershed Management ■ Shafiq, M.; Ikram, M.Z.; Nasir, A. (1995) *Water Harvesting Techniques for Sustainable Agriculture in Dry and Cold Mountain Areas.* Paper presented at the Workshop on Sustainable Agriculture in Dry and Cold Mountain Areas, Pakistan Agricultural Research Council, 25-27 September1995, Queta, Pakistan

Contact person(s): HIMCAT/WOCAT Coordinator, International Centre for Integrated Mountain Development (ICIMOD), GPO Box 3226, Kathmandu, Nepal, himcat@icimod.org