Left: A drip system irrigating bitter gourd seedlings – seedlings are generally transplanted in February-March when water availability is low (PARDYP)
Right: Bitter gourd and cauliflower under drip irrigation (PARDYP)

Low cost drip irrigation

Nepal: थोपा सिंचाई

An irrigation system which allows the slow and precise delivery of water to crops

Drip irrigation is a very water-efficient irrigation system. Water is dripped to individual plant root zones at low rates (2.25 l/hr) from emitters embedded in small diameter plastic pipes.

Farmers in the Jhikhu Khola watershed, Nepal, suffer from a shortage of water for irrigation between the end of one monsoon (June to September) and the next pre-monsoon period (May). This seriously limits agricultural production and leads to much land being left fallow after the monsoon crops have been harvested. Only a small area is planted with winter crops. The sources of irrigation water (such as rivers, and streams) are limited and the amount of water they provide is inadequate for cropping. Most of the sources remain dry outside the monsoon. Farmers expend considerable time and labour gathering what water they can to irrigate their crops. Low cost drip irrigation (LCDI) has been introduced in the watershed as a cost effective way of making the best use of the limited available water.

The cropping pattern of this area sees pre-monsoon vegetables established in February and March and winter vegetables in September and October. The low cost drip irrigation sets are installed while the fields are being prepared by ploughing, levelling, and ridging. Lateral pipes (12m long) are laid along the ridges which lie 1.5m apart. A wooden platform with storage tank is installed and connected to the lateral pipes. After the lateral pipes are laid out, planting holes are dug along the ridges spaced to coincide with the drip holes. These holes are usually set every 0.6 or 1.2m along the pipes depending on the crop. Farmyard manure and chemical fertiliser is placed in each pit and mixed well with the soil. Next, vegetable seedlings are planted in each hole and daily drip watering begins. Bitter gourd is the most commonly grown crop followed by cauliflower. Irrigation water is generally applied either in the morning or the evening. If needed, stakes are placed next to each plant a week later to allow the plants to climb. The climber crops like bitter gourd are netted one month after planting to provide more space for fruiting

Harvesting starts in mid-May and continues until September. Farmers maintain the system by repairing leaks in the pipe joints and by unblocking blocked drip holes.

WOCAT database reference: QT NEP6
Location: Kubinde village, Jhikhu Khola watershed, Kabhrepalanchok district
Technology area: ~ 0.1 km^2
SWC measure: Management
Land use: Annual cropping
Climate: Humid subtropical
Related approach: Participatory action research for drip irrigation, QA NEP6
Compiled by: Madhav Dhakal, ICIMOD
Date: August 2004, updated December 2005

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

ICIMOD

Schweizerische Eidgenossenschaft
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Swiss Agency for Development and Cooperation SDC

WOCAT

Classification

Land/water use problems

Insufficient water limits agricultural production during the winter and pre-monsoon seasons (Nov-May) leading to low farm incomes from the small landholdings. The increasing inputs of chemical fertilisers are a matter of concern for environmental protection.

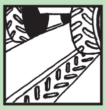
Land use

Annual crops: maize (before SWC),vegetables (after SWC)

Climate

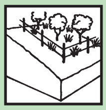
Humid subtropical

Degradation



Physical degradation: soil moisture problem

SWC measures



Management: from traditional irrigation to drip irrigation

Technical function/impact

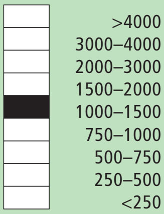
Main:
- slow and precise delivery of water to plant root zones, enhanced photosynthesis
- increase or maintenance of soil moisture

Secondary:
- reduction of evaporation losses
- reduction of water distribution losses

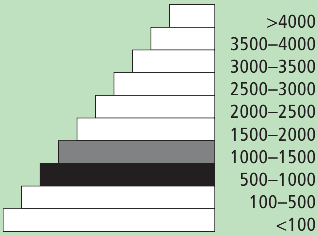
Environment

Natural environment

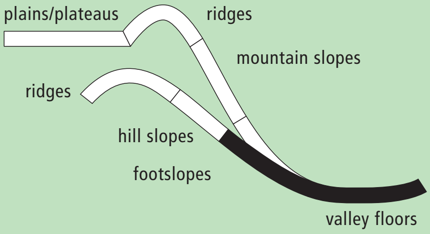
Average annual rainfall (mm)



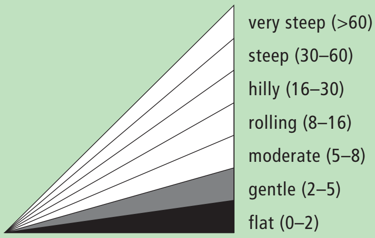
Altitude (masl)



Landform

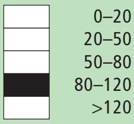


Slope (%)



■ Applied (large extent) ■ Applied (medium extent)

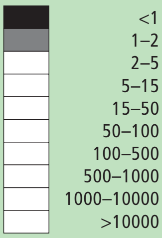
Soil depth (cm)



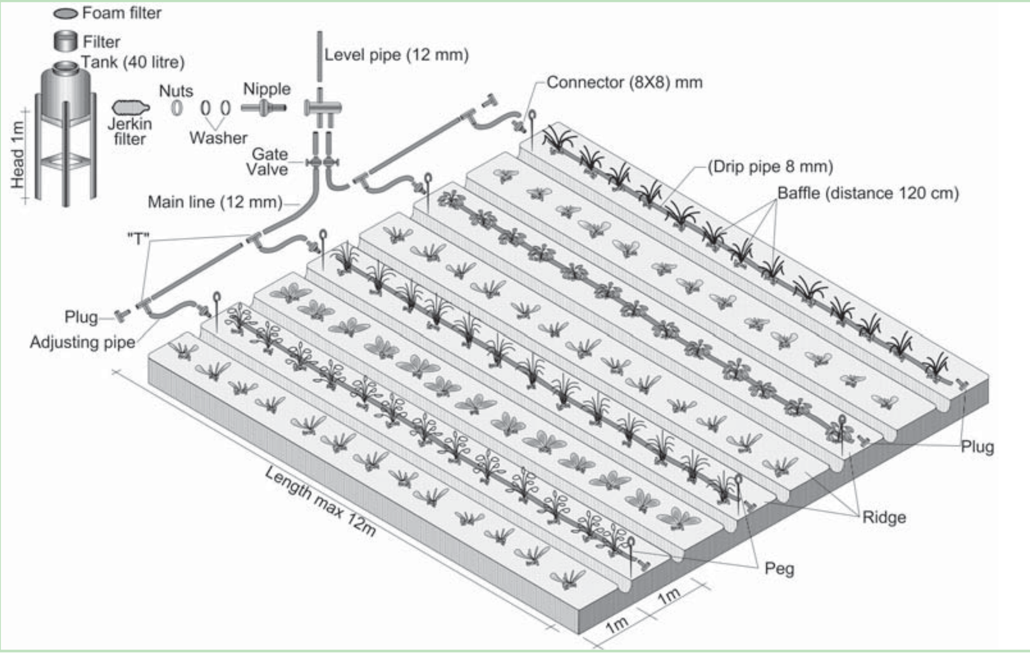
Growing season: 150 days (June to October) and 120 days (November to February)
Soil fertility: medium
Soil texture: mostly medium (loam)
Surface stoniness: no loose stones
Topsoil organic matter: low to medium
Soil drainage: good
Soil erodibility: mostly low

Human environment

Cropland per household (ha)



Land use rights: individual
Land ownership: individually owned/titled
Market orientation: mixed (subsistence and commercial), commercial vegetable growing
Level of technical knowledge required: field staff/extension worker: low, 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
Technical parts and design of a low cost drip irrigation system (IDE-Nepal)

Implementation activities, inputs and costs

Establishment activities

The technology is established in February and March for pre-monsoon vegetables and September and October for winter vegetables, using manual labour and local agricultural tools like spades. The major steps are as follows.

1. Levelling of land for uniform water distribution
2. Construction of wooden platform to raise the storage tank generally 1m above the ground
3. Installation of lateral pipes along the ridges/beds; check the spacing of drip holes by turning on the system and noting where the drips fall, then dig about 0.5m deep and 0.3m diameter planting pits for the vegetable seedlings to coincide with the drip holes - usually every 0.6 or 1.2m along the pipes
4. Connection of the lateral pipes to the water storage tank
5. Opening and closing of gate valves

Establishment inputs and costs per unit system (2004)

Inputs	Cost (US$)	% met by land user
Labour (1 person day)	2.8	100%
Equipment	25.8	0%
TOTAL	**28.6**	**100%**

Maintenance/recurrent activities

Maintenance mostly involves repairing leaks in pipe joints and unblocking drip holes.

1. Prevent leakage by replacing damaged or worn out parts
2. Clean the drip holes with water and a pin

Maintenance/recurrent inputs and costs per unit per year (2004)

Inputs	Cost (US$)	% met by land user
Labour & spare parts	7	100%
TOTAL	**7**	**100%**

Remarks: In the first year, PARDYP provided a 100% subsidy on drip kits to demonstrate the technology. The next year only 50% of the capital costs were covered and after 2-3 years of demonstration the subsidy was withdrawn.
The above mentioned total cost was for a medium-sized drip system with 8 lateral lines having 160 dripping holes in total (as in 2004). Exchange rate US$1 = NRs 73 in 2004.

Assessment

Acceptance/adoption

Local farmers started to adopt the technology after the 1999 to mid-2001 testing and demonstration period. The technology was promoted by government, community-based, and non-government organisations. About 50 PARDYP-organised farmers accepted and adopted the technology. Among them about 58% accepted the technology with the cost of the kit subsidised whilst 42% adopted it without any subsidy. Fifty-five other households in the watershed accepted the technology as promoted by a local NGO with technical support from PARDYP.

Drivers for adoption

- Testing and demonstrating the technology in a participatory way
- Making the drip sets and spare parts available in local markets
- Providing technical support for establishing and maintaining the sets; local NGOs and lead farmers can provide this.
- Microcredits for poor families to buy drip sets

Constraints to adoption

- Farmers do not have easy access to the drip sets and associated parts
- Capacity building programmes on drip irrigation often target only well-off families and male farmers
- Lack of micro-credit facilities for poor families

Benefits/costs according to land users

The practice delivers quick and tangible benefits so that users usually get a return on the cost of investment after only one crop season.

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 incomes: extra income (US$ 700/ha) due to early harvest (22 days earlier) of bitter gourd under drip irrigation allowing it to be sold as an off-season vegetable for a higher price
- + + + Reduced cost and time for irrigation and applying fertiliser (fertigation)

Production and socioeconomic disadvantages

none

Socio-cultural benefits

- + + + Improved knowledge of SWC/erosion: land users become familiar with new technology, they share experience on drip during gatherings
- + + Strengthened community institution due to increased number of drip users

Socio-cultural disadvantages

- \- Cropping area increased due to the technology; this increased women's workload, but also increased their self-esteem

Ecological benefits

- + + + Increased soil moisture due to applying water directly to plants' root zones
- + + Reduced water loss through evaporation, percolation, and distribution
- \+ Reduced soil loss due to slow and precise delivery of water

Ecological disadvantages

- \- - Mono-cropping practised: majority of farmers grow bitter gourd, cauliflower is the second most popular vegetable

Off-site benefit

- + + Water saving: less water used to irrigate crops making more water available for other uses/crops

Off-site disadvantages

- \- Spread of the system could lead to increased upstream water consumption that leaves less water available for downstream users

Concluding statements

Strengths and ➔how to sustain/improve	**Weaknesses** and ➔how to overcome
Drip irrigation saved 60% of water compared to bucket irrigation; dry season (off-season) vegetable production became possible and cropping area increased on areas with limited access to irrigation water ➔ Construction of water harvesting ponds and the use of collected water in drip systems makes for sustainable crop production	Technology is not suitable for sloping land and covers only a small area (using a medium-sized kit) ➔Modifying and levelling slopes and increasing the number of drip kits can overcome this limitation
Plant to plant visits are not required while irrigating, so irrigation, fertigation, and weeding take less time – the technology needs 50% less labour compared to bucket irrigation ➔ Experience sharing and interactions among drip users and non-users, easy access to technology with necessary trainings	The spacing of the drip holes does not match the farmer's needs ➔Make pipes available with at least 50 cm distance between drip holes
Additional household income (~$700/ha) due to early fruiting in case of bitter gourd (comparative study of drip vs. bucket irrigation) ➔Options for other potential high value cash crops should be explored	Spare parts are not available in the local market and farmers have to travel far (to Kathmandu) to get spare parts ➔ Make parts available locally

Key reference(s): ICIMOD (2007) *Good Practices in Watershed Management, Lessons Learned in the Mid Hills of Nepal.* Kathmandu: ICIMOD ■ Prajapati-Merz, B. (2003) *'Drip Irrigation System.'* In PARDYP Annual Report 2003 submitted to ICIMOD, Kathmandu ■ Shrestha, S. (2004) *Adoption of Drip Technology and It's Impact on Gender: a Case Study from Jhikhu Khola Watershed,* a report submitted to PARDYP project, ICIMOD, Kathmandu, Nepal ■ Von Westarp, S. (2002) *Agricultural Intensification, Soil Fertility Dynamics, and Low Cost Drip Irrigation in the Middle Mountains of Nepal,* M.Sc. Thesis. Vancouver: University of British Columbia

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