Left: Urine application with drip irrigation technology for bitter gourd (Juerg Merz)
Right: Filtration of urine through a cloth (Juerg Merz)

Urine application through drip irrigation for bitter gourd production

Nepal: करेला खेतीमा थोपा सिंचाइको साथमा पशुमूत्रको प्रयोग

Application of cattle urine through drip irrigation technology to provide constant flow of fertiliser to bitter gourd

Bitter gourd vegetables fetch a high price in the off-season and respond well if grown with drip irrigation. This crop is planted in December/January and harvested from May through to July/August. The growing period mainly falls in the driest period of the year and therefore requires irrigation.

In addition to water, the plants need fertiliser to ensure healthy growth and good production. Nitrogen is the most important macronutrient for plants and high crop productivity can only be achieved if sufficient nitrogen is available. Nitrogen is also the most limiting nutrient in most areas of Nepal's midhills. Traditionally farmers applied farmyard manure; but in many places this is being supplemented or entirely replaced by inorganic fertiliser, mainly urea. However, fertiliser prices have increased substantially in recent years and this type of fertiliser is often not available in sufficient quantities in areas away from the roadheads. At the same time cultivation practices are intensifying with greater cropping intensities and more nutrient demanding crops as local varieties are replaced by hybrids and new crops are introduced. This can easily lead to nutrient mining and soil fertility decline unless there is an equivalent increase in inorganic or mineral fertilisation.

Cattle urine is a viable alternative to mineral fertiliser; it is nitrogen rich. The urine is collected in improved cattle sheds (fact sheet on urine collection QT NEP1). For constant fertiliser application and to reduce the water requirement, the collected urine can be added to the irrigation water in the drip irrigation tanks (fertigation). Farmers who have tried this say it has increased the yield of bitter gourd and other cash crops, in some cases by as much as 100%. Other crops that can be grown using drip irrigation with a water-urine mixture are cauliflower, cucumber, and other types of gourd.

The Sustainable Soil Management Programme (SSMP) implements its projects in several midhills districts of Nepal
(dark green: previous working districts;
light green: districts in 2007)

Wocat database reference: QT NEP24
Farmer's name: Iman Singh Basnet, Latikoili VDC, Ward 1
Location: Surkhet district, western midhills of Nepal
SWC measure: Management
Land use: Annual cropping on rainfed agricultural land
Climate: Humid subtropical
Related approach: Farmer-to-farmer diffusion (QA NEP1); Farmer-led experimentation (QA NEP3);
Farmer field schools on integrated plant nutrient systems (QA NEP4)
Compiled by: SSMP
Date: 18 April 2007

The Sustainable Soil Management Programme is implemented by Helvetas Nepal and Intercooperation in collaboration with the Government of Nepal and civil society actors. It is financed by the Swiss Agency for Development and Cooperation. The technology was documented using the WOCAT (www.wocat.org) tool.

Classification

Land use problems

Intensifying cultivation practices with either 1) inadequate application of fertilisers leading to a decline in soil fertility and the mining of soil nutrients or 2) application of too much fertiliser causing environmental problems through excessive leaching, and losses of fertiliser in surface runoff and consequent eutrophication or nitrification of streams, ponds, or groundwater. Also, irrigation water is in short supply during 6 to 8 months of the year. Fertigation allows about 20 to 30% of the irrigation water to be replaced by urine.

Land use	Climate	Degradation	SWC measures
			
Annual crops: maize-wheat, potato, mustard, different types of vegetables	Humid subtropical	Chemical degradation: soil fertility decline, soil nutrient mining	Management: application of urine rather than urea; drip irrigation

Technical function/impact

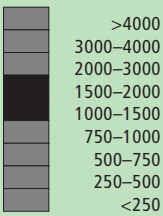
Main: - supplementary irrigation
- constant and slow supply of nutrients
- increase in soil fertility
- increase in soil productivity

Secondary: - pest control

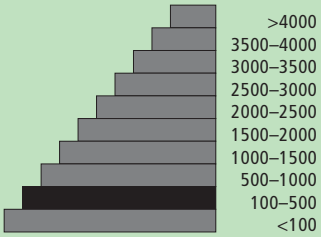
Environment

Natural environment

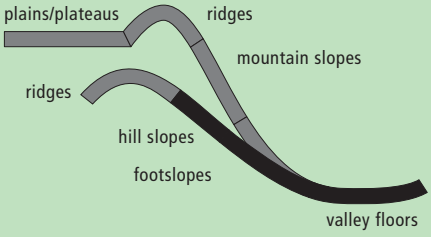
Average annual rainfall (mm)



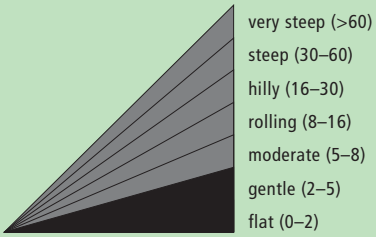
Altitude (masl)



Landform



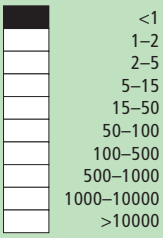
Slope (%)



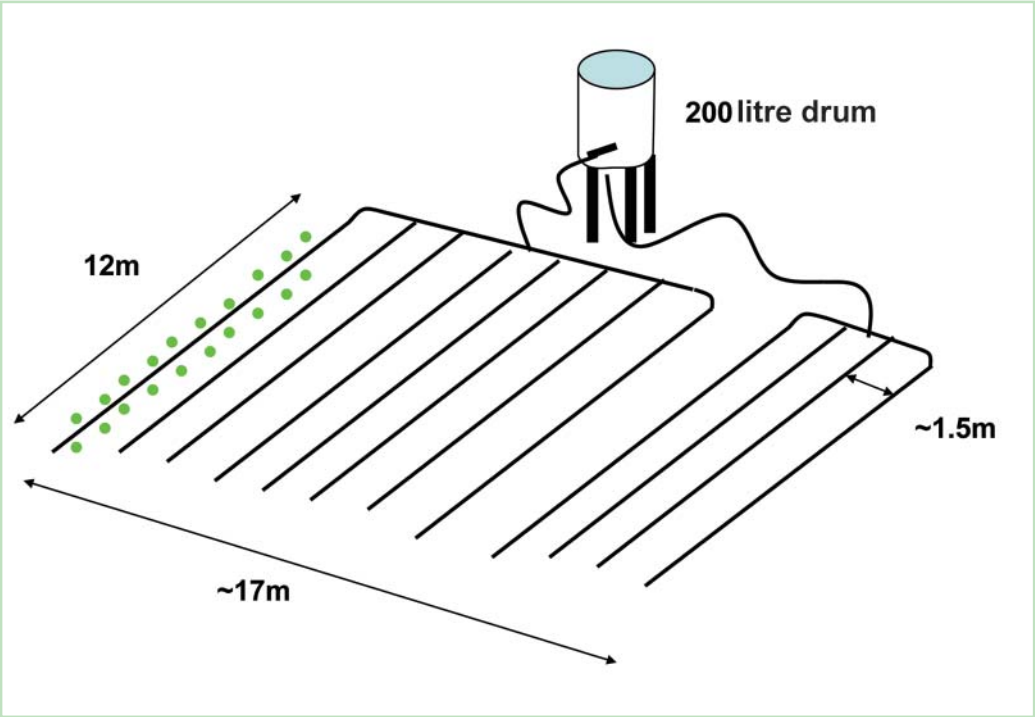
Applied Potential

Human environment

Cultivated land per household (ha)



Land use rights: individual, leased (sharecropping between owner and tenant)
Land ownership: individually owned, titled and not titled
Market orientation: subsistence, commercial and mixed (subsistence/commercial)
Level of technical knowledge required: low
Number of livestock: poor households usually have some goats and a cow or buffalo; wealthier households often own several cattle, buffaloes and a pair of oxen for ploughing.
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

The following setup was used in Iman Singh Basnet's field:

- two drip irrigation sets: one set with 8 lines, one with 4 lines
- a 200 l plastic drum
- 20 bitter gourd plants per line with 1.5m spacing between lines
- approximate area covered: 200m^2

Note that the drum was not delivered with the drip irrigation set. Mr Basnet uses the same drum for irrigating other crops where drip irrigation is not feasible, in which case he connects a pipe with a rose to the drum.

Implementation activities, inputs and costs

Establishment activities

1. Collect urine (see WOCAT fact sheet 'Improved cattle shed for improved urine collection – QT NEP1)
2. Grow bitter gourd seedlings
3. Set up drip irrigation set and prepare field
4. Transplant seedlings
5. Prepare and place stakes

Duration of establishment: about 2 days spread over 1 month

Establishment inputs and costs (average)

Inputs	Cost (US$)[1)]	% met by land user
Labour (2 days)	4	100%
Drip irrigation set	36	100%
Drum (200 l)	4	100%
Stakes	6	
TOTAL	**50**	**100%**

[1)] Exchange rate US$1 = NRs 67 in January 2007

Maintenance/recurrent activities

1. Clear drip holes
2. Double filter the urine – once when taking out of the collection tank, and again when pouring into the drip irrigation tank
3. Irrigate every alternate day with 160 l water and 40 l urine.
4. Fix shoots to the stakes
5. Raise ridges for better irrigation efficiency
6. Harvest the crop

Maintenance/recurrent inputs and costs per crop

Inputs	Cost (US$)[1)]	% met by land user
Labour (1.5 hr/day every alternate day → 15 days))	30	100%
TOTAL	**30**	**100%**

[1)] Exchange rate US$1 = NRs 67 in January 2007

Assessment

Acceptance/adoption

Drip irrigation was introduced to Latikoili VDC in particular and other VDCs of Surkhet district, western Nepal in recent years by Smallholder Irrigation and Market Initiatives (SIMI) Nepal, a project supported by USAID. A number of farmers have taken up drip irrigation sets for commercial vegetable production. Iman Singh Basnet bought his set himself and started applying urine through drip irrigation in 2005. In 2006/07 he grew his second crop in this way. Other local farmers started to use the same technology in 2006. Their experiences still need to be documented.

Drivers for adoption

- local resource
- reduced need for costly mineral fertilisers
- reduced water requirement
- positive impact on crop productivity
- pest control

Constraints to adoption

- inadequate amount of urine
- increased labour requirement due to increased blockage of holes in the drip irrigation system
- high initial establishment cost
- exact quantity of nitrogen cannot be measured
- needs correct dilution with irrigation water

Benefits/costs according to land users

The high cost of mineral fertiliser and the high price that bitter gourd fetches means that the establishment costs are soon recovered. In the long-term, a major reduction in fertiliser costs and improved income leads to increased benefits.

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

Impacts of the technology*

Production and socioeconomic benefits

+ + + Reduced expenses for agrochemicals (fertilisers, pesticides)
+ + + Increased yield
+ + Allows organic production of high value crops

Production and socioeconomic disadvantages

- - - High establishment costs

Socio-cultural benefits

+ Social prestige as a progressive farmer

Socio-cultural disadvantages

- Requires handling of dung and urine

Ecological benefits

+ + + Reduced application of agrochemicals (fertilisers, pesticides), reduced eutrophication, nitrification of water bodies due to uncontrolled outflow of urine

Ecological disadvantages

none

Off-site benefit

+ + Reduced dependence on costly external inputs
+ + Reduced influx of nutrients into water bodies

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
Urine as a liquid manure is applied at the same time as irrigation (fertigation) ➔ The link between urine application and drip irrigation or other forms of small scale irrigation needs to be promoted	The initial establishment costs for a drip irrigation set may hinder adoption ➔ Prepare a business plan and calculate the cost-benefit to convince farmers of the technology's benefits
The on-farm use of collected urine reduced the need for mineral fertiliser thereby reducing cash expenditure and outside dependency ➔ Further promote the technology to increase this impact	Lack of availability of urine may inhibit the commercial application of urine with drip irrigation ➔Urine needs to be established as a tradeable good produced by livestock farmers and bought by vegetable farmers to apply to their crops
Human urine can also be used, but needs to be fermented longer and may be socially less acceptable ➔Further promote the use of urine and show that there is no problem with using human urine	

Key reference(s): none

Contact person(s): Director, Soil Management Directorate, Department of Agriculture, Harihar Bhawan, Lalitpur, +977 1 5520314 or
Team Leader, Sustainable Soil Management Programme (SSMP), GPO Box 688, Kathmandu/Nepal, +977 1 5543591 ssmp@helvetas.org.np