Left: Polypit with a bamboo frame (Sanjeev Bhuchar)
Right: Vegetable seedlings in the polypit (Madhav Dhakal)

Polypit nursery

Nepal: प्लास्तिक खाल्टे नर्सरी

A simple, inexpensive and practical method for raising healthy plant seedlings

During the winter in Nepal's middle mountains, the soil temperature generally remains at 5-10^{0}C above the ambient air temperature. This principle was used to design a simple, inexpensive, and effective nursery technology for raising vegetable and horticulture seedlings in colder regions. The polypit technology allows seedlings to be raised by protecting them from the freezing temperatures that occur mostly at night.

Polypits are about 1m deep pits dug into the ground and covered with semi-transparent polythene sheets, preferably UV stabilised and supported on bamboo frames. A 30 cm high mud wall is built across the slope on the upper side of the pit. The polythene sheet is sealed on the upper side of the pit, leaving three sides unsealed but held down with stones that can be lifted to access the pit. The base and sides of the polypit are left as they are with no form of plastering.

The polythene sheet covering the pit reduces the photosynthetic photon flux (PPF) by around 30% inside the pit, still allowing sufficient sunlight to reach the plants inside. The polythene is usually removed during the day from 11 am to 4 pm to allow full sunlight to reach the plants except on rainy and very cold days. A modified version of these polypits – only 70 cm deep – were used in the Jhikhu Khola watershed to grow vegetable seedlings during the winter. The pits can be made of any reasonable size depending on the number of seedlings to be grown and the layout of the land. The Jhikhu Khola pits were about 3m long, 1.5m wide, and 0.7m deep.

Since the polypits are closed at night, the CO_2 released by the plants and soil microbes accumulates and increases to well above levels outside the pit. In a completely sealed polypit, the CO_2 concentration could reach up to 3000 ppm during the night which would be harmful for plants. Thus the polythene cover is only loosely sealed along the edges at night to regulate and maintain the concentration of CO_2 at about two to four times the ambient concentration.

The warmer protected conditions and CO_2 enrichment leads to extra growth and biomass gain for plants grown inside the pits during the winter. This technology is easy to maintain with the only maintenance costs being to repair damaged polythene sheets and frames.

WOCAT database reference: QT NEP19
Location: Panchkhal VDC of the Jhikhu Khola watershed, Kabhrepalanchok district, Nepal
Technology area: <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

General comments: The polypit technology is useful for mountain farmers where water scarcity and low temperatures limit the potential to raise quality seedlings. The technology is being promoted in the northwest Indian state of Uttarakhand, although only a few farmers have adopted it so far. It is a very promising technology and its use should be encouraged by hill farmers and research and development organisations engaged in raising seedlings. The technology needs more participatory action research to improve it and to encourage more farmers to adopt it spontaneously.

The technology was documented using the WOCAT (www.wocat.org) tool.
ICIMOD
Swiss Agency for Development and Cooperation SDC
WOCAT

Classification

Land use problems

Production is limited due to insufficient water during winter and the pre-monsoon season (from Nov-May); insufficient farm income due to small landholdings; increased inputs of chemical fertilisers.

Land use

Annual crops: maize, rice and vegetables

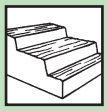
Climate

Humid subtropical

Degradation

Physical: excess harvesting of available water resources reduced

SWC measures



Structural: pit

Technical function/impact

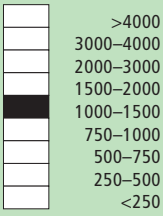
Main: - protecting seedlings from frost
- reduction of water loss
- carbon dioxide enrichment

Secondary: - none

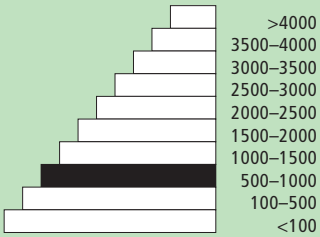
Environment

Natural environment

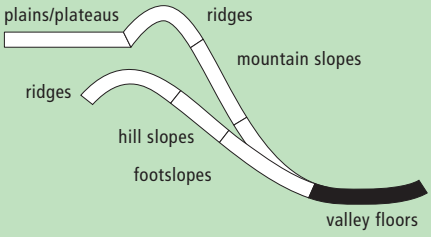
Average annual rainfall (mm)



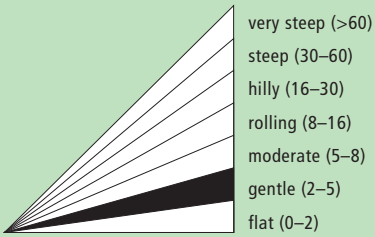
Altitude (masl)



Landform

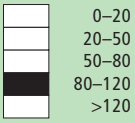


Slope (%)



Applied

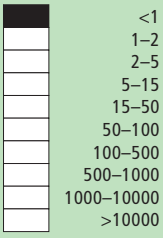
Soil depth (cm)



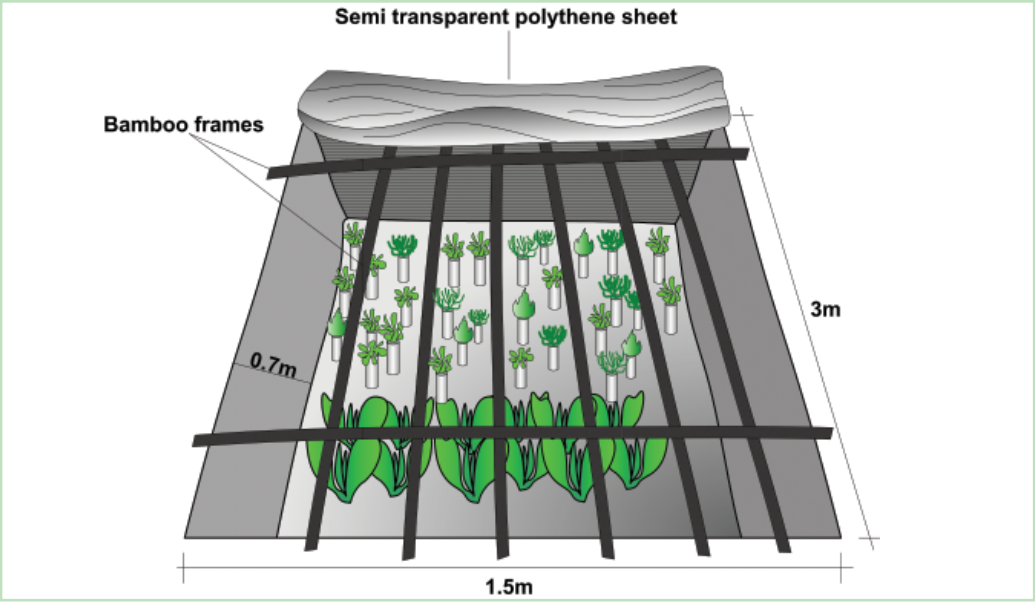
Growing season: 150 days (June to October) and 120 days (November to February)
Soil fertility: medium
Soil texture: fine to medium
Surface stoniness: no loose stones
Topsoil organic matter: medium
Soil drainage: medium
Soil erodibility: low

Human environment

Crop land per household (ha)



Land use rights: individual
Land ownership: individually owned/titled
Market orientation: mixed (subsistence and commercial)
Level of technical knowledge required: field staff/extension worker: low, land user: low
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
Polypit covered with semi transparent plastic sheet which is supported on a bamboo frame.

Implementation activities, inputs and costs

Establishment activities

Establishment activities are generally performed at the beginning of the winter season. All the activities are carried out manually using local agricultural tools including a wooden/iron peg spade, shovel knife, and saw. The major steps are as follows.

1. Determine the appropriate size (length, width and depth) of the pit
2. Mark the area for soil excavation
3. Excavate soil from the marked area
4. Make a mud wall (~30 cm high) from the ground, sloping on two sides
5. Make a bamboo frame of an appropriate size
6. Lay the frame over the pit with one end resting on the mud wall
7. Lay the plastic sheet over the frame
8. Seal the polythene sheet on the higher side of the mud wall and leave three sides unsealed
9. Lay the other three sides of the polythene sheet normally at ground level and weigh down with stones that can be removed to access the pit.

The base and sides of the polypit do not need any form of plastering (even with mud).

Establishment inputs and costs per unit system (2006)

Inputs	Cost (US$)	% met by land user
Labour (1 person day)	2.1	100%
Materials		
- plastic (2kg)	4	0%
- bamboo	1.3	100%
- rope	0.2	100%
TOTAL	**7.6**	**47%**

Maintenance/recurrent activities

The polythene cover is opened to acclimatise the plants to the outside environment from 11 am to 4 pm every day.

The main maintenance involves cleaning the pit and replacing the frame and polythene sheet if it gets damaged.

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

Inputs	Cost (US$)	% met by land user
Labour (1 person day)	2.1	100%
TOTAL	**2.1**	**100%**

Remarks: Exchange rate US$1 = NRs 73 in 2006

Assessment

Acceptance/adoption

This technology was tested in the Jhikhu Khola in two places for demonstration purposes. There were not enough dissemination and awareness raising activities to inform farmers of the benefits of the technology and convince them to use it.

Drivers for adoption

- Helps farmers raise better quality seedlings in less time
- The technology is useful for raising seedlings where the winters are cold
- The technology helps save water and leads to better acclimatisation of seedlings

Constraints to adoption

- Farmers have only limited knowledge of the benefits of the technology

Benefits/costs according to land users

The investment costs can be recouped within one season leading to positive results due to higher production.

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

+ + + Farm income increased by 46% due to 1) the higher number of seedlings surviving in polypits (93%) compared to open nursery beds (50%) and 2) the seedlings being ready 15 days earlier compared to open nursery beds

Production and socioeconomic disadvantages

- Hindered farm operations

Socio-cultural benefits

+ + Improved knowledge of soil and water conservation and erosion: and about polypits and their advantages

Socio-cultural disadvantages

none

Ecological benefits

+ + Increased soil moisture because of high relative humidity maintained inside the pits

Ecological disadvantages

none

Other benefit

+ + + Protects seedlings against frost

+ + Increased quality of seedlings, customers prefer to buy seedlings grown in polypits compared to those grown outside

Other 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
Polypits are a simple, inexpensive, practical and effective technique for raising and protecting plant seedlings from severe winter temperatures. They can be called 'poor farmers greenhouses' → More dissemination and awareness raising activities are needed to inform more farmers about the benefits of this technology	In completely sealed polypits, the CO_2 concentration can become so high during the night that it harms the plants → Only loosely seal the sheet at night to regulate and maintain the CO_2 concentration
The high relative humidity in polypits means that watering only needs to be carried out once or twice a month in comparison to five to six times for open nursery beds, thus saving labour and water → Every aspect of the technology should be highlighted through experience sharing programmes	In the demonstration, the bamboo frame to hold the sheet was too heavy making it difficult for the farmer to remove the frame and work inside → Use a modified frame with a space built in to allow a person to enter the pit easily without having to remove the frame
The more conducive physical conditions and CO_2 enrichment in the pits during the winter months are reflected in the extra growth and biomass gain of plants grown inside the pits →As above	
The survival rate for vegetable seedlings is higher and seedlings mature about two weeks earlier than if grown outside where they take about one month to be ready, leading to additional income for farmers → As above	

Key reference(s): Bhuchar, S. (2004) *Polypit: a Green-chamber for Poor Farmers,* an article prepared for PARDYP Quarterly e-Newsletter-8, ICIMOD, Kathmandu ■ Palni, L.M.S.; Bhuchar, S.; Kothyari, B.P. (1994) 'A Simple Polypit can Greatly Reduce Nursery Time of Tree Seedlings". In *Journal of HIMA-PARYAVARAN,* 6(2):10-11 ■ Vyas, P.; Bisht, M.S.; Bhuchar, S.; Sharma, S.; Palni, L.M.S. (1999) 'Polypit: An Improved Technique for Raising Nursery Plants'. In *Journal of Sustainable Forestry,* 8(1): 43-59

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