**Left:** This open-sided polyhouse is constructed using local materials; it is a low cost solution used to grow tomatoes during the rainy season. (SSMP)
**Right:** Harvesting off-season tomatoes from a polyhouse. (SSMP)

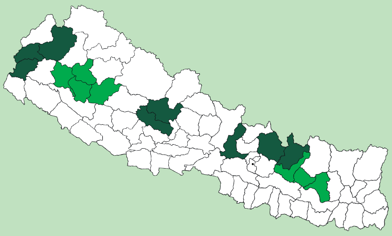
# A low-cost polyhouse for tomato production in the rainy season

**Nepal:** सस्तो प्लाष्टिक घरमा वर्षे गोलभेडा खेति

**Smallholder farmers can use polyhouses to produce high demand vegetables, such as tomatoes, and can earn a substantial income from even a relatively small plot of land in a short time.**

During the wet season (June–October), the monsoon rains severely limit the type of crops that can be grown in open fields and they also restrict the production of seedlings. Low-cost polyhouses can be used to protect crops from excessive rainfall and can provide a sheltered environment for the production of better quality crops over the rainy season cropping period. For example, smallholder farmers who produce high demand vegetables such as tomatoes can earn as much as USD 350–500 from a plot of land which measures only 100 m$^2$ in area over the short time period from June to November. This is much more than they can earn by growing any traditional crop by conventional methods. The Sustainable Soil Management Programme (SSMP) is promoting this technology in several mid-hill districts of Nepal.

Polyhouses should be situated in well-drained areas where sunshine is abundant and there is no shade throughout the cropping period. The bamboo frame can be constructed earlier in the year but the plastic roofing is not added until after one or two rainfall events. The height of the polyhouse frame varies depending on the altitude. At higher elevations, the polyhouses are lower to help trap more heat and moisture, whereas at lower elevations the polyhouses are higher to allow more air to circulate and moisture to evaporate. The preparations, which take place mid-May to early June, consist of fertilizing the soil and planting the tomato seedlings. Throughout the growing season the tomato plants are staked, trained, and pruned and a top dressing of fertilizer is added to produce a higher quality product.



**WOCAT database reference:** QT NEP 31
**Location:** Nepal mid-hills
**Technology area:** Sustainable Soil Management Programme (SSMP) implements its programmes in several mid-hill districts of Nepal. The map above shows districts where they have worked in the past (dark green) and where they worked in 2011 (light green).
**Conservation measure(s):** Agronomic
**Land Use:** Annual cropping (rainfed)
**Stage of intervention:** Prevention of land degradation
**Origin:** Introduced through projects
**Climate:** Humid/subtropical
**Related approach:** Farmer-to-farmer diffusion (QA NEP 1) and Farmer-led experimentation (QA NEP 3)
**Compiled by:** Bishnu Kumar Bishwakarma, SSMP and Helvetas Nepal
**Date:** April 2011, updated March 2013

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

ICIMOD HELVETAS Swiss Intercooperation NEPAL WOCAT

## Classification

### Land use problems

In the mid-hills of Nepal, the arable land of most farm households has been divided into very small plots. If this land is used to produce traditional crops such as maize, wheat, and millet using conventional farming methods, it cannot provide full employment for all of the householders and cannot yield sufficient cash income for the household. The risk of intense rainfall during the monsoon season, which can damage crops, has prevented these farmers from switching to more lucrative high value crops.

**Land use**

Annual crops; maize, wheat, vegetables

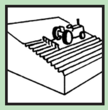
**Climate**

Humid/ subtropical

**Degradation**

Land and crops can be damaged by heavy rainfall events during monsoon

**Conservation measures**



Agronomic: introduction of a new crop

**Stage of intervention**

- Prevention
- Mitigation/reduction
- Rehabilitation

**Origin**

- Land users' initiative
- Experiments/research
- Externally introduced: project
- Other (specify)

**Level of technical knowledge**

- Low
- Medium: land users
- High

**Main causes of land degradation:** During the summer monsoon (June-October), continuous or heavy rainfall can damage seedlings and erode the land; it is difficult to establish crops during this time.

**Technical function/impact**

**Main:**
- Increases productivity
- Introduces a high value crop

**Secondary:**
- Improves nutrition

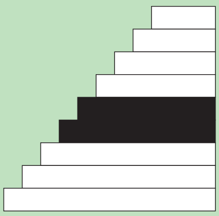
## Environment

### Natural environment

**Average annual rainfall (mm)**

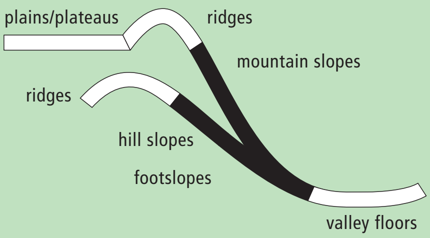
- >4000
- 3000–4000
- 2000–3000
- 1500–2000
- 1000–1500
- 750–1000
- 500–750
- 250–500
- <250

**Altitude (masl)**

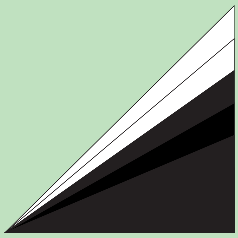


- >4000
- 3000–4000
- 2500–3000
- 2000–2500
- 1500–2000
- 1000–1500
- 500–1000
- 100–500
- <100

**Landform**




**Slope (%)**



- very steep (>60)
- steep (30–60)
- hilly (16–30)
- rolling (8–16)
- moderate (5–8)
- gentle (2–5)
- flat (0–2)

**Soil depth (cm)**

- 0–20
- 20–50
- 50–80
- 80–120
- >20

**Growing season(s):** one (May to November)
**Soil texture:** medium
**Soil fertility:** medium to high
**Topsoil organic matter:** medium to high
**Soil water storage capacity:** medium to good
**Tolerant of climatic extremes:** heavy rainfall

**Sensitive to climatic extremes:** high temperatures and high relative humidity
**If sensitive, what modifications were made/ are possible:** optimize the plant density; train and prune plants often to avoid overcrowding; modify the structure to provide more ventilation (ventilated polyhouse) in especially hot areas

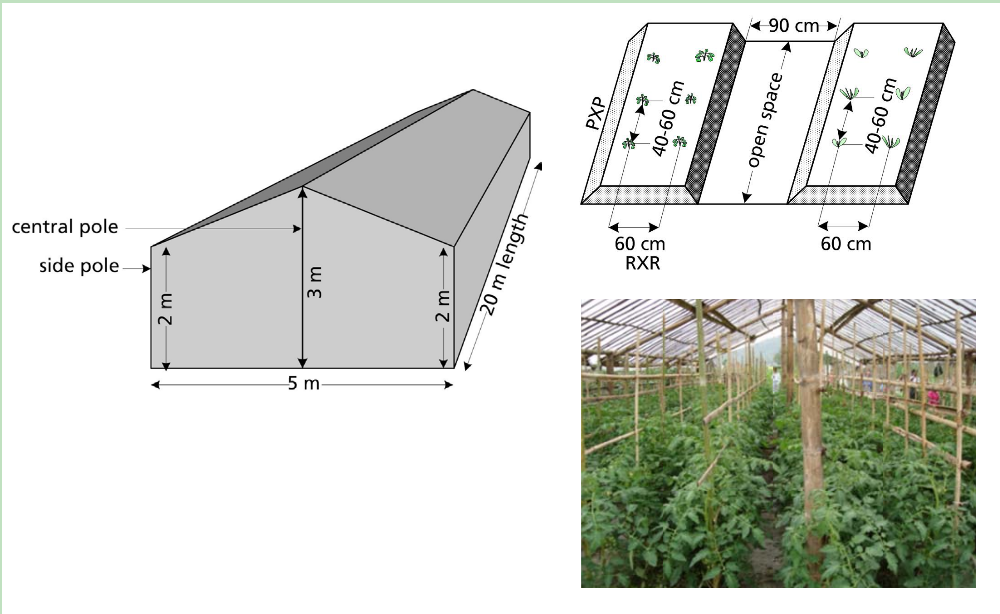
### Human environment

**Crop land per household (ha)**

- <0.5
- 0.5–1
- 1–2
- 2–5
- 5–15
- 15–50
- 50–100
- 100–500
- 500–1000
- 1000–10000
- >10000

**Land user:** individual, leased
**Land ownership:** individually owned, titled and not titled
**Land/water use rights:** individual (land) and communal (organized)
**Importance of off-farm income:** in most farm households, off-farm income plays only a minor role. Occasional opportunities for off-farm income present themselves in the form of daily wage labour. Some households receive remittances from family members working abroad.

**Market orientation:** commercial
**Mechanization:** manual and animal traction




**Technical drawing**
**Left:** Sketch of a polyhouse. The optimum length is 20 m and the width 5 m. The height of the central and side poles varies depending on the elevation. Note that there should be a space of at least 1 m between polyhouses.

**Right top:** Cross sectional view of a planting bed showing row-to-row (RXR) and plant-to-plant (PXP) distances. Note that there should be a space of at least 90 cm between beds.

**Right bottom:** Inside the polyhouse, the tomatoes can be staked using bamboo poles; the plants are trained along these trellises.
(AK Thaku)

## Implementation activities, inputs and costs

### Establishment activities

1. Construction of the polyhouse using bamboo poles, wooden posts, clear plastic sheet, nails, and rope.
2. How long it takes to construct the polyhouse and plant the crops depends on how much labour is available. Depending on their level of expertise, four to five people can construct the structure in one day; and two people can complete the soil preparation and planting in one day.

**Technical guidelines for erecting a polyhouse**

The optimum length of a polyhouse is 20 m, and the width is 5 m; 400–500 gauge plastic sheeting is used. The height of the polyhouse depends on the elevation: at 1200–1600 masl, the optimum height of the central pole is 3 m and the side poles are 2 m high; at 1600–2000 masl, the central pole is 2.5 m high and the side poles are 1.6 m high. There should be an open space of at least 1 m between polyhouses.

**Technical guidelines for preparing the soil and planting tomatoes**

Per plant, at least 3–4 kg of well-decomposed farmyard manure and compost are worked into the soil. Before transplanting the seedlings, the soil around each is dressed with 10 g of DAP (diammonium phosphate) and 6 g of MoP (muriate of potash). The seedlings are transplanted when they are 20–25 days old. In an open row system, the suggested row to row (RxR) spacing is 90 cm and the suggested plant to plant (PxP) spacing is 60 cm; in a closed row system the row to row and plant to plant spacing can both be 60 cm.

At least two top dressings of DAP and MoP (10:10 g) are necessary 20–25 and 40–45 days after transplanting; 1 kg per 0.05 ha of borax is also added at the time of the first top dressing. Alternatively, these two top dressings can be substituted by a mixture of cattle urine (50 ml) and water (200 ml water) per plant. The dressing with this mixture can begin 20–25 days after transplanting, and is repeated every 10–12 days.

### Establishment inputs and costs per poly house

| Inputs | Cost (USD) | % met by land user |
|---|---|---|
| Labour | | |
| – construction of polyhouse (5 person days) | 15–20 | 100% |
| – planting, training, pruning, staking | 15–20 | 100% |
| Materials | | |
| – Bamboo or /wooden poles, plastic sheeting, rope, nails, seeds, poles for staking | 80–90 | 35% |
| Agricultural | | |
| – Seeds, fertilizers, crop protection | 7–10 | 50% |
| **TOTAL** | **117–140** | **71%** |

### Maintenance/recurrent activities

There are no major maintenance costs during the cropping season; but occasionally some minor maintenance is required (e.g., replacing damaged stakes and plastic sheet, or securing with additional rope and nails).

### Maintenance/recurrent inputs and costs per poly house per year

| Inputs | Cost (USD) | % met by land user |
|---|---|---|
| Labour (1 person day) | 5 | 100% |
| Equipment | 5 | 100% |
| Materials | 10 | 100% |
| Agricultural | 5 | 100% |
| **TOTAL** | **25** | **100%** |

**Remarks:**

- All costs and amounts are rough estimates by the technicians and authors. Exchange rate USD 1 = NPR 71 in April 2011

## Assessment

### Impacts of the technology

**Production and socioeconomic benefits**
- +++ Reduced risk of crop failure
- +++ Increased on-farm income
- ++ Diversification of income sources
- ++ Increased crop diversification

**Production and socioeconomic disadvantages**
- −− Set-up cost is high
- −− Labour intensive
- −− Some technical know-how is needed

**Socio-cultural benefits**
- +++ Improved situation of socially and economically disadvantaged groups
- +++ Improved food security and reduced need for either seasonal migration or outside help

**Socio-cultural disadvantages**
none

**Ecological benefits**
- +++ Reduced danger of crops being affected by hazards and extreme events (heavy rainfall, drought)
- + Reduced soil loss

**Ecological disadvantages**
- − Can be susceptible to some fungal diseases

**Off-site benefit**
- ++ Areas downstream benefit from soil retention

**Off-site disadvantages**
- −− Carelessly discarded plastic sheeting can be an environmental nuisance

**Contribution to human wellbeing/livelihood**
- +++ This technology provides employment and income opportunities to smallholder farmers; improved economic situation leads to overall livelihood improvement

### Benefits/costs according to the land user

| Benefits compared with costs | short-term | long-term |
|---|---|---|
| Establishment | positive | positive |
| Maintenance/recurrent | positive | positive |

**Acceptance/adoption:**
Although the technology is only moderately expensive to implement and provides a higher rate of return than traditional crops, smallholder farmers often need technical support and encouragement to get started. This support can be in the form of improved seed varieties and plastic sheeting for the polyhouse.

**Driver for adoption:**
- relatively simple technology
- higher economic return
- provides on-farm employment

**Constraints**
- smallholder farmers and poorer households need initial support to establish the polyhouse
- farmers need technical support
- farmers need practical information and technical backstopping

## Concluding statements

| **Strengths** and ➔how to sustain/improve | **Weaknesses** and ➔how to overcome |
|---|---|
| Cost effective in terms of output as compared to traditional crops ➔ Identify other cash crops that can also provide improved income opportunities | Need to provide training and technical know-how and need on-farm research to identify alternative cash crops ➔ Farmer-to-famer extension can help to identify other crops |
| This technology can be integrated to make maximum use of farm niches; it is especially beneficial for smallholder farmers ➔ Provide training on the construction of polyhouses to experienced lead farmers so that they can provide technical support to others. | Vulnerable to diseases and pests ➔ Adjust planting time to local conditions; build the polyhouses in appropriate locations; plant resistant varieties; modify the structure to improve air circulation; prune and train plants throughout the cropping season; improve staking techniques; rotate crops or move polyhouse every three years |
| It mostly uses local materials ➔ Ensure bamboo poles are available on the farm; encourage the use of silpaulin which is more durable than polyethylene | Some initial set-up cost ➔ Silpaulin can be purchased at lower cost when farmers' groups buy in bulk. |
| Uses local expertise, farmer knowledge, and practices ➔ Farmers can make the most of their investment by linking with markets and by providing support for value chain development. | |

**Key reference(s):** SSMP (2010) *Construction of polyhouse and rainy season tomato cultivation inside polyhouse* (in Nepali). Kathmandu, Nepal: Sustainable Soil Management Programme, Helvetas Nepal
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