Terraces with improved seed and fertilizer application (Afghanistan)

Terraces are established on mountain slopes used mainly for cropping wheat, with the purpose of soil protection from erosion, preserving runoff, sediments and nutrients on-site. Improved seeds and fertilizer are applied on the terraces for increasing crop yield, but also vegetation cover and biomass production, and thus prevent further land degradation.

Project supported implementation of terraces with application of improved seeds and fertilizer has taken place in the villages Sari Joy, Jawaz Khana and Dashti Mirzai, located in Chokar watershed of Rustaq District in Northern Afghanistan. The Chokar watershed is a mountainous area situated between 600 - 2,500 m above sea level. The climate is semi-arid with harsh and cold weather in winter and hot and dry summers. The annual precipitation in average years is 580mm. Land degradation affects all forms of land use and includes low vegetation cover, heavy top soil erosion from water, and poor soil fertility. Unsustainable agricultural practices, over-exploitation and high pressure on the natural resources are adversely impacting on the socio-economic well-being of local communities as well as contributing to the risk for being adversely affected by drought as well as landslides and flash floods triggered by heavy rainfall.

The data used for the documentation of the technology is based on field research conducted in Chokar watershed, namely in the villages: Sari Joy, Jawaz Khana and Dashti Mirzai. These villages represent the upper, the middle and the lower zone of Chokar watershed, respectively. They differ considerably in access to services and infrastructure, but in general are poorly served. The communities depend mainly on land resources for sustaining their livelihoods. In a good year with high yields, wheat-self-sufficiency lasts about 5 months.

Since 2012 the Livelihood Improvement Project Takhar (LIPT) implemented by Terre des hommes (TdH) Switzerland has initiated a range of NRM interventions. The project introduced terraces as sustainable land management practices on private plots, situated on rolling (11-15%) and hilly (16-30%) slopes to protect the land from soil erosion and prevent the loss of water and fertile topsoil, seeds and fertilizers. The average plot size for terrace implementation is 2 Jerib (0.4 hectares) with contour strips of 40m x 4m. The height of the risers is 1m-1.5 m. Terrace benches are built along the contour by moving the soil above the bench downwards. The levelled benches of the terrace are cultivated with wheat. The risers of the terrace are mostly used for growing fodder crops, mostly alfalfa, which also helps to stabilize the terrace. If medicinal herbs (ferula) are included they are cultivated along the bench contours.

Maintenance activities include small repair work on the riser by adding some amount of soil and re-sowing of alfalfa seeds on those spots. The terraces allow application of improved seeds and fertilizers without them being washed off. The land-users report noticeable increase of wheat yield from the terraced plot with application of improved seeds and fertilizer compared to the non-terraced plot. An average plot of 0.2 ha on non-terraced hilly cropland used to give about 70 kg of wheat (350kg/ha). On terraces the yield has increased/doubled to 140 kg on the same plot area (700kg/ha). The expectations regarding terraces remain high as over the time the land user hope their land will become more stable and improved soil moisture and fertility will have positive impact on the productivity as well. However, so far no cost-benefit assessment has been conducted allowing attribution of individual measure to the wheat increase.

Many land users are interested in the terrace technology due to a number of environmental and economic benefits expected, however the costs for building the terrace are considered high by an average local land user. They have to rely on external support in order to have sufficient resources for implementation. Women considered an advantage that during the establishment phase, men were paid by the project to work on their own land (or other villagers land) when building the terraces. Thus, there was no need for men to go for seasonal labour migration and they stayed at home.

Terraced plot in Sari Joy (Mia Jan Maroofi)

Terraces with improved seed and fertilizer application (Afghanistan)

Palbandi bo tukhmihoi behbudyofta va kud

DESCRIPTION

Terraces are established on mountain slopes used mainly for cropping wheat, with the purpose of soil protection from erosion, preserving runoff, sediments and nutrients on-site. Improved seeds and fertilizer are applied on the terraces for increasing crop yield, but also vegetation cover and biomass production, and thus prevent further land degradation.

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Establishment works on the terraces in Sari Joy village (Mia Jan Maroofi)

Completed terraces in Sari Joy Village (Mia Jan Maroofi)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose
- ✓ improve production
- ✓ reduce, prevent, restore land degradation
- ✓ protect a watershed/ downstream areas – in combination with other Technologies
- ✓ preserve/improve biodiversity
- ✓ reduce risk of disasters
- ✓ adapt to climate change/ extremes and its impacts
- ✓ mitigate climate change and its impacts
- ✓ create beneficial economic impact
- ✓ create beneficial social impact

Land use
- Cropland
  - ✓ Annual cropping
  - Perennial (non-woody) cropping
  - Number of growing seasons per year: 1

Water supply
- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation
- ✓ prevent land degradation
- ✓ reduce land degradation
- ✓ restore/ rehabilitate severely degraded land
- ✓ not applicable

Degradation addressed
- soil erosion by water - Wt: loss of topsoil/ surface erosion, Wg: gully erosion/ gullyng, Wo: offsite degradation effects
- physical soil deterioration - Pi: soil sealing
- biological degradation - Bc: reduction of vegetation cover, Bq: quantity/ biomass decline
- water degradation -

SLM group
- ✓ cross-slope measure

SLM measures
- ✓ agronomic measures - A2: Organic matter/ soil fertility
- ✓ vegetative measures - V2: Grasses and perennial herbaceous plants
- ✓ structural measures - S1: Terraces

TECHNICAL DRAWING

Terraces are established predominantly on a privately owned land in a mountainous landscape with varying steepness of slopes.

The average size of a plot is 2 Jerib, which is equal to 0.4 ha. The design of the terrace depends on the steepness of the slope. Mostly rolling (11-15%) and hilly (16-30%) slopes are used for building terraces.

Using an A-frame, the terrace is designed by dividing the slope into contour strips. Depending on the slope steepness, the terrace bench is around 4m wide and the height of the risers is 1m-1.5 m. The terrace benches are built along the contour by moving the soil of upper bench to the lower bench. The leveled benches of the terrace are cultivated with wheat. The risers of the terrace are mostly used for growing fodder crops, such as alfalfa, which also helps to stabilize the terrace. If medicinal herbs are included, such as ferula, they are cultivated along the bench contours.

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: 1 ha)

Most important factors affecting the costs
- Due to the remoteness of the villages where the Technology has
Establishment activities

1. Selection of the area for establishing a terrace (Men) (Timing/ frequency: Autumn)
2. Designing of the terrace using A-frame, assisted by trained technician/project staff (Men) (Timing/ frequency: End of autumn after rainy days)
3. Leveling the soil with a shovel (Men) (Timing/ frequency: Autumn/Winter)
4. Sowing of alfalfa seeds on the risers (Men/women) (Timing/ frequency: After 20 days of sowing wheat)
5. Sowing of wheat seeds on benches (Men/Women) (Timing/ frequency: Winter/ Spring)
6. Sowing of ferula along the contours (Men/women) (Timing/ frequency: Winter/ Spring)

Establishment inputs and costs (per 1 ha)

<table>
<thead>
<tr>
<th>Specify input</th>
<th>Unit</th>
<th>Quantity</th>
<th>Costs per Unit (USD)</th>
<th>Total costs per input (USD)</th>
<th>% of costs borne by land users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>person-day</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Designing the terrace using A-frame</td>
<td></td>
<td></td>
<td>10.0</td>
<td>90.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Leveling the soil with a shovel</td>
<td>person-day</td>
<td></td>
<td>150.0</td>
<td>795.0</td>
<td>51.0</td>
</tr>
<tr>
<td>Sowing of wheat and alfalfa seeds</td>
<td>person-day</td>
<td></td>
<td>10.0</td>
<td>53.0</td>
<td>51.0</td>
</tr>
<tr>
<td>Sowing of ferula</td>
<td>person-day</td>
<td></td>
<td>2.0</td>
<td>10.6</td>
<td>100.0</td>
</tr>
<tr>
<td>Equipment</td>
<td>pcs</td>
<td></td>
<td>1.0</td>
<td>3.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Pick axe</td>
<td></td>
<td></td>
<td>1.0</td>
<td>3.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Pitchfork</td>
<td>pcs</td>
<td></td>
<td>1.0</td>
<td>3.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Wheel barrow</td>
<td>pcs</td>
<td></td>
<td>1.0</td>
<td>3.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Shovel</td>
<td>pcs</td>
<td></td>
<td>1.0</td>
<td>3.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Hoe</td>
<td>pcs</td>
<td></td>
<td>1.0</td>
<td>3.0</td>
<td>100.0</td>
</tr>
<tr>
<td>A-frame</td>
<td>pcs</td>
<td></td>
<td>1.0</td>
<td>3.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Plant material</td>
<td>pcs</td>
<td></td>
<td>1.0</td>
<td>3.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Wheat seeds</td>
<td>kg</td>
<td></td>
<td>140.0</td>
<td>112.5</td>
<td>80.0</td>
</tr>
<tr>
<td>Alfalfa seeds</td>
<td>kg</td>
<td></td>
<td>17.5</td>
<td>26.5</td>
<td>100.0</td>
</tr>
<tr>
<td>Ferula seeds</td>
<td>kg</td>
<td></td>
<td>2.5</td>
<td>6.35</td>
<td>100.0</td>
</tr>
<tr>
<td>Fertilizers and biocides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAP</td>
<td>kg</td>
<td></td>
<td>125.0</td>
<td>112.5</td>
<td>80.0</td>
</tr>
<tr>
<td>Urea</td>
<td>kg</td>
<td></td>
<td>125.0</td>
<td>56.25</td>
<td>45.0</td>
</tr>
<tr>
<td>Herbicide</td>
<td>liter</td>
<td></td>
<td>50.0</td>
<td>12.5</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Establishment costs in USD: **1,275.48**

Total costs for establishment of the Technology in USD: **19.04**

Maintenance activities

1. Ploughing the land with animal traction (Men) (Timing/ frequency: Winter/ Spring/Annually)
2. Sowing of wheat seeds on benches (Men/Women) (Timing/ frequency: Winter/ Spring/Annually)
3. Application of fertilizer (Men/Women) (Timing/ frequency: Fall)
4. Weeding (Women) (Timing/ frequency: Summer)
5. Harvesting wheat (Men and women together) (Timing/ frequency: Summer/Fall)
6. Harvesting alfalfa (Men and women together) (Timing/ frequency: Summer/Fall)
7. Collecting and delivering harvested wheat (Men and women) (Timing/ frequency: Fall)
8. Collecting and delivering harvested alfalfa (Men and women) (Timing/ frequency: Fall)
9. Repairing terrace risers with a shovel (Men) (Timing/ frequency: Winter/ Spring/After heavy rain or snow)
10. Sowing alfalfa seeds on the repaired area (Men/Women) (Timing/ frequency: Winter/ Spring/When required)

Maintenance inputs and costs (per 1 ha)

<table>
<thead>
<tr>
<th>Specify input</th>
<th>Unit</th>
<th>Quantity</th>
<th>Costs per Unit (USD)</th>
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<td>person-day</td>
<td></td>
<td>2.5</td>
<td>13.25</td>
<td>100.0</td>
</tr>
<tr>
<td>Sowing of wheat seeds on benches</td>
<td>person-day</td>
<td></td>
<td>5.0</td>
<td>26.5</td>
<td>100.0</td>
</tr>
<tr>
<td>Weeding and fertilizer application</td>
<td>person-day</td>
<td></td>
<td>5.0</td>
<td>26.5</td>
<td>100.0</td>
</tr>
<tr>
<td>Harvesting and delivering wheat and alfalfa</td>
<td>person-day</td>
<td></td>
<td>7.0</td>
<td>37.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Equipment</td>
<td>pcs</td>
<td></td>
<td>1.0</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Plant material</td>
<td>pcs</td>
<td></td>
<td>1.0</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Wheat seeds</td>
<td>kg</td>
<td></td>
<td>140.0</td>
<td>58.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Fertilizers and biocides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAP</td>
<td>kg</td>
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<td>125.0</td>
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<td></td>
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<td>liter</td>
<td></td>
<td>50.0</td>
<td>12.5</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Maintenance costs in USD: **677.3**

Total costs for maintenance of the Technology in USD: **10.11**

**NATURAL ENVIRONMENT**

**Average annual rainfall**
- 501-750 mm
- 751-1,000 mm
- 1,001-1,500 mm
- 1,501-2,000 mm
- 2,001-3,000 mm
- 3,001-4,000 mm
- > 4,000 mm

**Agro-climatic zone**
- Humid
- Sub-humid
- Semi-arid
- And

**Slope**
- Flat (0-2%)
- Gentle (2-5%)
- Moderate (6-10%)
- Rolling (11-15%)
- Hilly (16-30%)
- Steep (31-60%)
- Very steep (>60%)

**Landforms**
- Plateaus/Plains
- Ridges
- Mountain slopes
- Hill slopes
- Troughs
- Footslopes
- Valley floors

**Altitude**
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- 501-1,000 m a.s.l.
- 1,001-1,500 m a.s.l.
- 1,501-2,000 m a.s.l.
- 2,001-2,500 m a.s.l.
- 2,501-3,000 m a.s.l.
- 3,001-4,000 m a.s.l.
- > 4,000 m a.s.l.

**Technology is applied in**
- Concave situations
- Convex situations
- Not relevant

**Soil depth**
- Very shallow (0-20 cm)
- Shallow (21-50 cm)
- Medium (51-100 cm)
- Deep (>100 cm)

**Topsoil organic matter content**
- High (>3%)
- Medium (1-3%)
- Low (0-1%)

**Soil texture (topsoil)**
- Coarse/ Light sandy
- Medium (loamy, silty)
- Fine (clayey, silty, loamy)

**Terrain type**
- Flat
- Rolling
- Hilly
- Mountainous
- Plateaus/Plains

**Other environmental factors**
- Climate
- Vegetation
- Soil
- Water availability

**Specifications on climate**
- Average annual rainfall in mm: 580.0
- Average annual precipitation for the area was calculated with 580 mm, with minimums in dry years (2000 and 2001) of 270 mm and maximums in wet years (2009, 2010) of 830 mm. The absolute maximum rainfall was calculated for 1986 with 1024 mm. The data series covers the time from 1979 to 2014.

**Specifications on topography**
- The area is characterized by rolling to hilly terrain, with elevations ranging from 501-1,000 m a.s.l.

**Specifications on soil**
- The soils are predominantly loamy, silty, with high organic matter content (3-5%).

**Specifications on vegetation**
- The vegetation is characterized by a mix of grasses and shrubs, with some areas of forest.

**Specifications on water availability**
- The area has a semi-arid climate, with limited water availability, particularly during the dry season.
### Characteristics of Land Users Applying the Technology

<table>
<thead>
<tr>
<th>Market orientation</th>
<th>Off-farm income</th>
<th>Relative level of wealth</th>
<th>Level of mechanization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixing (self-supply)</td>
<td>10-50% of all income</td>
<td>Very poor</td>
<td>Manual work</td>
</tr>
<tr>
<td>Commercial</td>
<td>&gt; 50% of all income</td>
<td>Poor</td>
<td>Animal traction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sedentary or nomadic</th>
<th>Individual or groups</th>
<th>Gender</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedentary</td>
<td>Individual/household</td>
<td>Women</td>
<td>Children</td>
</tr>
<tr>
<td>Semi-nomadic</td>
<td>community cooperative</td>
<td>Men</td>
<td>Youth</td>
</tr>
<tr>
<td>Nomadic</td>
<td>employee (company, government)</td>
<td></td>
<td>Elderly</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area used per household</th>
<th>Scale</th>
<th>Land ownership</th>
<th>Land use rights</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.5 ha</td>
<td>Small-scale</td>
<td>State</td>
<td>Open access (unorganized)</td>
</tr>
<tr>
<td>0.5-1 ha</td>
<td>Medium-scale</td>
<td>Company</td>
<td>Leased</td>
</tr>
<tr>
<td>1-2 ha</td>
<td>Large-scale</td>
<td>Communal/ village group</td>
<td>Individual</td>
</tr>
<tr>
<td>2-5 ha</td>
<td></td>
<td>Individual, not titled</td>
<td>Communal (organized)</td>
</tr>
<tr>
<td>5-15 ha</td>
<td></td>
<td>Individual, titled</td>
<td>Leased</td>
</tr>
<tr>
<td>15-50 ha</td>
<td></td>
<td></td>
<td>Individual</td>
</tr>
<tr>
<td>50-100 ha</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-500 ha</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500-1,000 ha</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,000-10,000 ha</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 10,000 ha</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Impacts

#### Socio-economic impacts

| Crop production | quantity before SLM: 350 kg / ha | Alfalfa is planted on the risers. |
| Non-fodder production | Quantity after SLM: 700 kg / ha | No change in total area for production, as the risers of the terraces are used for fodder production. However, there is some reduction of area available for annual crop production. |
| Product diversity | | |
| Production area (new land under cultivation/ use) | | |

#### Socio-cultural impacts

<table>
<thead>
<tr>
<th>Food security/ self-sufficiency</th>
<th>SLM/ land degradation</th>
<th>Situation of socially and economically disadvantaged groups (gender, age, status, ethnicity etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced</td>
<td>Improved</td>
<td>worsened</td>
</tr>
</tbody>
</table>

#### Ecological impacts

<table>
<thead>
<tr>
<th>Surface runoff</th>
<th>Soil moisture</th>
<th>Soil loss</th>
<th>Vegetation cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased</td>
<td>Increased</td>
<td>Decreased</td>
<td>Increased</td>
</tr>
<tr>
<td>Decreased</td>
<td>Increased</td>
<td>Increased</td>
<td>Decreased</td>
</tr>
</tbody>
</table>

#### Off-site impacts

<table>
<thead>
<tr>
<th>Downstream flooding</th>
<th>Downstream siltation</th>
<th>Buffering/ filtering capacity (by soil, vegetation, wetlands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased</td>
<td>Increased</td>
<td>Decreased</td>
</tr>
<tr>
<td>Decreased</td>
<td>Decreased</td>
<td>Improved</td>
</tr>
</tbody>
</table>

### Cost-Benefit Analysis

**Benefits compared with establishment costs**
Benefits compared with maintenance costs

Costs: As larger parts of the establishment of the technology were covered by the project, farmers' consideration of the total costs are likely underestimated. Benefits: Two plots were terraced in 2012, and 5 plots in 2013. However, most terraces were implemented in 2014 (11 plots) and 2015 (8 plots). The Rustaq NRM study was conducted in autumn 2016. 1-2 years of cultivating the terrace system is too short a period for providing evidence on short- and long-term returns.

Climate-related extremes (disasters)

<table>
<thead>
<tr>
<th>local rainstorm</th>
<th>drought</th>
</tr>
</thead>
<tbody>
<tr>
<td>not well at all</td>
<td>very well</td>
</tr>
</tbody>
</table>

Adoption and adaptation

<table>
<thead>
<tr>
<th>Percentage of land users in the area who have adopted the Technology</th>
</tr>
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<tbody>
<tr>
<td>single cases/ experimental</td>
</tr>
<tr>
<td>11-50%</td>
</tr>
</tbody>
</table>

Of all those who have adopted the Technology, how many have done so without receiving material incentives?

<table>
<thead>
<tr>
<th>percentage of those who have adopted the Technology</th>
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<tbody>
<tr>
<td>0-10%</td>
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<tr>
<td>51-90%</td>
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</table>

Number of households and/ or area covered

10.7 ha has been terraced within the 3 study villages with LIPIT project support.

Has the Technology been modified recently to adapt to changing conditions?

Yes

No

To which changing conditions?

climate change/ extremes
changing markets
labour availability (e.g. due to migration)

Weaknesses/ disadvantages/ risks: land user's view

- The implementation costs are high and land users state that it is impossible for them to cover establishment costs on their own.
- Farmers expect the actual yield harvested from the terraces to be increased, which helps to protect the soil from erosive rains. Due to the damage, the terrace can lead to further degradation through water erosion. If not maintained properly for a longer period of time, the terrace can contribute to soil erosion.

REFERENCES

CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland
Bern University of Applied Sciences, School of Agricultural, Forest and Food Sciences (HAFL) - Switzerland
CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland
Swiss Agency for Development and Cooperation (DEZA / COSUDE / DDC / SDC) - Switzerland
Terre des Hommes (Terre des Hommes) - Switzerland

Documentation was facilitated by

Approaches: Watershed Association (WSA) and Natural Resource Management Committees (NRMC)


10.7 ha has been terraced within the 3 study villages with LIPIT project support.

Terracing provides an opportunity to decrease soil degradation and even to even to rehabilitate degraded lands. Application of improved seeds and fertilizer contribute in the establishment year to increased crop and fodder yields.

Strengths: land user's view

- Notable higher crop yields on the plots where improved seeds and fertilizer are applied on newly established terraces. Farmers have high expectations for the years to come and for yields of annual crops (such as wheat) to remain high.
- Diversity of crops planted on terraces is valued by the land users. For example, cultivating wheat and alfalfa on the terraced plot provides household with the key crop and also fodder for livestock. Thus, terraces help to contribute to family income and to maintain the economic viability of farms.
- Farmers perceive soil quality on terraced plots with fertilizer application to improve. An improvement in soil fertility (which may relate first of all to the effects of fertilizer application) and increased soil moisture have been reported. Single statements also related to effectiveness of applying fertilizer on terraced plots, here fertilizer is not washed away during rain.
- Terraced plots are considered less vulnerable to the effects of rainstorms and dry spells, than non-terraced plots on slopes where annual crops are cultivated.
- Women considered an advantage that during the establishment phase, men were paid by the project to work on their own land when building the terraces. Thus, there was no need for men to go for seasonal labour migration and they stayed at home. At the same time the terracing of the land is seen as an opportunity to improve the land resources on their families plots. An increase in women's workload related to bringing food to the field during establishment was considered to be acceptable, especially compared to the expected increase in yields.

Strengths: compiler's or other key resource person's view

- The application of fertilizer on terraces is expected to show multiple effects: yields from these fertility depleted croplands can be increased. This includes an increase in biomass production, which may be used as green manure on the field or as animal feed or as straw. Further, vegetation cover during the growing period can be increased, which helps to protect the soil from erosive rains.
- The project paid establishment of terraces on farmers' plots provided 20 days of employment per 2 jerib (0.4 ha) plot for farmers in their home villages. At the same time the terracing is a long-term investment into the land resources: Terracing provides an opportunity to decrease soil degradation and even to rehabilitate degraded lands. Application of improved seeds and fertilizer contribute in the establishment year to increased crop and fodder yields.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view

- The technology requires technical knowledge for implementation and maintenance, which is key for successful adoption, replication and upscaling. The project trained technicians to support farmers with the design of terraces. While the project aided implementation of terraces has improved the general knowledge and awareness of the land users on the benefits of SLM practices, most farmers will not be able to design terraces on their own.
- Technically correct design of the terrace presents a challenge and might not be always achieved. Forward sloping terrace benches may lead to channelled runoff and have the risk of rills and gully formation.
- There is a gap regarding the increased wheat yields, especially with regard to individual contribution of the terraces, the application of improved seeds and fertilizer, and the combined effects (role of terraces in making improved seed and fertilizer application effective). A cost benefit analysis (CBA) needs to be conducted to determine short- and long-term returns of the SLM technology. On-farm trials are necessary for assessing impacts of the different measures (agricultural, vegetative and structural measures) before- and after, as well as with- without the SLM technology.
- Terrace maintenance is crucial. If not maintained properly for a longer period of time, the damaged terrace can lead to further land degradation through channeled runoff, severe erosion and possible risks of disaster for the surrounding settlements on the slopes.
- The technology is established mainly by better-off households, which own more land than the average SLM implementer.