# Conversion of grazing land to fruit and fodder plots

## Tajikistan

### Fencing part of an overgrazed hillside, combined with terracing, manuring and supplementary irrigation for grape, fruit and grass production.

In the Varzob valley of Tajikistan, slopes of around 30% are used communally, and are heavily overgrazed. This has led to a reduction in vegetation cover, to soil compaction, and to severe sheet and rill erosion. In 1982, one innovative land user began to set up half a hectare vineyard/fruit plot with intensive grass/fodder production for cut-and-carry and also a separate section above for hay making - by his own initiative. By the application of various conservation measures, within five years an area exposed to severe water erosion was converted into an area of sustainable use. Fodder and fruits are now flourishing and the natural resources of soil and water are conserved more effectively.
The start of the process was fencing of the plot to keep out animals. Scrap metal and other materials from a machinery depot were used to build a 1.5 m high fence. To harvest and hold runoff water from the hillside for grapes and fruit trees, narrow backsloping terraces were constructed, each with a water retention ditch along the contour. During the initial phase, the terraces did not harvest enough water for establishment of the seedlings. So water for supplementary irrigation was carried to the plot by donkeys in old inner tubes from car tyres. Manure is applied to the plot to improve soil fertility. The manure is collected on the high pastures where the herders graze their animals during summer. The total amount of manure applied to the plot so far amounts to about 3 t/ha over 20 years.
The establishment of such a plot is very demanding in terms of manpower. However within 5-6 years the system becomes self-sustaining and the productivity of the land is improved several times over. Following this positive experience, other households in the area have adopted the technology spontaneously, and today about 15 ha of degraded grazing land in the Varzob valley have been converted into productive fruit gardens.
For the innovator, his most valuable fruits are grapes, followed by apricots, almonds and plums. He has also successfully grown mulberry, pomegranate and cherry trees. Not all the seedlings survive: the farmer considers a 40% survival rate of grape vines to be reasonable. The fruit harvest is mainly used for home consumption. However, in a good year the table grapes and apricots are sold on the market. The hay harvest, from naturally regenerated grasses and fodder plants between the fruits amounts on average to 0.2 t/ha/year. The pruned branches from the vines are collected and used as firewood. The establishment of such a plot is very demanding in terms of manpower. However within 5-6 years the system becomes self-sustaining and the productivity of the land is improved several times over. Following this positive experience, other households in the area have adopted the technology spontaneously, and today about 15 ha of degraded grazing land in the Varzob valley have been converted into productive fruit gardens.

**left:** Narrow terraces, each with a water retention ditch, for fruit trees (note grape vine in the foreground). (Photo: Bettina Wolfgramm)
**right:** Agroforestry plot surrounded by overgrazed and heavily degraded grazing land; note also fenced plot with grass plot for hay making above the plot. (Photo: Hanspeter Liniger)

Location: Tajikistan
Region: Varzob
Technology area: 0.15 $km^2$
Conservation measure: agronomic, vegetative, structural, management
Stage of intervention: rehabilitation / reclamation of denuded land
Origin: Developed through land user`s initiative,
Land use type:
Mixed: Agro-silvopastoralism
Land use:
Grazing land: Extensive grazing land (before), Mixed: Agro-silvopastoralism (after)
Climate: subhumid, temperate
WOCAT database reference: T_TAJ004en
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Contact person: Murod Ergashov, Tajik Soil Institute soil_m@rambler.ru

## Classification

### Land use problems:

- - shortage of cultivable land on the gentle slopes next to the rivers - low yield of natural pastures due to overgrazing - heavy erosion taking place near residential areas (expert's point of view)
heavy erosion near the settlements (land user's point of view)

**Land use**

Agro-silvopastoralism
Grazing land: Extensive grazing land (before)
Mixed: Agro-silvopastoralism (after)
full irrigation

**Climate**

subhumid

**Degradation**

Soil erosion by water: loss of topsoil / surface erosion, Physical soil deterioration: compaction, Biological degradation: reduction of vegetation cover

**Conservation measure**

Agronomic: Organic matter / soil fertility
Vegetative: Tree and shrub cover
Structural: Bench terraces (slope of terrace bed <6%)
Management: Change of land use type

**Stage of intervention**

- [ ] Prevention
- [ ] Mitigation / Reduction
- [x] Rehabilitation

**Origin**

- [x] Land users initiative
- [ ] Experiments / Research
- [ ] Externally introduced

**Level of technical knowledge**

- [ ] Agricultural advisor
- [x] Land user

**Main causes of land degradation:**
Direct causes - Human induced: overgrazing

**Main technical functions:**
- improvement of ground cover
- increase in organic matter
- increase in nutrient availability (supply, recycling,...)
- retain/trap dispersed runoff
- increase in soil fertility

**Secondary technical functions:**
- reduction of slope angle
- water harvesting / increase water supply
- reduction in wind speed
- retain/trap concentrated runoff (prevention of gully erosion)

## Environment

### Natural Environment

**Average annual rainfall (mm)**

- [ ] > 4000 mm
- [ ] 3000-4000 mm
- [ ] 2000-3000 mm
- [ ] 1500-2000 mm
- [ ] 1000-1500 mm
- [x] 750-1000 mm
- [ ] 500-750 mm
- [ ] 250-500 mm
- [ ] < 250 mm

**Altitude (m a.s.l.)**

- [ ] > 4000
- [ ] 3000-4000
- [ ] 2500-3000
- [ ] 2000-2500
- [ ] 1500-2000
- [x] 1000-1500
- [ ] 500-1000
- [ ] 100-500
- [ ] <100

**Landform**

- [ ] plateau / plains
- [ ] ridges
- [x] mountain slopes
- [ ] hill slopes
- [ ] footslopes
- [ ] valley floors

**Slope (%)**

- [ ] flat
- [ ] gentle
- [ ] moderate
- [ ] rolling
- [x] hilly
- [ ] steep
- [ ] very steep

**Soil depth (cm)**

- [x] 0-20
- [ ] 20-50
- [ ] 50-80
- [ ] 80-120
- [ ] >120

**Growing season(s):** 210 days(March-October)
**Soil texture:** medium (loam)
**Soil fertility:** low
**Topsoil organic matter:** low (<1%)
**Soil drainage/infiltration:** good

## Human Environment

**Mixed per household (ha)**

| | |
|---|---|
| | <0.5 |
| | 0.5-1 |
| | 1-2 |
| | 2-5 |
| | 5-15 |
| | 15-50 |
| | 50-100 |
| | 100-500 |
| | 500-1,000 |
| | 1,000-10,000 |
| | >10,000 |

**Land ownership:** state
**Land use rights:** communal (organised)

**Importance of off-farm income:** 10-50% of all income: 50% of the families' total income comes from three sons working in Moscow
**Access to service and infrastructure:**
**Market orientation:** subsistence (self-supply)

**Technical drawing**

The fenced-off agroforestry system comprising fruit trees and cereals grown on a steep hillside. Terracing is crucial for water conservation. Grass cover (right) is established for fodder production and simultaneous soil conservation. Note the adjacent plot for haymaking (above) and degraded rangeland outside the protected area (right). (Mats Gurtner)

## Implementation activities, inputs and costs

### Establishment activities

- Planting of vines and fruit tree seedlings (apricot, plums, almonds)
- 1. Fencing of an area of 0.5 ha using waste material from a machinery depot.
- 2. Construction of backward sloping bench terraces.

**Establishment inputs and costs per ha**

| Inputs | Costs (US$) | % met by land user |
|---|---|---|
| Labour | 600.00 | 100% |
| Equipment | | |
| - machine use | 50.00 | 100% |
| - animal traction | 200.00 | 100% |
| Agricultural | | |
| - seedlings | 40.00 | 100% |
| - grape vines | 1500.00 | 100% |
| - manure (kg) | 300.00 | 100% |
| **TOTAL** | **2690.00** | **100.00%** |

## Maintenance/recurrent activities

- Irrigation (old inner tubes filled with water carried to the plot by donkeys). In summer: 5 litres of water per tree, per week.
- Irrigation of new seedlings.
- Harvesting of fruits and fodder: transport of the yield to the house by donkey
- Manuring, when replacing grapes or trees that had died.
- Manuring: applied at first to the newly planted vines/trees only,with restricted availability. During the second half of the establishment phase also applied elsewhere within the plot
- Grapes and trees pruned
- Vines and trees that fail are replaced.
- 1. Repairs to the fence

**Maintenance/recurrent inputs and costs per ha per year**

| Inputs | Costs (US$) | % met by land user |
|---|---|---|
| Labour | 180.00 | 100% |
| Equipment | | |
| - animal traction | 200.00 | % |
| Agricultural | | |
| - seedlings | 20.00 | 100% |
| - grape vines | 150.00 | 100% |
| - manure (kg) | 20.00 | 100% |
| **TOTAL** | **570.00** | **100.00%** |

**Remarks:**

Labour cost per day is US$2. The fence constructed by the farmer was free because he utilised scrap from a machinery depot. Note that the total length of fencing is relatively less for a larger plot. In the villages, almost no money changes hands: there is a barter system between the farmers. Even salaries are often paid in terms of fruits, wood or free rent of land.

## Assessment

### Impacts of the Technology

**Production and socio-economic benefits**

+++ increase in fruit production
++ increase in production of high quality fodder
+ increased wood production
+ increased farm income

**Production and socio-economic disadvantages**

+++ labour constraints:
+ increased input constraints

**Socio-cultural benefits**

+++ improved conservation / erosion knowledge
+ community institution strengthening

**Socio-cultural disadvantages**

++ socio cultural conflicts

**Ecological benefits**

+++ increased soil moisture
+++ improved excess water drainage
+++ improved soil cover
+++ reduced soil loss
+++ increase in soil fertility
++ biodiversity enhancement

**Ecological disadvantages**

++ poorly maintained terraces may lead to increased erosion

**Off-site benefits**

++ reduced transported sediments
+ reduced flooding of the road at the bottom of the slope

**Off-site disadvantages**

+ increased risk of landslides due to water harvesting

**Contribution to human well-being / livelihoods**

**Benefits /costs according to land user**

| Benefits compared with costs | short-term: | long-term: |
|---|---|---|
| **Establishment** | negative | positive |
| **Maintenance / recurrent** | negative | very positive |

**Acceptance / adoption:**

100% of land user families (5 families; 100% of area) have implemented the technology voluntary.
There is moderate trend towards (growing) spontaneous adoption of the technology. Adoption was spontaneous in all cases and there are signs of further spread.

## Concluding statements

| Strengths and → how to sustain/improve | Weaknesses and → how to overcome |
|---|---|
| Rehabilitation of degraded areas: reduced soil erosion and increased productivity → Complement manure inputs by using other fertilisers. | Bringing water for supplementary irrigation to the orchard is very labour intensive → An irrigation supply system could be installed (irrigation channels, water tank). But so far this is too expensive, and it is questionable whether irrigation could be installed and maintained sustainably |
| Production increase: good fruit yields → Introduce low input demanding crops | Not all tree species can grow in these dry conditions (for example apple trees will not survive without regular irrigation or watering) → irrigation water required (see above). |
| Diversification: different kinds of fruit trees growing on the plot → Other trees (nuts for example) and annual crops such as wheat might also be suitable for this area. | Difficulty in establishment of the young vines in the well developed grass → Remove or cut down grass and herbaceous plants around the vines at least until they have been well established. |
| Income generation. → | Generally high manual labour input → Difficult to reduce labour inputs. |

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