Young apple trees in small pits, the traditional method (Wang Fei)

Progressive bench terrace (China)

树盘，逐年扩盘

DESCRIPTION

Bench terraces are progressively expanded to form a fully developed terrace system in order to reduce runoff and soil erosion on medium- to high- angled loess slopes.

n Miaowan Village, the technology is mainly applied to apple tree plantations. Tree seedlings are planted in rows every 4 m along the contour with a spacing of 2.5-3.5 m between rows. Trees are planted in pits 40 cm diameter and 3040 cm deep. Manure and/or fertilizer are applied and the seedlings are watered.

Around each tree, soil from the upper parts of the slope is removed and deposited below in order to extend the flat terrain. Over 5-10 years, the terraces become enlarged around each tree and form a terrace with the neighbouring trees along the contour, such that the slopes are transformed into level bench terraces. The fruit trees are located in the middle of the terrace. All the work is done manually using shovels.

Purpose of the Technology: The main purpose of this technology is to reduce runoff and soil erosion on the slope and to improve soil quality and soil moisture retention. It is a sustainable land use technology for small farmers because farmers can use their spare time to improve the land's condition during the growth of the trees.

A major aim is to conserve water and reduce runoff. Soil erosion in this village is very severe and the soil erosion rate before amounted to 60-100 tonnes per hectare per year and was reduced practically to zero as a result of building the terraces. Slope gradients are very steep (around 20-35 degrees). The main income of local farmers is from orchards.

Establishment / maintenance activities and inputs: The establishment phase thus takes 5-10 years. Afterwards maintenance inputs are restricted to repairing the terrace walls.

LOCATION

Location: Miaowan Village, Xuejiagou Watershed, Shaanxi, China

No. of Technology sites analysed:

Geo-reference of selected sites
- 109.332, 36.899

Spread of the Technology: evenly spread over an area (2.55 km^2)

In a permanently protected area?:

Date of implementation: 10-50 years ago

Type of introduction
- [x] through land users' innovation
- [ ] as part of a traditional system (> 50 years)
- [ ] during experiments/ research
- [ ] through projects/ external interventions

The progressive bench terraces with apple trees (Wang Fei)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [ ] improve production
- [x] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] 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

Land use mixed within the same land unit: Ja - Agroforestry

Cropland

- Annual cropping: root/tuber crops - potatoes
- Tree and shrub cropping: pome fruits (apples, pears, quinces, etc.)

Water supply

- [x] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation

Purpose related to land degradation

- [x] prevent land degradation
- [x] reduce land degradation
- [ ] restore/ rehabilitate severely degraded land
- [ ] adapt to land degradation
- [ ] not applicable

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion

water degradation - Ha: aridification

SLM group

- cross-slope measure

SLM measures

structural measures - S11: Others

TECHNICAL DRAWING

Technical specifications

i: first year: planting of fruit trees along the contour in small pits
ii: after 3-4 years: a small terrace is built up around each tree (as the tree grows it needs more water, which is collected from the platform around the trees..
iii: after 5-8 years: terraces develop
iv: final stage: fully developed level bench terraces

Owing to the soil properties of loess, there is no need to separate surface and subsoil as there is little difference between them. Therefore, soil can be moved directly from upper to lower parts of the terrace without changing soil fertility.

Location: Miaowan Village, Xuejiagou Watershed. Ansai County, Shaanxi Province, China

Date: 2008-12-20

Technical knowledge required for land users: moderate (It is easy to understand and implement.)

Main technical functions: control of concentrated runoff: retain / trap, reduced soil loss

Secondary technical functions: reduction of slope angle, increase of infiltration

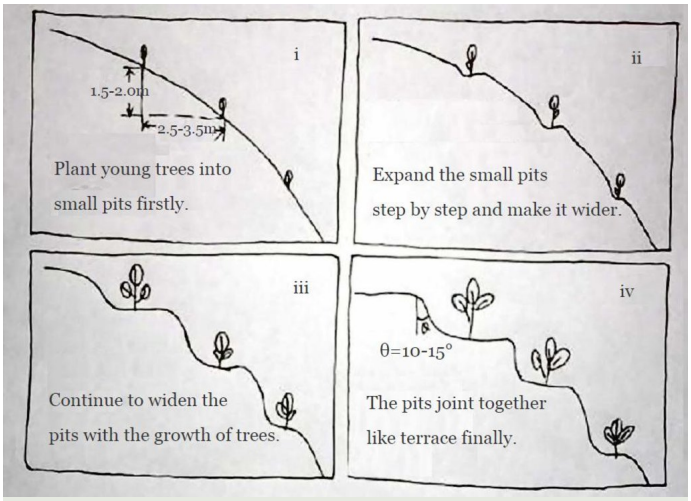
Reshaping surface
Vertical interval between structures (m): 1
Spacing between structures (m): 2.5
Depth of ditches/pits/dams (m): 1..5
Width of ditches/pits/dams (m): 2.5
Length of ditches/pits/dams (m): 100-150

Construction material (earth): Using the earth of the same land.

Slope (which determines the spacing indicated above): 45%

If the original slope has changed as a result of the Technology, the slope today is: 2%

Lateral gradient along the structure: 2%



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ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated:
- Currency used for cost calculation: **USD**
- Exchange rate (to USD): 1 USD = n.a
- Average wage cost of hired labour per day: 14.2

Most important factors affecting the costs

Slope is the most important factor. The steeper it is, the higher the cost. Labour was not considered as a cost before, but now it is expensive so that some local farmers do not use this technology.

Establishment activities

1. Plant the young trees with small pits. (Timing/ frequency: Before practice)
2. The soils from the upper parts of the slope is shovelled away and deposited on the lower side of the trees (Timing/ frequency: None)
3. Expand the pits into a large platform year by year. (Timing/ frequency: None)
4. 3.4 years after planning the trees a level platform of 2 to 3 square meters around the trees is build. (Timing/ frequency: None)
5. The platforms increase and the space between trees is change into terrace. (Timing/ frequency: None)

Establishment inputs and costs

Specify input	Unit	Quantity	Costs per Unit (USD)	Total costs per input (USD)	% of costs borne by land users
Labour					
Planting trees	Person/day	120.0	7.3	876.0	100.0
Building pits	Person/day	750.0	7.3	5475.0	100.0
Total costs for establishment of the Technology				**6'351.0**	
Total costs for establishment of the Technology in USD				*6'351.0*	

Maintenance activities

1. Repair the bank of year-after-year terraced land (Timing/ frequency: Annual after it formed)

Maintenance inputs and costs

Specify input	Unit	Quantity	Costs per Unit (USD)	Total costs per input (USD)	% of costs borne by land users
Labour					

Reparing of terraced land	Person/day	15.0	14.6	219.0	100.0
Total costs for maintenance of the Technology				**219.0**	
Total costs for maintenance of the Technology in USD				*219.0*	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [x] 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
- [x] semi-arid
- [ ] arid

Specifications on climate
The mean annual rainfall in the basin is 515.2 mm in the duration from 1952 to 2000. The rainfall from May to Oct accounts for 446.8 mm, up to 86.7%; and that from Jun to Sep accounts for 367.6 mm
Thermal climate class: temperate. The accumulating time that temperature above 0 ℃ about 3800 hours, and that above 10 ℃ is more than 3200 hours
It is based on the classification sysytem only based on the rainfall

Slope
- [ ] flat (0-2%)
- [ ] gentle (3-5%)
- [ ] moderate (6-10%)
- [ ] rolling (11-15%)
- [ ] hilly (16-30%)
- [ ] steep (31-60%)
- [x] very steep (>60%)

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

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [x] 501-1,000 m a.s.l.
- [x] 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
- [ ] convex situations
- [ ] concave situations
- [x] not relevant

Soil depth
- [ ] very shallow (0-20 cm)
- [ ] shallow (21-50 cm)
- [ ] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [x] very deep (> 120 cm)

Soil texture (topsoil)
- [ ] coarse/ light (sandy)
- [x] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Soil texture (> 20 cm below surface)
- [ ] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Topsoil organic matter content
- [ ] high (>3%)
- [ ] medium (1-3%)
- [x] low (<1%)

Groundwater table
- [ ] on surface
- [ ] < 5 m
- [x] 5-50 m
- [ ] > 50 m

Availability of surface water
- [ ] excess
- [ ] good
- [x] medium
- [ ] poor/ none

Water quality (untreated)
- [x] good drinking water
- [ ] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [ ] unusable

Water quality refers to:

Is salinity a problem?
- [ ] Ja
- [ ] Nee

Occurrence of flooding
- [ ] Ja
- [ ] Nee

Species diversity
- [ ] high
- [x] medium
- [ ] low

Habitat diversity
- [ ] high
- [ ] medium
- [ ] low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [ ] mixed (subsistence/ commercial)
- [x] commercial/ market

Off-farm income
- [ ] less than 10% of all income
- [x] 10-50% of all income
- [ ] > 50% of all income

Relative level of wealth
- [ ] very poor
- [ ] poor
- [ ] average
- [x] rich
- [ ] very rich

Level of mechanization
- [x] manual work
- [ ] animal traction
- [ ] mechanized/ motorized

Sedentary or nomadic
- [ ] Sedentary
- [ ] Semi-nomadic
- [ ] Nomadic

Individuals or groups
- [x] individual/ household
- [ ] groups/ community
- [ ] cooperative
- [ ] employee (company, government)

Gender
- [x] women
- [x] men

Age
- [ ] children
- [ ] youth
- [ ] middle-aged
- [ ] elderly

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [x] 2-5 ha
- [ ] 5-15 ha
- [ ] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

Scale
- [x] small-scale
- [ ] medium-scale
- [ ] large-scale

Land ownership
- [x] state
- [ ] company
- [x] communal/ village
- [ ] group
- [ ] individual, not titled
- [ ] individual, titled

Land use rights
- [ ] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [x] individual

Water use rights
- [x] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [ ] individual

Access to services and infrastructure

health	poor	good
education	poor	good
employment (e.g. off-farm)	poor	good
roads and transport	poor	good
drinking water and sanitation	poor	good
financial services	poor	good

IMPACTS

Socio-economic impacts

Crop production	decreased	increased	Quantity before SLM: 45000kg Quantity after SLM: 52500kg Yield increasing by 16.7%
farm income	decreased	increased	Quantity before SLM: 9883 Quantity after SLM: 11530 Income increases by 1647 USD per ha.
workload	increased	decreased	Quantity before SLM: 1500 Quantity after SLM: 1650 10% person days increases annually in the first 5 years

Socio-cultural impacts

situation of socially and economically disadvantaged groups (gender, age, status, ehtnicity etc.)	worsened	improved	Quantity before SLM: 2700 Quantity after SLM: 3200 Not excluding of the labour input of the local farmers themselves.
Livelihoods and human well-being	reduced	improved	

Ecological impacts

surface runoff	increased	decreased	Quantity before SLM: 60 mm/yr Quantity after SLM: <10 mm/yr no runoff in common
soil loss	increased	decreased	Quantity before SLM: 60 t/yr/ha Quantity after SLM: 10 t/yr/ha Soil erosion is well controlled

Off-site impacts

reliable and stable stream flows in dry season (incl. low flows)	reduced	increased	Quantity before SLM: 60mm/yr Quantity after SLM: <10mm/yr
downstream flooding (undesired)	increased	reduced	Quantity before SLM: 60 mm/yr Quantity after SLM: <10 mm/yr

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative	very positive
Long-term returns	very negative	very positive

Benefits compared with maintenance costs

Short-term returns	very negative	very positive
Long-term returns	very negative	very positive

It is very cheap to maintain this measure. More trees could be planted on degraded land in future.

CLIMATE CHANGE

Gradual climate change

annual temperature increase	not well at all	very well	

Climate-related extremes (disasters)

local rainstorm	not well at all	very well	
local windstorm	not well at all	very well	
drought	not well at all	very well	
general (river) flood	not well at all	very well	Answer: not known

Other climate-related consequences

reduced growing period	not well at all	very well	Answer: not known

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology

- [ ] single cases/ experimental
- [ ] 1-10%
- [x] 11-50%
- [ ] > 50%

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

- [ ] 0-10%
- [ ] 11-50%
- [ ] 51-90%
- [x] 91-100%

Number of households and/ or area covered

65 households (15percent of the stated area)

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

- [ ] Ja
- [ ] Nee

To which changing conditions?

- [ ] climatic change/ extremes
- [ ] changing markets
- [ ] labour availability (e.g. due to migration)

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Higher yield and income.

  How can they be sustained / enhanced? If they have time, they wish to adopt this technology.

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

- Establishing the technology over a long time. Local farmers have enough time to do it

  How can they be sustained / enhanced? Show to land users that they have time and can spread to work over many years and fit the labour into the time they have available.
- It can reduce water loss and soil erosion and prevent the degradation of land

  How can they be sustained / enhanced? Give subsidy to the local farmers to reduce the sediment delivery into the downstream river.
- It can increase soil moisture.

  How can they be sustained / enhanced? Makes people understand the importance of conserving water with such a technology.
- Higher yield and income.

  How can they be sustained / enhanced? Share ideas through meeting in the field. Present this measure to more people and show them how to apply it and promote the technology to more farmers.

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome

- It takes a lot of time to establish it. It is difficult to use it, because the people could balance the establishment costs and work at the labour market. If they can get some subsidy from government, they may adapt this measure.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome

- It takes considerable time to establish and labour is more and more expensive so that farmers are looking for paid work Subsidy for farmers using this measure.

REFERENCES

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Full description in the WOCAT database
https://qcat.wocat.net/af/wocat/technologies/view/technologies_1522/

Linked SLM data
n.a.

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Key references
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