Rainfed paddy rice terraces

Philippines - Palayan

Terraces supporting rainfed paddy rice on steep mountain slopes: these have been in existence for more than a thousand years.

Terraced paddy rice on steep mountain slopes is the main method of rice cultivation in Cordillera Administrative Region (CAR) of the Philippines. This is a traditional technology: most of the terraces are at least a thousand years old. The terraces were constructed manually on steep hill slopes (30-60%) with small portions located in narrow valley bottoms. Farmers generally own one hectare or less of terraced land, and cultivation is intensive. The terraces ('paddies') curve along the contour, and are narrow, ranging from one to five meters in width, depending on the slope. The height of the riser is between one and two meters. Water supply for the rice crop depends on rainfall, and only one rice crop is grown per year. The terraces impound rainwater - average rainfall is around 2,000 mm - and thus prevent soil erosion. Soil fertility is largely maintained because the impounded water and a zero rate of erosion preserve organic matter levels. Some nutrient loss occurs however with each harvest. The terraces are multi-functional: in addition to their agricultural use, they assist in environmental protection through flood mitigation, and they contribute to biodiversity. Furthermore they have become a tourist attraction. Land preparation is mainly manual. Farmers puddle the soil with their bare feet. Excess water is drained to the terrace below by a small opening in the lip on top of the riser. Maintenance consists basically of repairing breached bunds/risers. Every planting season, a few centimetres of soil is added. To strengthen the bunds, some farmers plant grasses, which may be cut and carried for animal fodder: napier grass (Pennisetum purpureum) is an example. It is important not to disturb the soil of the bund, as this may encourage breaching. The area where the technology is practiced is mostly between 2,000 and 2,500 m. Because of the cool climate caused by the high elevation, crop maturity takes longer than in the lowlands. In some cases, vegetables such as cabbages and sweet potatoes are grown after the rice is harvested. The farmers, indigenous to the area, have a distinct culture that is different to lowland rice farmers. Rituals connected with farming are widely practiced. There is an added economic benefit from tourism, as people from all over the Philippines - and beyond - travel there for the spectacular views and mild climate.

left: Paddy fields in the form of bench terraces is very effective in impounding water for rice cultivation and in preventing soil erosion (Photo: Jose D. Rondal)
right: Close-up showing rice crop on the narrow benches. (Photo: William Critchley)

Location: Cordillera Region
Region: Cordillera Region
Technology area: 15000 km^2
Conservation measure: structural
Stage of intervention: mitigation / reduction of land degradation
Origin: Developed through land user`s initiative, traditional (>50 years ago)
Land use type:
Cropland: Annual cropping
Climate: humid, tropics
WOCAT database reference: T_PHI012en
Related approach:
Compiled by: Not registered
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Classification

Land use problems:

- The terraces allow crop cultivation in an area characterised by steep slopes and high rainfall. However, farming in this marginal areas is labour intensive, mechanisation is not an option on the narrow paddies, and even animal traction is rarely possible due to the steepness of the terrain and the high terrace risers. Non-terraced hill slopes are prone to very high runoff and soil erosion, production is zero. (expert's point of view)
High runoff and soil erosion, zero productivity. (land user's point of view)

Land use

Annual cropping
rainfed

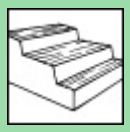
Climate

humid

Degradation

Soil erosion by water: loss of topsoil / surface erosion, Chemical soil deterioration: fertility decline and reduced organic matter content

Conservation measure



Structural: Bench terraces (slope of terrace bed <6%)

Stage of intervention

- Prevention
- Mitigation / Reduction
- Rehabilitation

Origin

- Land users initiative: traditional (>50 years ago)
- Experiments / Research
- Externally introduced

Level of technical knowledge

- Agricultural advisor
- Land user

Main causes of land degradation:

Main technical functions:

- control of dispersed runoff: retain / trap
- increase / maintain water stored in soil

Secondary technical functions:

- reduction of slope angle
- reduction of slope length
- indirect maintenance of fertility

Environment

Natural Environment

Average annual rainfall (mm)

- > 4000 mm
- 3000-4000 mm
- 2000-3000 mm
- 1500-2000 mm
- 1000-1500 mm
- 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
- 1000-1500
- 500-1000
- 100-500
- <100

Landform

- plateau / plains
- ridges
- mountain slopes
- hill slopes
- footslopes
- valley floors

Slope (%)

- flat
- gentle
- moderate
- rolling
- hilly
- steep
- very steep

Soil depth (cm)

- 0-20
- 20-50
- 50-80
- 80-120
- >120

Growing season(s): 240 days
Soil texture: fine / heavy (clay)
Soil fertility: low
Topsoil organic matter: medium (1-3%)
Soil drainage/infiltration: poor (eg sealing /crusting)

Soil water storage capacity: high

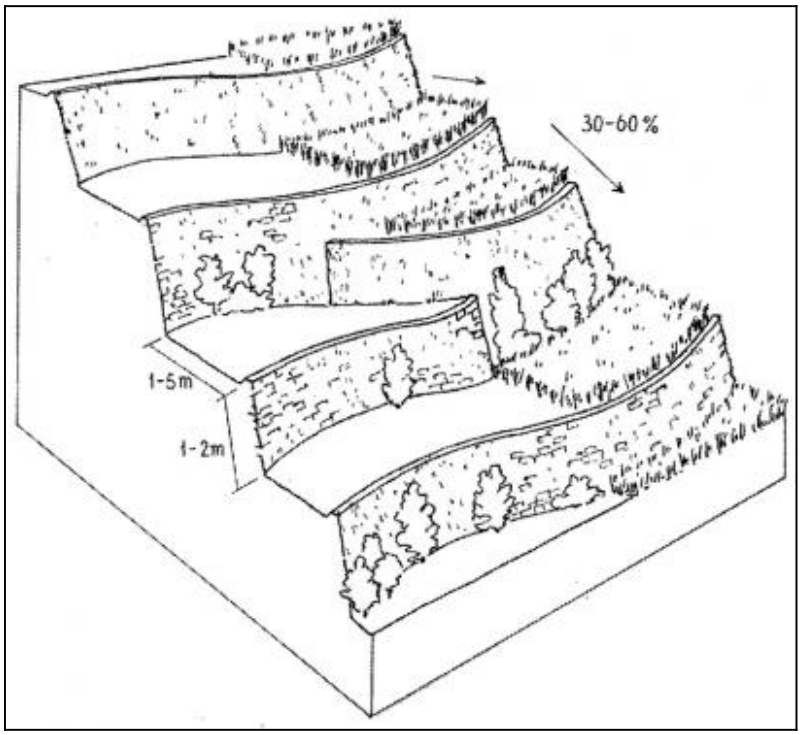
Human Environment

Cropland 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: individual, titled
Land use rights: individual

Importance of off-farm income: 10-50% of all income: carpentry, trading, labour for neighbouring farms, overseas employment, transport services, activities associated with tourism
Access to service and infrastructure:
Market orientation: mixed (subsistence and commercial)
Mechanization:
Livestock grazing on cropland:



Technical drawing

Layout of rainfed paddy rice terraces. The level terraces allow cultivation of paddy rice (right) on steep slopes. In some places the terrace risers are as tall as the beds are wide. (Mats Gurtner)

Implementation activities, inputs and costs

Establishment activities

-
- Levelling by moving soil from the upslope to the downslope part
- Construction of bunds (lip at the terrace edge) of about 50-100 cm
- Determination of contour lines by eye.

Establishment inputs and costs per ha

Inputs	Costs (US$)	% met by land user
Labour	2500.00	100%
Equipment		
- tools	200.00	100%
TOTAL	**2700.00**	**100.00%**

Maintenance/recurrent activities

- Weeding by cutting grasses on the bund/riser using hand tools. Hoeing
-
-
- Land preparation by puddling. In most cases, the use of animal traction is not possible because of the steepness of the slope and height of the risers.
- Repairing breached portion of the bunds. Adding a few centimetres

Maintenance/recurrent inputs and costs per ha per year

Inputs	Costs (US$)	% met by land user
Labour	30.00	100%
Equipment		
- tools	10.00	100%
TOTAL	**40.00**	**100.00%**

Remarks:

The costs of establishment are estimates - as new terrace construction no longer takes place. The land has already been terraced for centuries. The 800 person days are for land levelling and bund construction, which comprises the main activity. The calculation was based on a land slope of 30-60%. The maintenance figure assumes regular light maintenance - and does not include major repairs to bunds.

Assessment

Impacts of the Technology

Production and socio-economic benefits	Production and socio-economic disadvantages
+++ increased crop yield	++ increased labour constraints
+++ increased farm income	++ inputs needed for fertility improvement
++ fodder production/quality increase	

Socio-cultural benefits	Socio-cultural disadvantages
++ community institution strengthening	
++ national institution strengthening	
++ improved conservation / erosion knowledge	

Ecological benefits	Ecological disadvantages
+++ increased soil moisture	
+++ improved excess water drainage	
+++ reduced soil loss	
++ biodiversity enhancement	

Off-site benefits	Off-site disadvantages
+++ reduced downstream siltation	
++ reduced downstream flooding	

Contribution to human well-being / livelihoods

Benefits /costs according to land user

Benefits compared with costs	short-term:	long-term:
Establishment	not specified	not specified
Maintenance / recurrent	positive	very positive

Acceptance / adoption:

There is no trend towards (growing) spontaneous adoption of the technology. The technology is widely accepted. As the terraces were constructed hundreds of years ago and construction of new terraces is no longer done the question of 'adoption' is not relevant.

Concluding statements

Strengths and → how to sustain/improve	Weaknesses and → how to overcome
Low maintenance cost → Regular maintenance	Lack of moisture for about six months → Moisture conservation (mulching): construction of water harvesting structures for supplementary irrigation.
Farmers are well versed (very familiar) with the rice production system – it is part of their culture → Continuous information education campaign (IEC)	Continuous mono-cropping → Crop diversification. Other crops (such as sweet potato, cabbage, chilli) could be grown after rice towards the end of the rainy season through minimum or zero tillage.
Terracing allows paddy rice production on very steep slopes, which are prone to very high erosion and water loss in such a monsoon area. It transforms steep unproductive slopes into productive land → Incentives to encourage continuation of the use and maintenance of the terraces.	Severe soil fertility decline in some locations – and therefore declining yields → Fertility enhancement using organic and inorganic sources (manure, crop residues, compost, fertilizers etc).
Know very well the agronomy of rice production → Continuous IEC campaign	Lack of irrigation facilities → Construction of water harvesting structure
	Declining yield → Fertilizer application