left: General view of the multi-storey cropping system in the Philippines. The uppermost storey is coconut, followed by papaya, banana, coffee and pineapple. Root crops are grown underneath the coffee. (Photo: Jose D. Rondal)
right: General view of the Multi-Storey Cropping system in the Philippines. The uppermost storey is coconut, followed by banana, coffee and pineapple. Root crops is also grown underneath the coffee. (Photo: Jose D. Rondal)

Multi-Storey Cropping

Philippines - Maramihang Pagtatanim or Planting in Great Numbers

Cultivating a mixture of crops with different heights (multi-storey) and growth characteristics which together optimise the use of soil, moisture and space.

Under the maramihang pagtatanim multi-storey cropping system, perennial crops (coconut, banana, coffee, papaya, pineapple) and annuals/biennials (root crops: taro, yam, sweet potato etc) are interplanted to maximise productivity and income. This is most applicable where farms are small and the system needs to be intensive. In this particular area, Cavite, coconuts are usually planted first. When they reach a height of 4.5 meters (after 3-4 years), bananas, coffee and/or papaya are planted underneath. Black pepper may also be part of the system. After sufficient space has developed at ground level in about three to four years, root crops are planted. At full establishment, the system develops different layers: coconut (tallest) followed by banana, coffee, papaya (middle), root crops and pineapple (lowest). In recent years, because of its relatively low productivity and decreasing price, coconut has tended to be replaced in the system with higher value crops like the fruit tree santol (Sandoricum koetjape), papaya and sometimes black pepper. However most multi-storey farms adhere to no specific planting layout. The multi-storey agroforestry system is intended to make the best use of resources (soil, moisture and space) for increased farm income. It is also very effective against soil erosion. Previously, continuous monocropping of annual crops resulted in erosion and serious soil fertility decline. Even though the land is sloping and rainfall during the monsoon is extremely intensive, multi-storey cropping provides adequate soil cover throughout the year, protecting the land from erosion. Fertilization, weeding and pruning are necessary elements of maintenance. 'Natural' mulching through fallen leaves from leguminous trees helps restore and maintain soil fertility The system is applied in a volcanic-derived soil with distinct wet and dry periods (6 months wet season, 6 months dry season). There is the risk of a destructive typhoon every 10 years. Farm income is relatively high, but labour and input costs are also high - and the technology is mostly used by relatively wealthy landowners. There is strong spontaneous adoption, as maramihang pagtatanim has been proven to be effective and remunerative. This technology has been practiced in Cavite since the 1970s. Implementation is by individual farmers with strong extension support from the Local Government Units (LGUs), NGOs and the Cavite State University.

Location: Philippines, Cavite
Region: Cavite
Technology area: 40 km^2
Conservation measure: agronomic, vegetative
Stage of intervention: prevention of land degradation
Origin: Developed through land user`s initiative, traditional (>50 years ago)
Land use type:
Mixed: Agroforestry
Climate: humid, tropics
WOCAT database reference: T_PHI007en
Related approach:
Compiled by: Not registered
Date: 2001-06-15
Contact person: Alejandro Mojica, Cavite State University, Indang, Cavite

Classification

Land use problems:

- Productivity decline, unstable prices of agricultural products and high costs of inputs are the main land use problems. Inputs also have to be increased to maintain the same yield level in annual cropping systems. There is a severe land use competition: a large proportion of the land is being converted to non-agricultural uses, especially residential and industrial areas because of the proximity to the rapidly expanding capital. (expert's point of view)
Productivity decline and unfavourable prices of agricultural products. High costs of inputs. (land user's point of view)

Land use

Agroforestry
rainfed

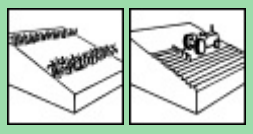
Climate

humid

Degradation

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

Conservation measure



Vegetative, Agronomic

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 raindrop splash
- improvement of ground cover

Secondary technical functions:
- control of concentrated runoff: retain / trap

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(May - Jan), 210 days(May - Dec)
Soil texture: medium (loam)
Soil fertility: medium
Topsoil organic matter: medium (1-3%)
Soil drainage/infiltration: good

Soil water storage capacity: high

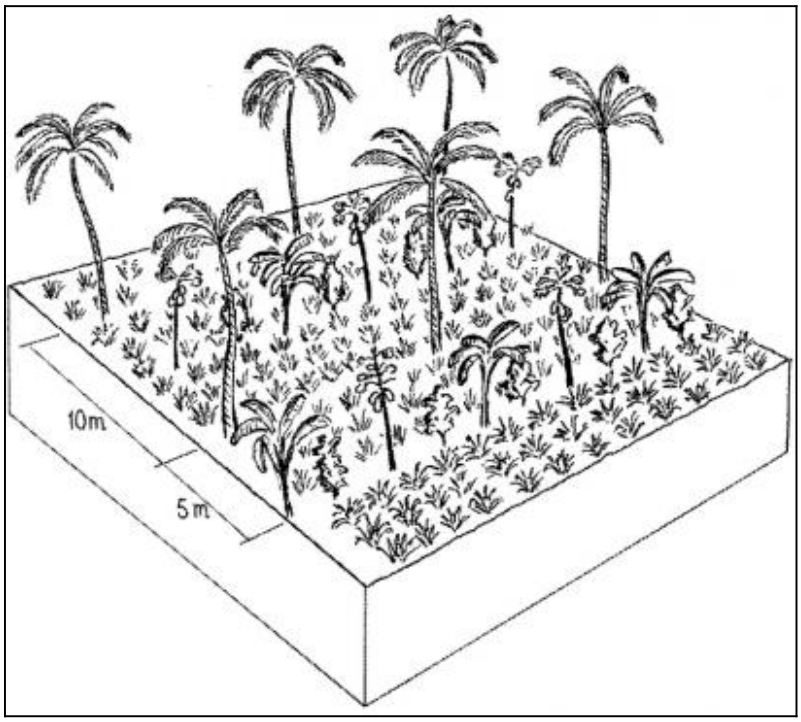
Human Environment

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

Population density: > 500 persons/km2
Annual population growth: 2% - 3%
Land ownership: individual, titled
Land use rights: individual
Relative level of wealth: rich, which represents 60% of the land users; 40% of the total area is owned by rich land users

Importance of off-farm income: 10-50% of all income: remittances from employment of at least one member of the household. Trading is also important.
Access to service and infrastructure:
Market orientation: commercial / market



Technical drawing

Multi-storey cropping includes various species interplanted systematically to optimise use of resources: pineapple and other root crops (lowest storey); rows of banana trees, coffee and papaya (middle storey); rows of coconut (highest storey). Note: in practice farmers adjust this layout to meet their needs. (Mats Gurtner)

Implementation activities, inputs and costs

Establishment activities

- 1. Planting of tallest storey (coconut).
- 3. Planting of lowest storey (pineapple).
- 4. Planting of lowest storey continued (root crops).
- 2. Planting of middle storey (coffee and banana).

Establishment inputs and costs per ha

Inputs	Costs (US$)	% met by land user
Labour	150.00	100%
Equipment		
- animal traction	50.00	100%
- tools	40.00	100%
Agricultural		
- seedlings	840.00	100%
- fertilizer	160.00	100%
- biocides	30.00	100%
- compost/manure	120.00	100%
TOTAL	**1390.00**	**100.00%**

Maintenance/recurrent activities

- 4. Spraying.
- 5. Fertilizing.
- 1. Pruning.
- 3. Harvesting.
- 2.Weeding

Maintenance/recurrent inputs and costs per ha per year

Inputs	Costs (US$)	% met by land user
Labour	300.00	100%
Agricultural		
- fertilizer	160.00	100%
- biocides	30.00	100%
TOTAL	**490.00**	**100.00%**

Remarks:
Labor is the most crucial especially during land preparation and planting, maintenance and harvesting.
Cost was calculated assuming a per hectare population of 100 coconuts, 400 coffee plants and 3,000 pineapples. Maintenance activities entail more work than during the establishment phase. Note that the establishment phase usually lasts for 4-5 years, so the labour is spread, unlike during the maintenance phase when all of the components have to be attended to.

Assessment

Impacts of the Technology

Production and socio-economic benefits	Production and socio-economic disadvantages
+++ increased crop yield	+++ increased labour constraints
+++ increased farm income	+++ increased input constraints

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

Ecological benefits	Ecological disadvantages
+++ improved soil cover	
+++ reduced soil loss	
+++ increase in soil fertility	
+ reduced wind velocity	
+ biodiversity enhancement	

Off-site benefits	Off-site disadvantages
++ reduced downstream flooding	
++ reduced downstream siltation	
++ reduced groundwater river pollution	

Contribution to human well-being / livelihoods

Benefits /costs according to land user

Benefits compared with costs	short-term:	long-term:
Establishment	slightly positive	very positive
Maintenance / recurrent	very positive	very positive

Acceptance / adoption:

100% of land user families (1000 families; 80% of area) have implemented the technology voluntary. estimates
There is strong trend towards (growing) spontaneous adoption of the technology. The technology has been proven to be very effective

Concluding statements

Strengths and → how to sustain/improve	Weaknesses and → how to overcome
The technology is flexible. It can be modified to suit market condition. Failure of one crop component can be compensated by other components (improved food security) → Try other high value crops as possible component of the system. Diversify further.	Prone to typhoon damage → Establishment of windbreaks: Leguminous trees such as Acacias could provide wind protection for lower crops like papaya or coffee.
It maintains soil fertility through the recycling of nutrients → Incorporate tree legumes in the system (Gliricida as support for Black pepper)	High labour requirement (eg weeding, harvesting).Weeding may be reduced for some components (eg coffee), but pineapple always requires difficult (due to its thorny leaves) and intensive weeding → (1) Use labour-reducing techniques (eg mulching), (2) spread activities over the growing season.
It is a very effective way of using and conserving water → Establish trashline along farm boundaries to add to this effect.	High investment cost → Government to provide low interest production loans (seeds, fertilizers).
Strong research and development: because of its importance in the economy, the technology has spawned various research activities → Adequate and sustained government support	Highly fluctuating farm prices → Spread out production schedule. Target off-season harvesting of crop (eg pineapple).
Generates high farm income → Strong extension service especially for pest and disease control	Pest and diseases (eg papaya virus, which may have developed because it has been part of the system for a long time) → Intensified research and development.
Failure of one crop component can be compensated by the other component → Diversify further	