



Multi-storied agroforestry cropping systems for micro-climatic modification and erosion control in Nepal

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Summary

The objective of this technology is to grow the best combination and interface between crops and trees to facilitate the control of land degradation by increasing system productivity and, thus, meeting domestic needs of food, fuel, fodder and timber of rural people.

Description

Multi-storied cropping systems and agroforestry systems help to reduce the impacts of hazards such as floods and droughts that lead to land degradation, while meeting the needs of local people for food, firewood, fodder and timber.

Under the multi-storied cropping, crops underneath the tall trees or horticultural crops withstand shading effects and provide micro-climatic conditions needed by all the crops. This system has at least three layers of intercropped plants of different heights. It is commonly developed by small farmers, as they:

- Plant nurse trees for shade-tolerant crops like coffee and cacao;
- make productive use of space between and under cash crops;
- enrich fallows with species like yams; and
- establish a variety of low input, low maintenance tree crops.

1. Implementation of the practice

Before initiating, it is essential to find the best combination possible, for this, an ecological and economic planning should be undertaken, considering the following:

1.1 Ecological planning

For any crop combination, predict how the multi-storied agroforestry system will grow and change over time. Each year, some plants will become less productive, and others will grow and cast additional shade. Plan the development of the multi-storied agroforestry system so that:

- the first plants established are adapted to full sunlight;
- plants that can give shade are planted before plants that can tolerate or require shade;
- plants that enrich the soil are planted before plants that give shade;
- plants that require sunlight are not planted where other plants will shade them before they mature;
- medium-sized and large trees will have room to grow and will not become too crowded later. Think ahead to the width of the tree's canopy when it is mature. Consider whether the trees around it will also grow tall



- and wide, if they will crowd it, they should be harvested or not planted at all; and
- all growing space is used: crops fit together vertically (tall, medium and short), horizontally (all planting spots occupied), and underground (deep-rooted and shallow-rooted plants).

1.2 Economic planning

Any farming system requires planning to diversify products and spread labour and income through the year. The first crops planted should provide food or income within 3 to 4 months (for example, sweet potato). Choose crops that give both subsistence produce and cash income. Plant trees that bear different fruits at different times of the year. A multi-storied agroforest will change every year for the first several years, with changes in labour requirements and products.

1.3 Steps to implement a multi-stories agroforestry system

1.3.1 Plant nurse trees

Fast-growing nitrogen-fixing trees can be planted first to improve site conditions. This approach is often used for crops like coffee on poor sites, where nurse trees are valued for shade and soil enrichment throughout the life of the coffee crop. Common species suitable for this method are *Albizia lebbek* (chres), *Gliricidia sepium* (snaov), *Dalbergia cochinchinensis* (kra ngoung), *Pterocarpus indicus* (thnong) and *Acacia mangium*.

All these species have special characteristics such as: they cast a light shade or can be pruned to adjust shade; are nitrogen-fixing; produce timber, fodder or other useful products; are sun-loving; adapted to local climates and soils; and fast growing.

1.3.2 Intercrop annual crops

Choose an intercrop each planting season that is adapted to current sun or shade conditions. Shade-tolerant under-storey crops include: *Ananas cosmosus* (pineapple), *Capsicum spp.* (peppers), *Colocasia esculenta* (sweet taro), *Curcuma domestica* (turmeric), *Anthurium spp.* (flowers), *Ipomea batatas* (sweet potato), *Xanthosoma sagittifolium* (dryland taro), *Zingiber officinarum* (ginger) and mushroom cultures.

1.3.3 Plant shade-tolerant trees

After one year or when the nurse trees provide enough shade, plant shade-tolerant trees. Plant them 3 to 4 m apart, or at the recommended spacing for the tree crop. Plant them 1 to 2 m away from the nurse trees.

1.3.4 Fertilize, prune and weed

Apply as for other tree crops.

1.3.5 Prune nurse trees

When nurse trees provide too much shade, cut branches and use the leaves as mulch.

1.3.6 Thin trees

Watch for adjacent trees with canopies starting to grow into each other. Also watch out for sun-loving trees to make space for healthy or higher – value trees. Be careful not to damage other trees when cutting. The remaining trees will grow faster.

1.3.7 Enrich with other crops.

Plant shade-tolerant crops for food and cash income.

2. Example of crop combinations in the mid-hills region in Nepal

Under multi-storied cropping, coffee and pineapple are the major crops being grown



as shade loving crops under tall trees in mid-hills (e.g. Arghakhanchi and Udaipur districts). Other crops taken under this system are normally citrus, maize, legumes, vegetables and finger millet for lower altitude. At higher altitudes, crops taken under this system are apple, walnut, maize, beans and finger millet. This multi-storied cropping system will reduce the impacts of hazards like high intensity rainfall, soil erosion and landslides.

Figure 1. Multi-storied agroforestry cropping systems for micro-climatic modification and erosion control in Nepal



Under agroforestry or agro-silvi-pastoral system, single, double or multiple crop and / or grass species such as single or double crops of maize, millet or grasses are planted between rows of tree species (e.g. *Dalbergia sissoo*) under various tree-crop intercropping systems. Some good examples of tree-crop intercropping practiced in the hills are Uttis (*Alnus nepalensis*) / cardamom intercropping for more productivity and benefits. Community agroforestry system implemented and regulated by users' group are the examples for a successful model. Agricultural lands below settlements / forest areas offer good agro-ecosystem by providing leaf litters and organic matter for agricultural production below. Thus both the multi-storied and

agroforestry systems lead to efficient utilization of resources, soil conservation, and minimizing risks of crop yield loss thereby increasing household income and employment opportunity.

3. Minimum requirements for the successful implementation of the practice

- Availability of appropriate technology and species combination in the system; and
- access to various enterprises like firewood, fruits, crop yields and grasses in the system / ownership by community.

4. Agro-ecological zones

- Subtropics, warm/mod cool

5. Objectives fulfilled by the project

- Labour-saving technology (LST);
- Resource use efficiency; and
- Pro-poor technology.