Demonstration of Sustainable Upland Agroforestry Systems in Chinese Taipei

Betel nut-coffee-*Cinnamomum osmophloeum* system in Kalala study site

Project title: Demonstration of Sustainable Upland Agroforestry Systems in Chinese Taipei [2011P1-CTN]
Executing Agency: Taiwan Forestry Research Institute (TFRI), Chinese Taipei
Budget in USD (total/APFNet grant): 537,000/400,000
Duration: 09/2011-08/2013
Project Category: Demonstration Project
Target economy: Chinese Taipei

Objectives:

- Develop at least two different agroforestry management systems to cope with different crop cultivation and tree planting demands.
- Demonstrate the ability of upland agroforestry systems to prevent destructive landslides and massive surface erosions on cultivated uplands.
- Develop the criteria and indicators for evaluating the sustainability of such agroforestry management systems.
- Encourage the communities of mountain villagers to participate in the development of new agroforestry systems and take part in the dissemination of new technologies.

Outputs:

Output 1: To develop at least two agroforestry management systems alongside the criteria and

indicators for evaluating the sustainability of such agroforestry management systems.

Output 2: To set up three demonstration areas for verifying these agroforestry systems' soil and water conservation ability.

Output 3: To foster three technical teams to be organized by farmers of village communities in uplands for technology dissemination.

Activities

Activity 1.1: Selection of three study sites and establishment of three experimental plots.

Activity 1.2 & 1.3: Data collection, analyses, and model simulation for agroforestry systems.

Activity 1.4: Establish and verify the criteria and indicators for evaluating the sustainability of these agroforestry systems.

Activity 1.5: Aboard training tours to different economies, including the US and China.

Activity 2.1: Selection of three upland villages for cooperative studies, including income analyses and land productivity evaluation.

Activity 3.1: Organizing 1-2 seminars for technical discussion and experience exchange.

Activity 3.2 & 3.3: Selecting and training farmers for organizing 2-3 technical teams from upland villages to help with technological dissemination and setting up two demonstration sites.

Project background

Chinese Taipei has lush and diverse forests occupying 58.5% of the island area. However, the upland area is very vulnerable and prone to huge landslides and debris flow disasters that have occurred in upland areas frequently in recent decades. Additionally, agricultural practices in upland areas are continuously carried out for the local communities' livelihood, increasing local erosion risks. One of the present research priorities for forest policymakers has been the carbon sink effect through afforestation and reforestation. In this regard, upland agroforestry could be a solution to address both the erosion risk and implications of current carbon emission levels on climate change. Despite the advantages of introducing agroforestry systems in upland areas, legal land management under the agroforestry system is still rare in Chinese Taipei. From 1951 to 1975, part of publicly owned forestland was leased to individuals, aboriginal people, and organizations to help the government with planting and managing trees, especially in upland areas. Agricultural crop planting and harvesting on forestland were not allowed according to their lease policy. However, to gain more income in a shorter period, many leaseholders had a low intention of reforestation but planted high-revenue agricultural crops instead.

Since agroforestry was not prioritized and encouraged in the past in Chinese Taipei, agroforestry-related research is insufficient and needs to be updated. The Chinese Taipei administration is aiming for sustainable management and increasing carbon sink solutions on these forest lands. Furthermore, agroforestry management systems that encourage the farmers to interplant trees on their cultivated lands can be a solution to harmonize the land use types in these upland areas. With the financial support of APFNet, this project entitled "Demonstration of Sustainable Upland Agroforestry Systems in Chinese Taipei" was carried out for two years to develop sustainable agroforestry systems and increase carbon sequestration in upland areas of Chinese Taipei. Fig.1 shows the map of the project's area.

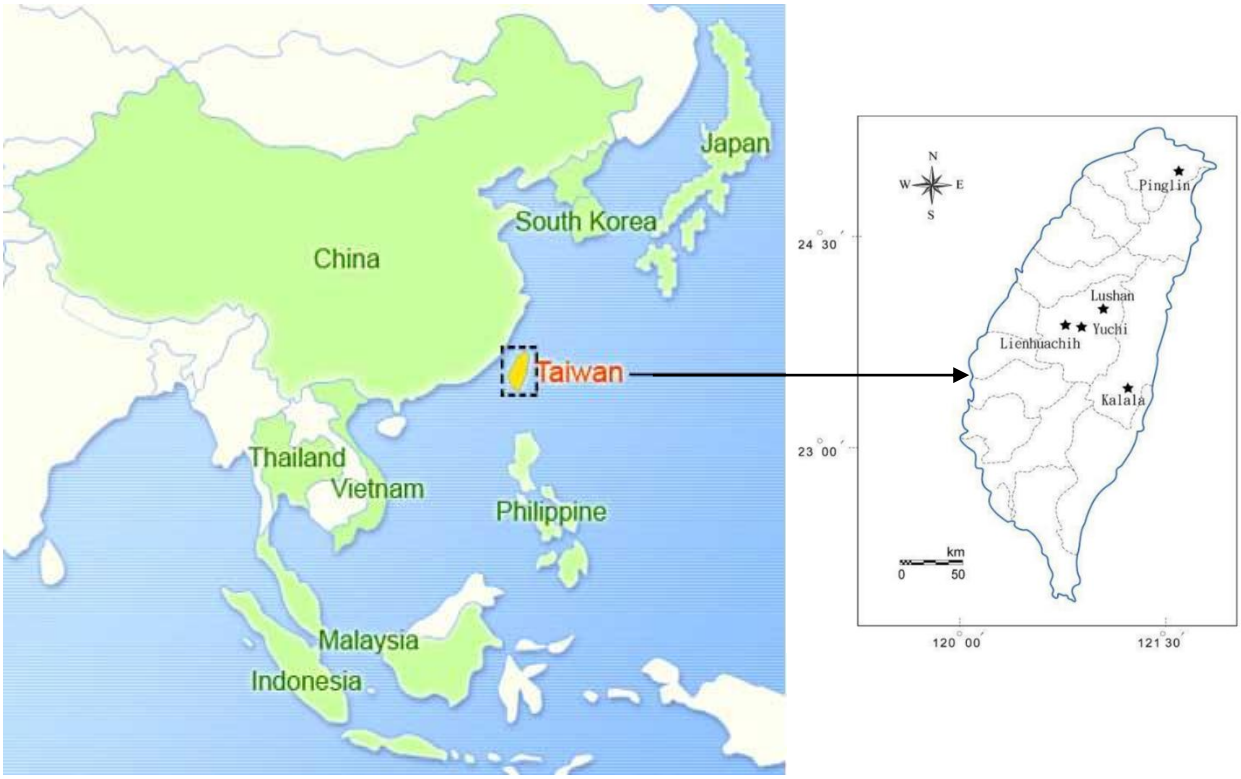

Fig.1 Map of the project area

Project featured topics

Agroforestry management systems

The main development objective of the project is to develop and demonstrate sustainable agroforestry systems adaptable in upland areas in Chinese Taipei. Five study sites, including three demonstration sites- Pinglin (northern Taiwan, Tea-*Cinnamomum kanehirae* system), Yuchi (central Taiwan, Betel nut-*Cinnamomum kanehirae* system), and Kalala (eastern Taiwan, Betel nut-coffee-*Cinnamomum osmophloeum* system) that cope with the demands of different stakeholders and two research sites were established. All the agroforestry systems can be easily replicated in similar regions by the landowners and communities who are leaders in nearby areas. Runoff and soil loss monitoring instruments were installed at the Kalala study site (Fig.2). With proper forestry management techniques, agroforestry may raise agricultural productivity, increase the afforestation area on cultivated lands, and enhance soil and water conservation in the long-term perspective. More than 30 indicators/criteria for evaluating the sustainability of agroforestry management systems of the five project sites were developed. The indicators/criteria are categorized into three main themes according to the conceptual framework in “Agenda 21” of Chinese Taipei: environment, economy, and society.

Fig.2 Installed runoff and soil loss monitoring instrument at the Kalala study site

Project Outcomes

This project has demonstrated that the agroforestry management system can be a solution for balancing agriculture for livelihood with ecosystem stability in upland villages of Chinese Taipei. Under an agroforestry system, agricultural land loss and degradation can be reduced, and resource use efficiency both above and below ground can be increased. For example, it is estimated that Stout camphor trees (*Cinnamomum micranthum)* at the density of 2,000 individual/ha (as planted at the Yuchi study site) under the condition of 6% mortality yearly, can sequester147-ton CO_2/ha at the end of the 15th year after planting. The cooperation among the stakeholders, including the research team, farmers, communities, and industries, is a very effective and sustainable way to establish study sites. Several enterprises were also interested in developing some particular forest product industry. For example, the small-flowered camphor tree (*Cinnamomum kanehirae)*, a unique culture medium for growing a famous medicinal fungus, is one of the species the industry is interested in. In Pinglin and Yuchi study sites, a company signed a contract with the landowners to guarantee the purchase of *Cinnamomum kanehirae* timbers after ten years. With the technical support and timber purchase guarantee, the farmers are motivated and willing to maintain the study sites.

Eight seminars and workshops were organized at TFRI and some upland villages, providing good opportunities to disseminate the concept of sustainable agroforestry and to understand the needs of

farmers. Visiting the project sites is one of the best ways to demonstrate and show people how agroforestry may be implemented and benefit. One good example was Kalala village, an aboriginal community in eastern Taiwan. Coffee is their famous agricultural product. A coffee farm is a proper place to develop agroforestry, as coffee is a shade-tolerance species. Additionally, agroforestry is close to the local, traditional form of agriculture. Therefore, the agroforestry concept can be disseminated relatively easily. Based on runoff and soil erosion monitoring data, surface runoff amounts of all treatments (mixed plantation plots with clear-cutting, reserved, and thinned betel palm) were little. Soil erosion amounts were less than Taiwan's average erosion rate (5.2 mm per year). This is because adding tree planting areas in agroforestry can increase evaporation consumption and reduce runoff and surface erosion.

As the agroforestry system is dynamic, it takes several years for the land to be stable in the newly developed agroforestry sites. Moreover, the actual performance of agroforestry systems also depends on the effectiveness of management practices by the landowners/farmers. The farmers currently have some income from crops (i.e., tea and betel nut). When the planted trees grow in a few years, more income may come from harvesting the leaves of *Cinnamomum osmophloeum* or timber of *Cinnamomum kanehirae*. The planted trees belong to the farmers; if they take good care of the trees, they can expect more rewards from the forestry products. The results of the project play an essential role in making sound agroforestry policies and regulations in Chinese Taipei. Further research on upland agroforestry practices and benefits in Chinese Taipei is needed to provide a baseline for future policymaking.