Rainforestation Farming: An alternative to conventional concepts

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ABSTRACT

Efforts to sustain human food production and simultaneously preserve the biodiversity of terrestrial ecosystems and their vital functions for mankind led to the development of a "Closed Canopy and High Diversity Forest Farming System", popularly termed **Rainforest Farming**. The system is aiming to replace the more destructive forms of kaingin practices, form a buffer zone around the primary forests, protect its biodiversity, help maintain the water cycle of the island, and provide farmers with a stable and higher income.

Contrary to conventional paradigm of farm management, the concept works with the hypothesis that a farming system is increasingly more sustainable as its physical structure and species composition becomes closer to the original local rainforest.

In field trials on a 7 ha hilly area at ViSCA, 100 selected local tree species were tested for their performance in achieving a three-storied and maximally diverse rainforest association. Crop production is enriching the system through understory species of e.g. *Colocasia* (gabi) and *Dioscorea* (ubi) and a variety of unconventional activities e.g. mushroom cultivation, apiculture, and flower production.

Farmer-researchers are adapting the system by applying the basic principles and modifying the flexible components to their needs and to site specific requirements.

A major drawback is the scarcity of seeds from highly valid tree species due to the almost complete extinction of the Philippine lowland rainforest and to ongoing selective timber poaching which is specifically eliminating "mother trees".

Keywords: "Closed canopy and high diversity forest farming system"

INTRODUCTION

Much has been published about indigenous farming practices in the Philippines. However, most of the data generally refer to single activities like growing grasses in contour lines to diminish erosion, use of native crop varieties and botanicals, and other isolated practices rather than an integrated and more holistic farming concept or practice.

It is doubtful that these practices have been merely adapted due to the manyfold efforts of extensionists, news articles, broadcasting of farmers' programs and the educational impact of demo farms or knowledge gained at educational institutions. These are scarcely known valid examples of lowland or upland farming systems which are characteristic to the Philippines only and which apply a considerable number of closely interwoven indigenous technologies to sustain a whole ecosystem with all its complex biotic and abiotic interrelationships except the rice terraces in the Mountain Province of Northern Luzon.

Probably, the *kaingin* system was and still is the very indigenous farming system in most parts of the Philippines. Cuevas (unpublished draft) states that majority of the 43 cultural minorities found in the different islands of the Philippine archipelago practices shifting cultivation. Ramakrishnan (1991) suggests that shifting cultivation is an advanced form of agro-ecosystem very closely adapted to the humid tropics. However, he considers a 10-year cycle as the minimum length both ecologically and economically. One of the chief reasons why all alternative land-use strategies have failed is because man has not come up with any other technology that could effectively replace the efficient way in which the natural process of secondary forest succession can build up soil fertility (Ramakrishnan 1991).

The Philippines, however, has one cultural group that combines sustainable farming without shifting and watershed management that successfully uses the above mentioned natural process of secondary forest succession while simultaneously managing highly diverse old forest stands. They are the Ifugaos who are receiving worldwide attention for their spectacular rice terraces. Their farming systems are sustainably managed for centuries and are closely interrelated with other compartments of the total watershed area (Fig. 1).

In addition, irrigated rice fields provide a variety of biotic processes unique to shallow waters in warmer climates that sustain productivity by mechanisms of nitrogen fixation and nutrient retention and trapping (Margraf, 1988).

HYPOTHESIS

The closer a farming system in the humid tropics is to a natural rainforest ecosystem in its physical structure, the more efficient it can maintain its ecosystem functions.

Such ecosystem functions are the maintenance of the small water cycle (Figs. 2 and 3), the continuous water supply to rivers and barrios, the reduction of erosion, the preservation of a high species diversity, and the continuous high production of fruits, root crops, lumber and other forest farming products.

ACTIVITIES AND PRELIMINARY RESULTS

Since 1990, research at ViSCA under the ViSCA-GTZ Ecology Program has focused on comparing different *kaingin* systems and primary forest for parameters such as soil nutrients, floral composition, fungi, insect communities, pest predator relationships aside from marine research.

In January, 1992, the Tropical Ecology Program started a demonstration farm and nursery to establish a "**Closed Canopy and High Diversity Forest Farming System**" in cooperation with the Department of Environment and Natural Resources (DENR), Tacloban, and several departments at ViSCA to develop a farming system that most closely resembles the structure of a natural Philippine rain forest ecosystem.

The scheme aims to provide *kaingineros* with a package that contains:

- a minimum of 50 fruit tree species (Table 1)
- a minimum of 50 lumber producing species (Table 2)
- a variety of climbing crops (e.g. sajote, passion fruit, rattan etc.)
- a variety of shade tolerant root crops (e.g. *Dioscorea* spp., *Colocasia* spp. etc.)

The livelihood range of a farmer's family in most parts of Leyte comprises all major ecosystems from the sea to the mountain forests (Fig. 4). The "Closed Canopy and High Diversity Forest

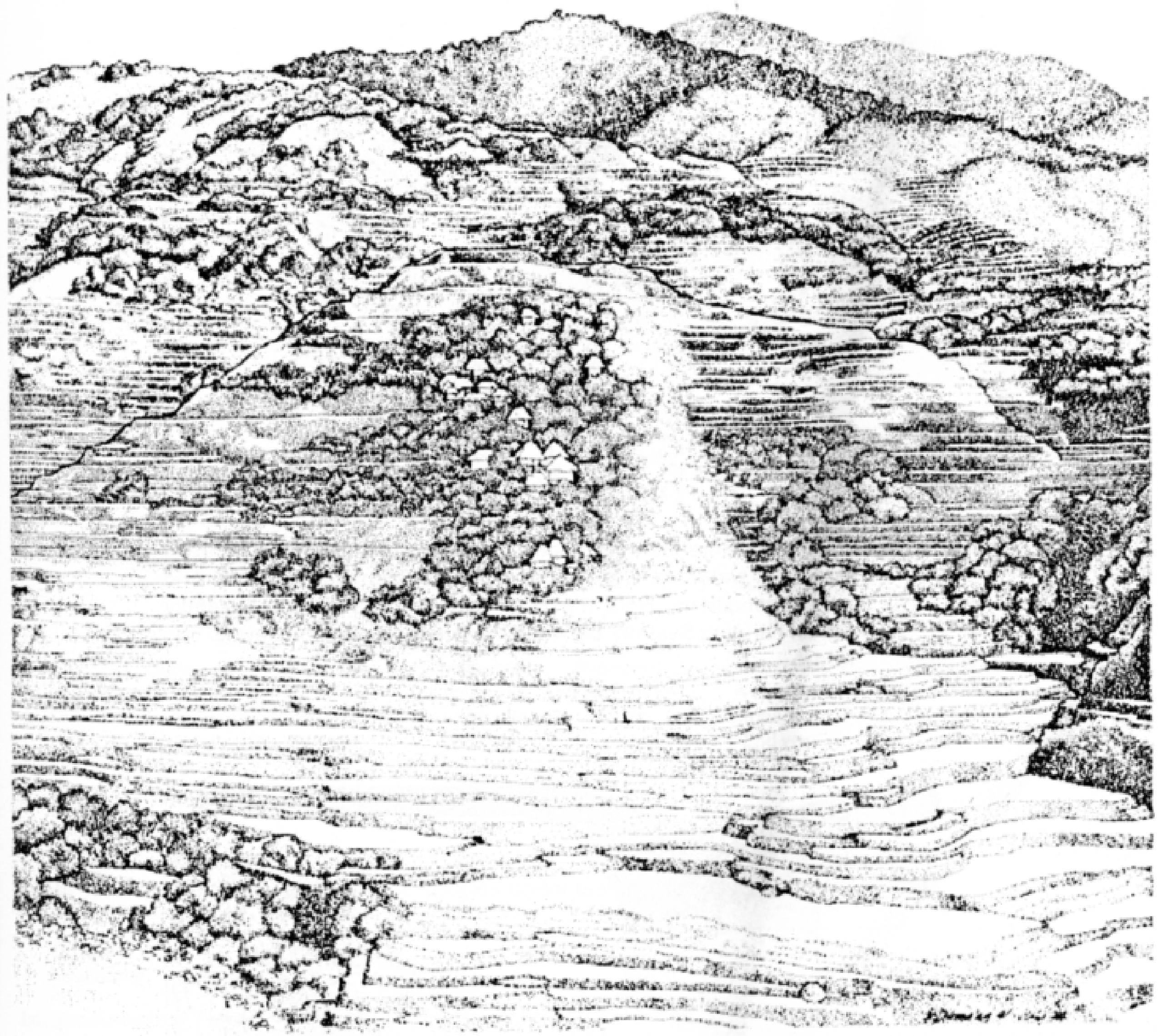

Figure 1. Ifugao rice terraces ecosystem. The different compartments of the watershed area are connected by nutrient flow and human activity (translated from Margraf and Voggesberger1988).

Farming System" is meant to gradually replace the environmentally destructive forms of upland and *kaingin* farming located between the lowland ricefields and the protected mountain forest.

So far, a research and model farm on 17 hectares within ViSCA boundaries is gradually being developed. In the near Baybay area, a total of 40 ha distributed from 50 m to 300 m a.s.l. and on volcanic as well as on limestone soils are provided for long term trials by cooperating farmers and land owners. The *kaingin* farmers of the pilot areas are presently organized and receive informal education. A nursery was established which is presently handling about 80 dif-

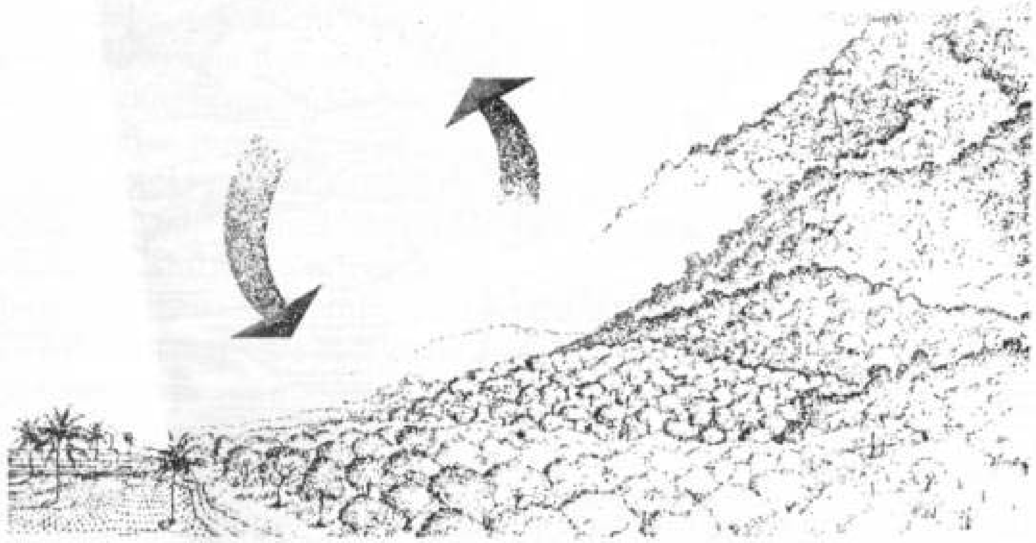

Figure 2. Philippine watershed with intact ecosystem structures and functions. The small water cycle is providing optimal evapotranspiration and rainfall conditions. Note the "Closed Canopy and High Diversity Forest Farming System" between the rice fields and the natural rain forest.

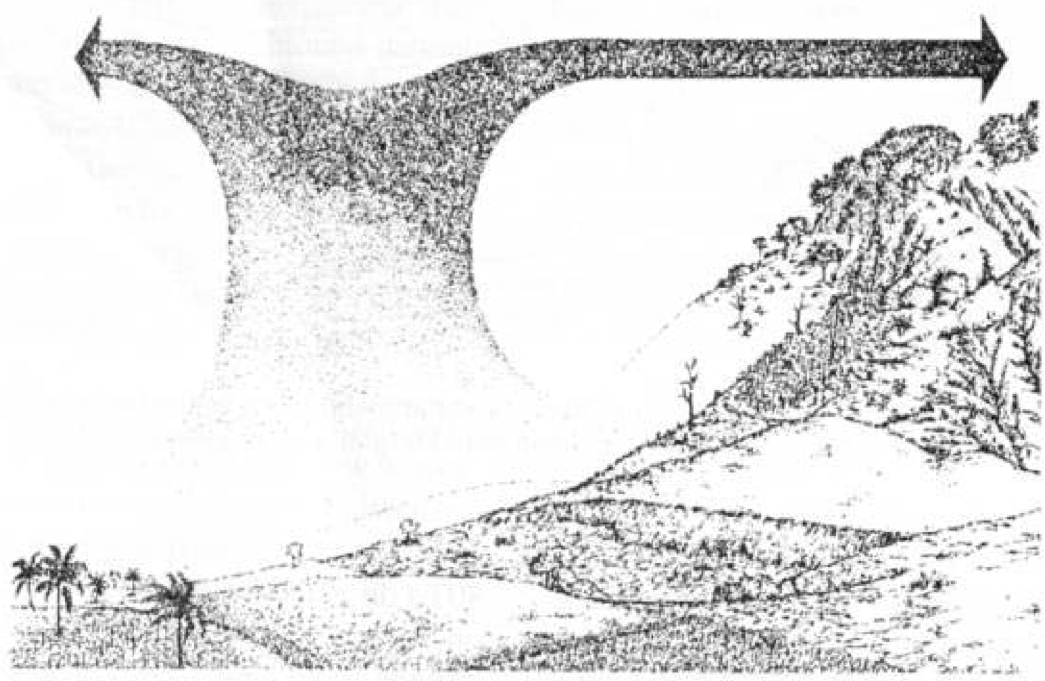

Figure 3. Philippine watershed with destroyed ecosystem structures and functions. The small water cycle is interrupted due to the destruction of the forest. The surfaces are heating up and convection is carrying up the reduced moisture to higher elevation where it is more easily disbursed by wind.

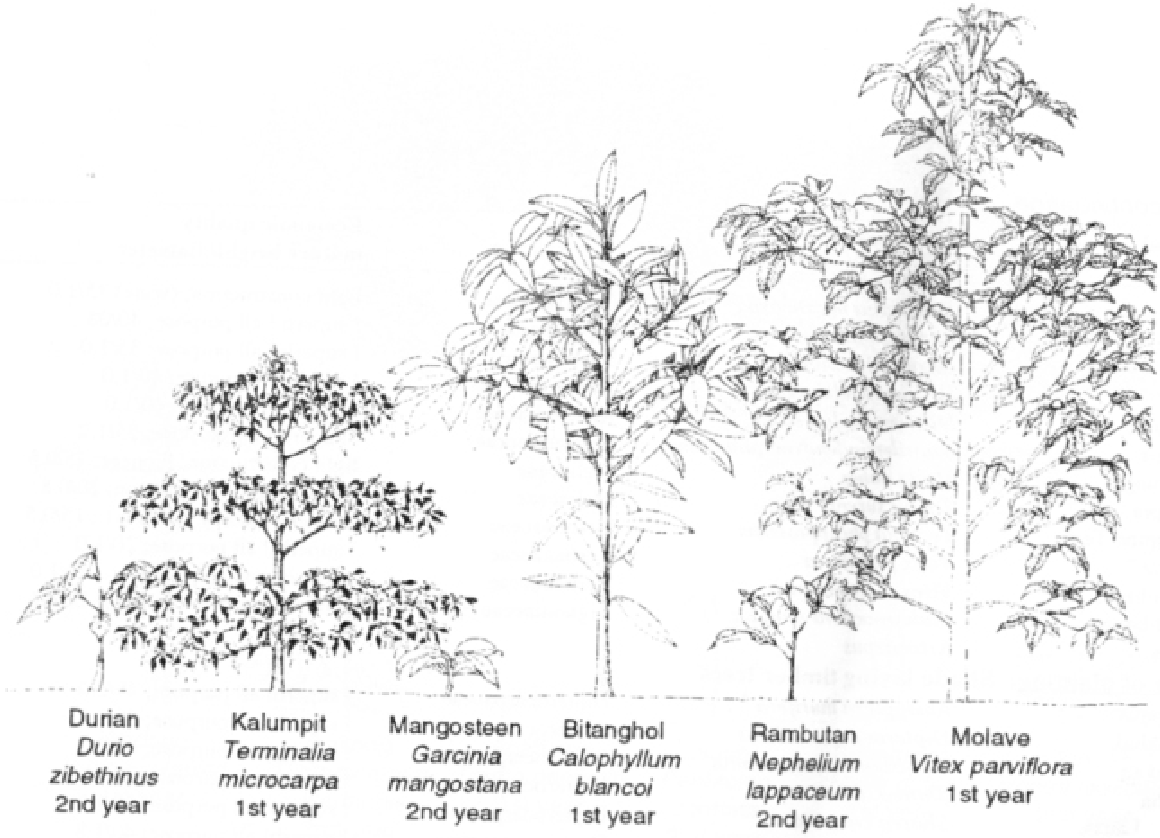

Table 1. Philippine local forest tree species under test for Rainforest Farming in ViSCA

Official local name	Scientific name	Family	Economic quality mature height/diameter
1st year of planting: Sun demanding timber trees			
Anabiong	*Trema orientalis*	Ulmaceae	light, good shade, Pioneer; 35/0.5
Gumihan	*Artocarpus sericicarpus*	Moraceae	! superb! all purpose, boats; 35/1.0
Agoho	*Casuarina equisetifolia*	Casuarinaceae	good, house posts; 30/1.0
Mntn. Agoho	*Casuarina nodiflora*	Casuarinaceae	good, house construction; 20/0.8
Bitanghol	*Calophyllum blancoi*	Clusiaceae	good, all purpose; 25/0.6
Bitaog	*Calophyllum inophyllum*	Clusiaceae	good, furniture; 20/1.5
Toog	*Petersianthus quadrialatus*	Lecythidaceae	! superb ! all purpose; 40/1.5
Tindalo	*Afzelia rhomboidea*	Caesalpiniaceae	! superb ! all purpose; 25/0.5
Narra	*Pterocarpus indicus*	Fabaceae	! superb ! furniture; 40/1.2
Ipil	*Intsia bijuga*		! superb ! furniture; 50/1.50
Akleng-parang	*Albizia procera*	Mimosaceae	! superb ! furniture; 25/0.7
Rain tree	*Samanea saman*	Mimosaceae	! superb ! furniture; 25/1.2
Bagras	*Eucalyptus deglupta*	Myrtaceae	good, construction, pulb; 70/2.4
Malabayabas	*Tristania decorticata*	Myrtaceae	! superb ! heavy construct.; 25/100
Talisay Gubat	*Terminalia foetidissima*	Combretaceae	good, house constr., boats; 25/0.8

Table 1 *continuation...*

Official local name	Scientific name	Family	Economic quality mature height/diameter
Kalumpit	*Terminalia microcarpa*	Combretaceae	light construction; (wine) 35/1.0
Malugai	*Pometia pinnata*	Sapindaceae	! superb ! all purpose; 40/08
Bogo	*Garuga floribunda*	Burseraceae	! superb ! all purpose; 35/1.0
Dao	*Dracontomelon dao*	Anacardiaceae	! superb ! furniture; 40/1.0
Lamio	*Dracontomelon edule*	Anacardiaceae	good, construction; 40/1.0
Amugis	*Koordersiodendron pinnatum*	Anacardiaceae	! superb ! all purpose; 25/1.2
Bagalunga	*Melia dubia*	Meliaceae	light construction, Pioneer; 15/0.5
Danupra	*Toona sureni*	Meliaceae	good, house construction; 20/0.8
Philippine Teak	*Tectona philippinensis*	Verbenaceae	! superb ! heavy construct.; 15/0.5
Molave	*Vitex parviflora*	Verbenaceae	! superb ! all purpose; 20/1.0
Lingo-lingo	*Vitex turczanihowii*	Verbenaceae	good, constr., music.instr.; 30/1.0
Banai-banai	*Radermachera pinnata*	Bignoniaceae	good, all purpose, Pioneer; 20/0.6
Lanka	*Artocarpus*		
2nd year of planting: Shade loving timber trees			
Palosapis	*Anisoptera thurifera*	Dipterocarpaceae	! superb! all purpose; 45/2.0
Hagakhak	*Dipterocarpus validus*	Dipterocarpaceae	! superb! all purpose; 50/1.8
Bagtikan	*Parashorea malaanonan*	Dipterocarpaceae	! superb! all purpose; 60/2.0
Almon	*Shorea almon*	Dipterocarpaceae	! superb! all purpose; 70/1.6
White Lauan	*Shorea contorta*	Dipterocarpaceae	! superb! all purpose; 50/1.8
Guijo	*Shorea guiso*	Dipterocarpaceae	! superb! all purpose; 40/1.8
Red Lauan	*Shorea negrosensis*	Dipterocarpaceae	! superb! all purpose; 50/2.0
Mayapis	*Shorea palosapis*	Dipterocarpaceae	! superb! all purpose; 50/1.5
Tangile	*Shorea polysperma*	Dipterocarpaceae	! superb! all purpose; 50/2.0
Talakatak	*Castanopsis philippinensis*	Fagaceae	! superb! furniture; 25/0.5
Ulaian	*Lithocarpus pruinosa*	Fagaceae	good, construction; 30/0.5
Kamagong	*Diospyros philippinensis*	Ebenaceae	good, furniture; 20/0.8
Dungan	*Heritiera sylvatica*	Sterculiaceae	! superb! construct., posts; 20/0.8
Kulatingan	*Pterospermum obliquum*	Sterculiaceae	good, construction; 25/0.7
Mangosteen			
3rd year of planting: Shade demanding, slow growing timber trees			
Manggachapui	*Hopea acuminata*	Dipterocarpaceae	! superb! hard construct.; 35/0.9
Dalingdingan	*Hopea foxworthyi*	Dipterocarpaceae	! superb! all purpose; 35/0.6
Gisok-gisok	*Hopea philippinensis*	Dipterocarpaceae	good, construction; 20/0.5
Yakal-kaliot	*Hopea malibato*	Dipterocarpaceae	! superb! hard construct.; 35/0.5
Yakal-malibato	*Shorea malibato*	Dipterocarpaceae	! superb! hard construc.; 35/0.8
Balobo	*Diplodiscus paniculatus*	Tiliaceae	good, light construction; 20/0.8

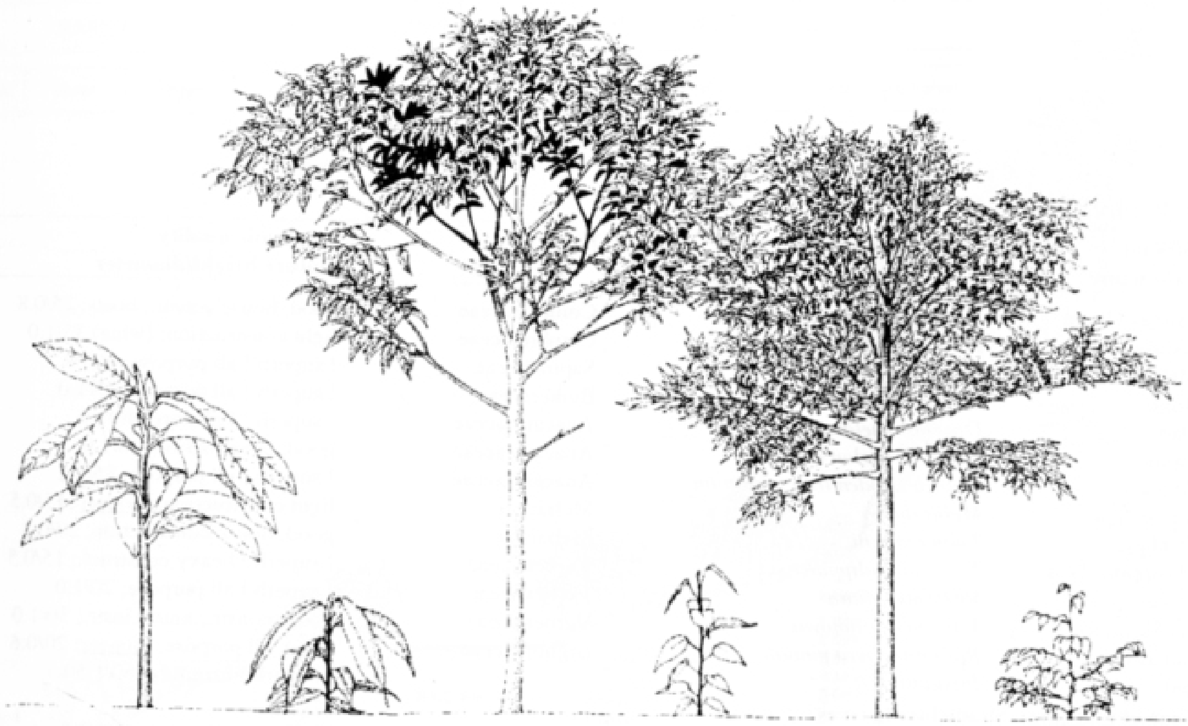

Table 2. Philippine local forest tree species recommended for ecological reforestation on islands with no pronounced dry season.

Official local name	Scientific name	Family	Economic quality mature height/diameter
<u>1st year of planting</u>: **Sun demanding trees**			
Palosapis	*Anisoptera thurifera*	Dipterocarpaceae	! superb! all purpose; 45/2.0
Anabiong	*Trema orientalis*	Ulmaceae	light, good shade, <u>Pioneer</u>; 35/0.5
Gumihan	*Artocarpus sericicarpus*	Moraceae	! superb! all purpose, boats; 35/1.0
Agoho	*Casuarina equisetifolia*	Casuarinaceae	good, house posts; 30/1.0
Mntn. Agoho	*Casuarina nodiflora*	Casuarinaceae	good, house construction; 20/0.8
Bitanghol	*Calophyllum blancoi*	Clusiaceae	good, all purpose; 25/0.6
Bitaog	*Calophyllum inophyllum*	Clusiaceae	good, furniture; 20/1.5
Toog	*Petersianthus quadrialatus*	Lecythidaceae	! superb ! all purpose; 40/1.5
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Akleng-parang	*Albizia procera*	Mimosaceae	! superb ! furniture; 25/0.7
Rain tree	*Samanea saman*	Mimosaceae	! superb ! furniture; 25/1.2
Bagras	*Eucalyptus deglupta*	Myrtaceae	good, construction, pulb; 70/2.4
Malabayabas	*Tristania decorticata*	Myrtaceae	! superb ! heavy construct.; 25/100

Table 2 *continuation...*

Official local name	Scientific name	Family	Economic quality mature height/diameter
Talisay Gubat	*Terminalia foetidissima*	Combretaceae	good, house constr., boats; 25/0.8
Kalumpit	*Terminalia microcarpa*	Combretaceae	light construction; (wine) 35/1.0
Malugai	*Pometia pinnata*	Sapindaceae	! superb ! all purpose; 40/08
Bogo	*Garuga floribunda*	Burseraceae	! superb ! all purpose; 35/1.0
Dao	*Dracontomelon dao*	Anacardiaceae	! superb ! furniture; 40/1.0
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Lingo-lingo	*Vitex turczanihowii*	Verbenaceae	good, constr., music.instr.; 30/1.0
Banai-banai	*Radermachera pinnata*	Bignoniaceae	good, all purpose, Pioneer; 20/0.6
Ipil	*Intsia bijuga*		! superb ! furniture; 50/1.50
2nd year of planting: Shade loving trees			
Hagakhak	*Dipterocarpus validus*	Dipterocarpaceae	! superb! all purpose; 50/1.8
Bagtikan	*Parashorea malaanonan*	Dipterocarpaceae	! superb! all purpose; 60/2.0
Almon	*Shorea almon*	Dipterocarpaceae	! superb! all purpose; 70/1.6
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Guijo	*Shorea guiso*	Dipterocarpaceae	! superb! all purpose; 40/1.8
Red Lauan	*Shorea negrosensis*	Dipterocarpaceae	! superb! all purpose; 50/2.0
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Tangile	*Shorea polysperma*	Dipterocarpaceae	! superb! all purpose; 50/2.0
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Dungan	*Heritiera sylvatica*	Sterculiaceae	! superb! construct., posts; 20/0.8
Kulatingan	*Pterospermum obliquum*	Sterculiaceae	good, construction; 25/0.7
3rd year of planting: Shade demanding, slow growing trees			
Manggachapui	*Hopea acuminata*	Dipterocarpaceae	! superb! hard construct.; 35/0.9
Dalingdingan	*Hopea foxworthyi*	Dipterocarpaceae	! superb! all purpose; 35/0.6
Gisok-gisok	*Hopea philippinensis*	Dipterocarpaceae	good, construction; 20/0.5
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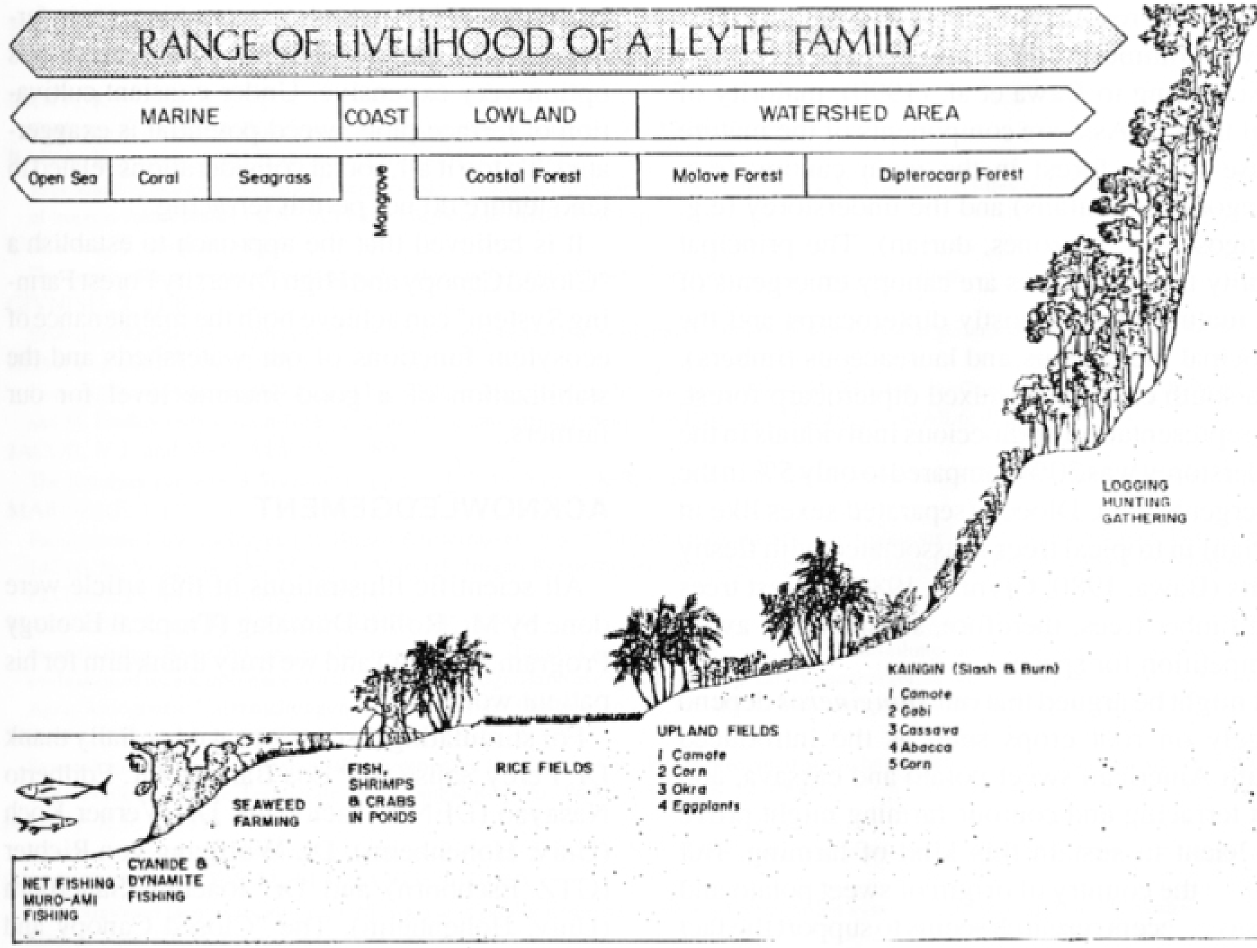

Figure 4. Livelihood range of a farmer's family in Leyte, Philippines. The ecosystem functions of each subecosystem has to be considered through a synecological approach for ecologically sound development (after Milan and Margraf, 1990).

ferent tree species and is continuously increasing its stock through seeds and seedlings gathered from the Mt. Pangasugan forest reserve.

DISCUSSION

Using Nair's (1989) classification of agroforestry systems, our "Closed Canopy and High Diversity Forest Farming System" ranges somewhere between a "Multilayer Tree Garden" and a "Homegarden" which are to be found especially in areas of high human population pressure. Okafor and Fernandes (1989) described compound farms of southeastern Nigeria which are characterized by diversified production including 69 trees and shrub species in a multistoreyed association. Homegardens are described from Sri Lanka where up to 1,700 trees and shrubs are listed in one hectare with a multistorey canopy configuration (Jacob and Alles, 1989).

This high density might be achieved only by allowing a high diversity of compatible trees with different life forms which are less competitive for resources against their immediate neighbor trees but might rather optimize the use of available resources through their tightly interwoven community structure.

According to Bawa et al. (1990), majority of fruit trees in Asia are components of the mature phase of the forest in the main canopy (e.g. mangoes, rambutans) and the understorey (e.g. mangosteens, lanzones, durian). The principal quality timber species are canopy emergents of the mature phase (mostly dipterocarps and the principal meliaceous and laureaceous timbers). In a south east Asian mixed dipterocarp forest, the representation of dioecious individuals in the understorey was 30% compared to only 5% in the emergent strata. Dioecy (separated sexes like in durian) in tropical trees is associated with fleshy fruits (Bawa, 1980; Givnish, 1980). Forest trees and timber trees, therefore, substantially avoid competition for space.

It might be argued that our *kaingineros* depend largely on root crops such as the introduced South American sweet potato and cassava, and that terracing and contour farming might prove sufficient to sustain this kind of farming. But even in the country of origin of sweet potato and cassava, recent research seems to support the fact that traditional agriculture was based on highly diversified land use within which useful trees and managed "natural forests" played a central role (Gomez-Pompa, 1991).

Likewise, terracing under rainfed conditions seems not to be the ultimate answer to sustainable farming. Ramakrishna (1991) states that terracing for sedentary agriculture is one alternative that has failed to find its acceptance. Apart from the fact that infiltration losses (particularly of nitrogen and phosphorus) are considerable, the fertility depletion is heavy as observed during the second year of terrace cultivation. In fact, both physical and chemical qualities of the soil are so badly altered such that the farmer often leaves the terrace plots after 6 - 8 years of continuous cropping because the land is totally degraded by then. Under high monsoonic rainfall conditions, maintenance costs for terraces are heavy. In addition, high inputs of inorganic fertilizers that are difficult to obtain make this option very expensive. Under constant cultivation of terrace plots, weed potential is exaggerated. To top it all, social considerations related to land tenure do not permit terracing."

It is believed that the approach to establish a "Closed Canopy and High Diversity Forest Farming System" can achieve both the maintenance of ecosytem functions of our watersheds and the stabilization of a good income level for our farmers.

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