Introduction of Agroforestry in the Philippines

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Abstract

Increase of population and its associated pressures on agricultural land have threatened tropical forests in the production of food, fuel, and timber. After deforestation, it is often difficult to sustain annual crop production since nutrients are rapidly leached from the soil due to high rainfall in the tropics. There are several sites and systems of agroforestry where agriculture is combined with forestry to provide food and wood without causing a degradation of the ecosystems in the Philippines. We investigated sites where agroforestry is applied using sloping agriculture land technology in Ilocos Norte and multistoried cropping systems in Cavite in 1991. Although the topography of these sites was different, the common feature was the emphasis placed on soil and water conservation as well as on soil fertility maintenance using trees and crops at the same time and sequentially, since these were the major factors affecting further development and sustainability of the upland areas.

Additional key words: agrisilviculture, soil erosion, multistoried cropping system, sloping agriculture land technology

Introduction

Increase of population and its associated pressures on agricultural land have threatened production in tropical forests. Actually, small-scale farmers are exerting a strong pressure on the

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upland areas for the supply of food, fuel, and timber in the Philippines[6]. According to Llapitan (1983), although 16.7 million ha (or 56%) in the Philippines were classified as forest, 5.6 million ha consisted of degraded land due to deforestation and slash-and-burn agricultural practices and 11.1 million ha forest land[4]. These farmers should adopt an the alternative system of land management that combines agriculture and forestry to obtain food and wood without causing the degradation of the ecosystems[3,7]. Such a land management system is currently referred to as agroforestry[5]. Without the protection of trees it is often difficult to secure annual production of food crops in the high rainfall tropical areas and nutrients are rapidly leached from the tropical soils[3,7].

Nair[8] designated agroforestry systems as agrisilvicultural systems (crops-including tree/shrub crops-and trees), silvopastoral systems (pasture/animals+trees), and agrosilvopastoral systems (crops+pasture/animals+trees) based on the nature of the components. For the agrisilvicultural systems, various sub-systems and practices are included such as hedgerow intercropping (alley cropping), multistorey combination of plant communities belonging to multiple species, multipurpose trees and shrubs on farmland, shade trees for commercial plantation crops, shelterbelts and windbreaks, soil conservation hedges on crop production fields, and so on[8]. These technologies aim at improving the soil fertility and promoting soil and water conservation[3].

In this paper, the following systems of agroforestry that were studied in 1991 in Luzon island in the Philippines will be presented with emphasis placed on sloping agriculture land technology and multistoried cropping systems for agrisilviculture. These technologies were described elsewhere in detail[1,7].

Materials and Methods

Site

Surveys were carried out of agroforestry sites located at the Mariano Marcos Memorial State University and Brgy, Payao, Batac, Ilocos Norte (about 18° 3'N Lat.) on 25 September, 1991 and the Sanayan sa Kakayahang Agrikuitura Village Farm Project, Indang, Cavite (about 14° 11'N Lat.) on 16 August, 1991 (Fig. 1). We conducted interviews with the representatives of these sites about the extent of the area, cultivation methods, tree and crop names, etc. The topography, type of agroforestry system, area of site, tree and crop names, fertilizer application and annual rainfall in these sites are shown in Table 1.

Results and Discussion

Sloping agriculture land technology (SALT)

Data collected in Ilocos Norte on SALT are listed in Table 1. Areas of agroforestry at the Mariano Marcos Memorial State University (MMMSU) and Brgy covered about 10 ha and 20 ha, respectively. In the upper portion of the hill land where the slope was too steep to grow agricultural crops, tree species with various habitats (acacia: *Acacia auriculiformis* Cunn. ex

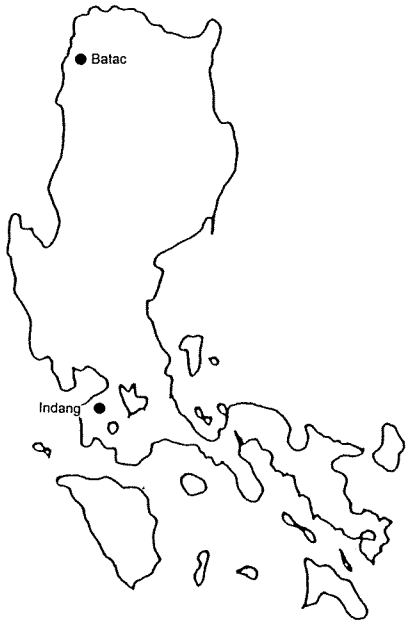

Fig.1. Locations of surveys on agroforestry site in Luzon island of the Philippines.

Table 1. Comparison of agroforestry sites at the Mariano Marcos Memorial State University (MMMSU) and Brgy with that at Sanayan sa Kakayahang Agrikultura (SAKA) Village

Site	MMMSU & Brgy	SAKA
Topography	sloping	flat
Agroforestry system	sloping agriculture land technology	multistoried cropping systems
Area of agroforestry	10 ha (20ha)[1)]	10 ha
Tree	acacia, eucalyptus, ipil-ipil,narra, rain tree, teak, kakawate, coffee, mahogany, yemane, tamarind, citrus, mango, papaya, kalamansi, citrus, guyabano	coconut, kakawate,coffee, santol,guyabano, guava, jackfruit, kalamansi, cacao
Crop	upland rice, soybean, string beans, black pepper eggplant, okra, squash gabi, pineapple, sweet pepper	ginger, black pepper, ubi, gabi,cassava, corn, pineapple, napier
Fertilization	no application or application of compost or manure	urea
Annual rainfall	1400~2600 mm	2000~2500 mm

[1)]Area at Brgy

Benth., eucalyptus: *Eucalyptus camaldulensis* Dehn., ipil-ipil: *Leucaena leucocephala* (Lam.) De Wit, kakawate: *Gliricidia sepium* (Jacq.) Walp., narra: *Pterocarpus indicus* Willd., tamarind: *Tamarindus indica* L., teak: *Tectona grandis* L. f., etc.) were planted of a suitable density for different purposes like firewood, fodder, green manure, charcoal, poles, furniture, construction materials, etc. Tree ages varied from 3 to 15 years. Ipil-ipil and kakawate were used as shade trees for coffee which cannot tolerate too much heat from the sun during the growing stage[3)]. In the counter-rows, hedgerows of kakawate which is a fast-growing species, vigorous sprouting and nitrogen fixation occurred for the prevention of soil erosion. After periodical trimming, the foliage of kakawate was used as green manure and mulch for the soil and associated crops[3,9)]. Between hedgerows upland rice (IR 5, IR 7, Maluit), soybean, vegetables, etc. were grown (Plate 1). Fruit crops were distributed at the bottom of the sloping land.

Generally, upland rice is extensively intercropped with trees[7,9)] as trees provide green-leaf fertilizer for upland rice. Nitrogen is almost always in short supply for upland rice[7)]. On the other hand, nitrogen application is not necessary for legumes due to symbiotic nitrogen fixation. Usually, legumes and the other crops are rotated to maintain productivity, fertility and good soil formation[7,9)].

Plate 1. Soybean and hedgerows of kakawate grown in counter lines.

Multistoried cropping system

Multistoried cropping systems were developed by farmers and spread over 12,285 ha in Cavite Province in the Philippines[2)]. Typically, coffee, upland rice, banana, pineapple, papaya, kakawate, fruit trees and tuber crops are grown together on rainfed and flat areas[2)]. Some crop combinations at the Sanayan sa Kakayahang Agrikultura (SAKA) Village Farm Project, Indang, Cavite are depicted in Table 1 (Plate 2). The age of coconut was about 60 years and age of the other

Plate 2. An example of multistoried cropping systems using coconut, papaya, banana and pineapple in Cavite.

crops was less than 4 years old. The plant height of coconut was about 30 to 40 m and that of coffee, santol, kakawate, guyabano and banana ranged from 2 to 4 m. The upper portion was occupied by coconut, followed by kakawate, fruit trees, coffee and banana. At the floor level, cassava, gabi (*Colocasia gigantea* Hook. f.), and pineapple were grown. Actually, there were many variations due to the differences in the socio-economic conditions of the households. Further more these combinations were sequentially established (relay-planting). The role of these trees and crops is as follows[2]. Coconut tree which has a relatively small and open crown intercepts only a small proportion of radiation and casts only little shade on the understorey species. Kakawate provides shade to the area and is used as a shade tree for coffee. As in the case of kakawate, bananas are effective in utilizing solar radiation and reducing soil temperatures[1]. Pineapples occupy the soil area between coffee trees and prevent soil erosion since the average annual rainfall ranges from 2000 to 2500 mm (Table 1). Napier grass (*Pennisetum purpureum* Schumach.) is also used for the prevention of soil erosion. Gabi can tolerate shade and its big leaves protect the soil from heavy rainfall. It was assumed that the roots of the trees and crops occupied different vertical layers of underground as well as open space.

With such a combination and sequence of crops in these multistoried cropping systems, the cash flow for the households is spread across the year and family labor utilization is evenly distributed and maximized[10]. However, urea was applied to crops intensively, especially to coffee.

Conclusions

Although the topography of these sites was different, the common feature was the emphasis placed on soil and water conservation as well as on soil fertility maintenance using trees and crops at the same time and sequentially, since these are the major factors affecting further development and sustainability of the upland areas.

On the other hand, it is expected that the social, production and environmental sectors will become involved in agroforestry systems to optimize the combined production of agricultural crops and trees and at the same time conserve and improve the sites.

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フィリピンにおけるアグロフォレストリーの紹介

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摘 要

イロコスノルテ州の実践地では土壌保全のため等高線上に早生樹のカカワテが帯状に植栽され，その間に陸稲，豆類及び野菜が輪作されていた。カビテ州では上層にココナツ，下層にカカワテ，パパイヤ，コーヒー，バナナ，パイナップル，サトイモなどが連続的に植栽され，空間の高度利用が行われていた。これらの地域の地形は傾斜地と平坦地とそれぞれ異なるが，どちらの技術も同時あるいは連続的に林木と作物を植栽することによって土壌の肥沃化や土壌保全化が図られ持続的農業を担っている点で共通していた。

一方でアグロフォレストリーの研究は，まず実行形態を把握し，社会的背景の究明や経営・経済的な分析が不可欠である。これには農業や林業における様々な研究分野に跨ることから，多くの分野の専門家が協力して研究を進めていくことが重要になる。

キーワード：農林業，土壌侵食，多層混農林作付体系，傾斜地農業技術

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