

## SYLVO-PASTORAL SYSTEMS IN THAILAND

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### ABSTRACT

The term sylvo-pastoral system refers to the production technique which integrates livestock, pastures and tree growing so as to get maximum benefit from a unit area of land. Advantages of this kind of integration include additional income from stock sale, reduction of the cost of weeding of the plantation, prevention of fire risk in the young plantation and improvement of soil fertility by growing legume fodder and production of cow dung. In Thailand the forest villages were established in a number of areas and the integration of the livestock into forest plantations was first implemented in 1979 by the Forest Industry Organization. Subsequent studies have revealed that an extra-income of US\$ 73.3 per family was obtained from stock sale. The villagers in the forest village are encouraged to adopt this system. Approach to produce sustainable fodder for livestock in the system is outlined. Fourteen native forage species which are shade-tolerant are listed. Recommended improved species are Centro, Puero, *Desmodium ovalifolium*, Calopo, Guinea, Ruzi, Cori and Signalgrass. Suitable tree legumes are *Leucaena*, *Sesbania*, *Gliricidia* and *Erythrina*. The author proposes that the agro-forestry system should receive high priority consideration not only for increasing the earnings of the villagers but also for protecting the valuable forest land of the country.

### Introduction

Agro-forestry system is a complex production technique aimed at increasing the benefits that man derives from a given area of forest land. Sustainable production of marketable products could be obtained by an appropriate integration of crop farming, fruit tree growing or pasture and livestock raising within the forest land. The area is managed so as to allow for the combined components in the system to proceed smoothly. In the developing countries where the population density is high, farm land area limited and supply of food is insufficient, the idea of diversifying farm area or forest land seems to be a new avenue, provided that conditions such as adequate water resources are fulfilled.

In the forestry world, with suitable techniques and management, crops, pasture and livestock or bee could be introduced to form a production system in the forest land which is modified to suit a particular purpose. Thus technical terms are coined for a special kind of activities involved in relation to tree production in the area. Thus the words agro-forestry system, sylvo-pastoral system and apsilviculture are used for crop-tree, pasture and livestock, and livestock and bee-keeping within the forest land respectively.

The idea of integrating livestock into the forest activities is not new. In New Zealand, for instance, Miller (1975) reported successful grazing of cattle under pine forests (*Pinus radiata*). In this case the forage grasses were well established and provided sufficient feed for the cattle. Very high stocking rate was used without deleterious effect on the pasture and the trees. In 1979 a Workshop was held in Costa Rica to discuss and formulate a plan for agro-forestry systems. At this meeting Budowski (1979) proposed three possible ways to combine any production activity to design an agro-forestry system. Fig. 1 illustrates his concept of combining agriculture, forestry and animal husbandry.

The system No 2 will involve growing suitable trees in combination with livestock raising on the same piece of land. The trees shall be considered as the main source of income and the livestock a complementary one.

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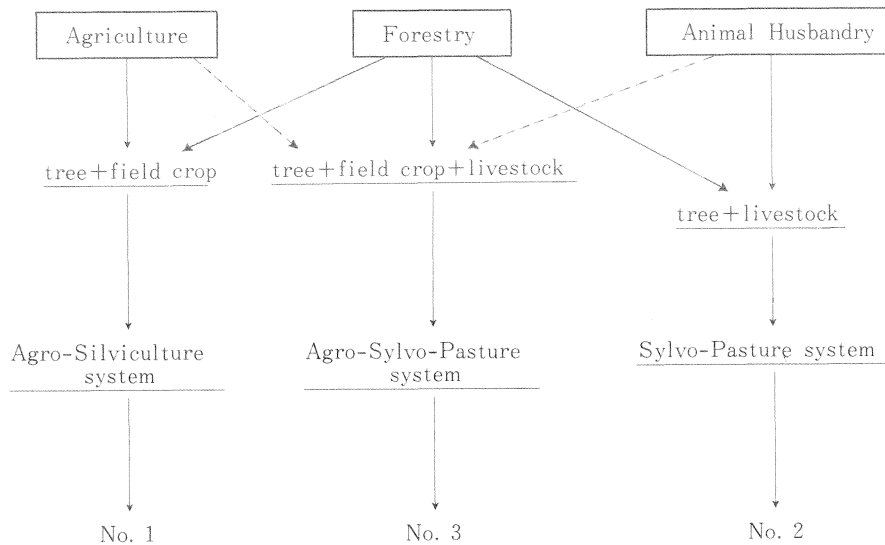


Fig. 1 Types of agro-forestry systems. After Budowski (1979).

Advantages that could be brought about in this system are:

1 To reduce cost for weeding. Weeds pose a problem in many forest plantations particularly in the early stage of tree planting. Tree seedlings are usually slow in their growth and are readily covered by weeds such as cogon or other fast-growing undesirable species. The livestock particularly cattle could graze off the grasses and fodder plants and keep the area clean, allowing the growing tree seedlings to receive sufficient sunlight and resume normal growth. The present cost of weeding in a forest plantation, which is performed twice a year, is US\$43.6 per hectare (Montee, 1984). By managing the herd properly, maintaining an appropriate stocking rate, the cost of weeding could be substantially reduced.

2 To provide an additional income. Normally it would take 6-10 years for a fairly fast-growing tree to reach the stage where it could be cut for timber or logging. The area of idle land under the trees could be used for raising pasture crops and livestock. Livestock sale could be a good source of additional income.

3 To avoid possible fire risk. If grasses are allowed to grow unchecked, fire hazard during the dry period could be deleterious to young plants. Livestock could keep the grass short and remove dry standing hay, thereby reducing the risk of uncontrolled burning.

4 To help increase soil fertility. Normally forage legumes are used for pastures and the fertility of soils could be built up by legume plants through the nitrogen fixation brought about by the *Rhizobium* bacteria associated with the legumes. Also, cattle manure would be a good source of material for this purpose. A mature cow of the indigenous breed can produce 350 kg/year of manure.

### Main aspects to be considered

There are three individual components that comprise the sylvo-pastoral system. These are the trees, pasture plants and the livestock. Being a living thing, each of them requires specific care and management so as to grow and produce a good yield. Selection of tree crop species, forage crops and kind of livestock is important. Equally important for a successful project, is the knowledge about the socio-economic characteristics of the community and the

market where the products from the system could be smoothly disposed off. In Thailand, for example, corn is recommended for agro-forestry systems (system No 2) for most of the area suitable for field crops. This is because there are good markets, both for local use and for export (Montee, 1982). Corn grain is one of the important export commodities of the country.

### Characteristics of suitable tree crops

Trees to be included in the system should be selected on the following basis:

1 Narrow branches. This is to reduce shading effect to promote forage growth. *Eucalyptus* is most useful in this respect. It produces relatively short branches even at the fully grown stage. *Acacia mangium* is another tree that deserves close attention for silvo-pastoral systems.

2 Deep root system. This is to prevent the strong competition for nutrients from the soils. Pasture plants have normally shallow roots and the roots of the forest trees should not interfere with their development and function.

3 Leaves for livestock feed. This is to provide feed for the livestock either as a supplement feed during the dry period or as a protein supplement during the growing season. Tree legumes such as giant *Leucaena*, *Sesbania* and *Acacia* are good for this purpose. Also soil fertility shall be improved by such legumes.

4 Economic value. Most important in selecting the trees for the system is the market value of the timber obtained from the trees.

### Characteristics of suitable forage species

The forage crops that should be chosen for inclusion in the system should have the following characteristics:

1 Adaptable to shady area. Yield of a forage species will be markedly reduced if the crop is grown in dense shade. Some species are able to tolerate light shade and these should be selected. Cori grass and Centro are most suitable. Species of *Microstegium* and *Axonopus* should be tried. *Desmodium ovalifolium* is collected in forest areas and this species should have a place in silvo-pastoral systems.

2 Acceptable to livestock. It is no use to grow plants that are avoided by the livestock. Such plants usually become a weed in the system, causing lot of trouble. The animals which do not have enough feed could cause damage to the planted young trees by browsing the leaves off the plants. This phenomenon has been observed in a *Casuarina* plantation of the Forest Industry Organization where a herd of cattle was allowed to graze the native grasses as a means of weed control. About 10 % of the *Casuarina* plants were damaged by topping of the top and leaves when green grasses were not available (Prasart, 1979).

3 Not toxic to livestock. It is important that the species to be grown for forage purpose is not harmful to the animals grazing on it. Plants with high toxic content should be avoided. The cattle will graze any green material when forage grasses are scarce as it happened in one of the reforestation plantations in the North. *Mimosa invisa* var. *inermis*, known in Thai as "spineless mimosa", was grown as a cover crop in the plantation. Excellent growth was observed. A herd of cattle belonging to the villagers nearby grazed on the plants and 10 head were found dead late in the day. The "spineless mimosa" was later examined for the presence of toxic substances and prussic acid and nitrate were detected. Forage feeding trial was conducted and toxic effect was confirmed (Matinee *et al.*, 1982).

## Agro-forestry in Thailand

### Problem of land use

According to the Center for Agricultural Statistics (1983), there are approximately 51,311,501 hectares of land. Of this area 37.8 % is for farm holdings and 31.3 % for forest. The problems arise because of the illegal use of land for shifting cultivation and swidden cultivation, particularly in the mountainous areas of the North where important watersheds originate. Living around this area are about 5 million hill tribe people. Montee (1982) has stated in his paper on agro-forestry systems that surveys using satellite technique showed that the forest areas decreased from 29.1 million hectares in 1961 to 12.5 million in 1978. These findings suggest that the rate of forest destruction was nearly one million hectares per year, which is an alarming situation.

### Establishment of forest villages

To prevent further destructive activity on forest land the government of Thailand has taken several measures such as closing forest land in some areas; encouraging the private sector to run a reforestation business; establishing national parks and forest villages. Under the supervision of the Forest Industry Organization, the forest villages were introduced in 1968. The objective has been to prevent the destruction of forest land and to help increase the villagers' earnings by growing crops in the reforestation plantations. The source of income for the members of the forest villages could be derived from crop growing and from wages such as those for planting the trees, weeding and other activities relating to the care of the plantation.

According to the plan, each forest village will support 100 families, each of which will receive 1.6 hectares of land in the forest plantation. The members are not allowed to own such land but could exploit it by growing crops between the trees or raising livestock to generate an income. At the beginning of the project only field crops are included due to their short life and since they are easy to manage. Major crops are cassava, corn, upland rice, peanut, cotton, chilli, soybean, tobacco and garlic. In the southern areas, coffee and rubber have their places. Up to 1982 the following data were obtained regarding the integration of crops within the agro-forestry system:

- total area of forest villages: 19,462.6 hectares.
- income from field crop sale: US\$1.98 million.
- average income/ha: US\$102.1.
- corn, cassava and upland rice are the major kinds of crop.

In the North, for a good year with a good price for agricultural products, crops like garlic, and chilli could fetch US\$1,228.1 and 900.6 per hectare, respectively (Table 1).

### Livestock in the agro-forestry system

Where possible, the villagers are also encouraged to raise cattle as a means to obtain an additional source of income complementary to crop farming, to improve soil fertility and to keep the weeds under control.

Two to three head of cattle of indigenous breed are kept for a family and feed sources are native grasses in the plantations. Major species are *Imperata cylindrica*, *Arundinaria pusilla*, *Axonopus affinis* and *Setaria*. List of grasses normally found in a particular condition are shown in Table 2. The management of the grazing land aims at keeping the stocking rate low and grazing the areas rotationally. The animals are allowed to graze during the day and return to night corrals in the evening. The most troublesome grass in a new forest plantation is *Imperata* which is very costly to control by mechanical or chemical means and cattle could be used to eliminate this noxious weed. Prasart (1979) reported that the *Imperata* in *Casuarina* plantation could be controlled within two years by grazing a herd of cattle. He suggested that a high stocking rate should be used. On the other hand, if the purpose of keeping cattle is for sale, a lower stocking rate is recommended. Peerapong (1982) observed the effect of grazing

**Table 1 Field crops which gave highest income for a particular year form 1973-1982 (Montee, 1984)**

Year	Crops	Average income (US\$/ha)
1973	Cassava	272.9
1974	Kenaf	106.9*
1975	Tobacco	443.3
1976	Squash	352.0
1977	Onion, garlic	361.0
1978	Kenaf	945.7
1979	Chilli	309.2
1980	Garlic	1,228.1
1981	Cassava	745.2
1982	Chilli	900.6

\* Prices of all crops were depressed in 1974.

**Table 2 Natural forage plants found in the forest plantations**

Species	Environmental conditions
<i>Arundinaria pusilla</i>	Slightly shaded, light soils, moderate rainfall. Northeast.
<i>Axonopus affinis</i>	Moderately shaded, light to heavy soils, high rainfall.
<i>Chrysopogon orientalis</i>	Slightly shaded, sandy coastal soils, high rainfall. Southern area.
<i>Coerhorachis glendulosa</i>	Slightly shaded, light soils, moderate rainfall. Northeast.
<i>Cyrtococum</i>	Moderately shaded, light soils, high rainfall.
<i>Desmodium ovalifolium</i>	Densely shaded, light soils, high rainfall. Southern area.
<i>Heteropogon contortus</i>	Slightly shaded, moderate rainfall, light to heavy soils. North and West.
<i>Imperata cylindrica</i>	Slightly shaded, upland soils all over the country.
<i>Microstegium ciliatum</i>	Densely shaded, very high rainfall, light soils, Southern area.
<i>Ottlochloa nodusis</i>	Densely shaded, light soils, high rainfall. Southern area.
<i>Optismenus burmanni</i>	Densely shaded, light soils, high rainfall. Southern and Eastern areas.
<i>Paspalum conjugatum</i>	Slightly shaded, moderately high rainfall, light soils, all over the country.
<i>Rottboellia exaltata</i>	Slightly shaded, light soils, moderately high rainfall.
<i>Setaria verticelata</i>	Slightly shaded, light to moderately heavy soils, high rainfall.

native grasses in a 3-year old *Eucalyptus* forest in the South and reported that with 175 head of native cattle grazing on an area of 96 hectares, the weeds were eliminated within 7 months, with only 3 % of trees damaged. On the average, an extra income of US\$73.7 was received per family.

#### **Improving pastures under agro-forestry systems**

Studies are being carried out to test the aerial oversowing of legume seeds on forest plantations with trees with narrow branches such as *Eucalyptus*. Charoonrote (1982) reported that in a 2-year old *Eucalyptus* forest of an area of 1,600 hectares *Stylosanthes hamata* grew satisfactorily. The seed was aerially sown in 1980 using a seeding rate of 3 kg/ha. The areas are being grazed by 1,500 head of cattle. For the areas which are planted to trees with

spreading branches other shade-tolerant species should be used. Centro, Puerto, *Desmodium ovalifolium* and Calopo are recommended. Calopo is low in palatability and will not be accepted by cattle during the wet season but it is a good feed for the dry period.

For small farmers, establishment of pastures is done by hand using family labor. Pilot project of this kind is being organized by the Department of Forestry. The recommended pasture species are Guinea, Hamil and Ruzi. In the case of coconut plantations, Signal, Cori and Ruzi are promising (Manidool, 1983). These species could be introduced into the forest plantation with a tree spacing of 2×8 m. In plantations that are less than 4-year old, stocking rate of 0.9 head/ha is recommended; lower rates are to be used in older plantations (Montee, 1982). But normally zero grazing system is used by the villagers to obtain longer life of the pastures.

On the highlands, up to 1,500 meter, in the North, green leaf *Desmodium* can be used. Gibson (1976) reported that this species could compete and thrive on *Imperata*-invaded areas.

#### **Sustainable production of forage crops within the agro-forestry systems**

To enable the farmers to produce feed continuously the forage program should include:

- interplanting of forage in forest plantation
- backyard pastures
- tree legumes on hedgerows
- feed conservation

Forage crop interplanting in the forest plantations shall form the main source of feed. Adapted species are to be selected for particular sites and kinds of forest trees. Shade-tolerant species are needed. These herbaceous species will not be able to produce green feed during the dry season. Tree legumes shall play an important role in this respect. Thus it is imperative to encourage the villagers to grow these special plants. They could be planted along the fence of the homestead or be interplanted with the forest trees. *Leucaena*, *Gliricidia*, *Erythrina*, *Sesbania*, *Acacia* and *Samanea* are good for this purpose. There might be a problem with *Samanea* which has a high lignin content and low palatability. Table 3 indicates that leaf from this tree legume has lower intake than *Leucaena* and *Acacia*. On the other hand, pods from this tree are relished by cattle and could give good results if fed during the dry period. Anoocha (1983) has shown that cattle could maintain an adequate body weight during the dry season by feeding on pure rice straw with 2 kg of *Samanea* pods. Those animals which received rice straw as a sole diet lost weight by 0.48 kg/head/day.

Feed conservation in the form of hay or silage or urea-treated rice straw hay should also be included in feed production programs. Hay-making seems to be more appropriate for small farmers and this practice should be done by using the improved pasture species with leafy, fine stem characters. Cori grass will be suitable for this purpose. Rice straw could be fed with

**Table 3 Intake of green leaves of some tree legumes by cattle and goat**

Legume trees	Intake, kg/head/day
	Cattle
<i>Delonix regia</i>	0.41
<i>Samanea</i>	0.88
<i>Leucaena</i>	11.60
<i>Acacia</i>	12.00
	Goat
<i>Leucaena</i>	1.34
<i>Acacia</i>	0.63

Manidool, 1984.

legume leaves such as *Leucaena* and *Gliricidia* or it could be treated with urea to improve its nutritive value. The urea-treated rice straw is widely used in the small dairy farms in Thailand and leaflets on the technique of improving rice straw quality are available.

Other important sources of forage for cattle raising in forest plantations consist of backyard pasture. The farmers are encouraged to spare a small piece of land for planting forage plants. This can be achieved in the garden near the house, hedgerows or other waste areas. This type of pasture is quite popular among the small dairy farmers. It has an advantage over the pasture under the forest in that many species could be selected because no limitation due to shade is involved. Normally guinea, Napier, Hamil and *Leucaena* are used.

To conclude, the author considers that silvo-pastoral systems will certainly have a good prospect, not only as a source of extra income for small farmers and the increase in cattle number but also for the conservation of valuable forest land. This system, however still needs intensive research in relation to production so that maximum income could be obtained from crops, livestock and woodlot.

### References

- 1) Anoocha, S. and Pisooth, N. (1983): A study on the levels of *Acacia* (*Samanea*) pods for cows fed with rice straw during dry season. Jour. Agric. Res. and Ext. 1, 10-17.
- 2) Budowski, G. (1978): Workshop on agro-forestry systems in Latin America. Proceedings. CATIE. Turrialba, Costa Rica.
- 3) Charoonrote, C. and Manat, A. (1982): Evaluation of aerial sowing of Verano on communal grazing land. In: Seminar on animal health and production. Dept. Livestock, Bangkok. (In Thai).
- 4) Gibson, T. (1976): Pasture research in Alang-Alang areas in northern Thailand. Biotrop Workshop. Bogor. Indonesia.
- 5) Malinee, L., Suchart, S. and Vimol, C. (1982): *Mimosa invisa* var. *inermis* poisoning in cattle. Kasetsart veterinarians. 3.(In Thai).
- 6) Manidool, C. (1983): Pastures under the coconuts in Thailand. ASPAC/FFTC Seminar. Khon Kaen, Thailand.
- 7) Manidool, C. (1984): Approach and techniques for sustainable production of forage crops within the agro-forestry systems. FAO Workshop. Nakornrasima, Thailand. (In Thai).
- 8) Miller, T. (1975): Cattle and trees thriving together. NZ. Jour. Agric, 53-55.
- 9) Montee, P. (1982): Managing approach for agro-forestry system. Forestry Industry Organization. Bul., 6. (In Thai).
- 10) Montee, P. (1982): Raising cattle in agro-forestry system. Forest Industry Organization Bul., 3. (In Thai).
- 11) Montee, P. (1984): Experience in agro-forestry. FAO Workshop. Nakornrasima, Thailand. (In Thai).
- 12) Montee, P. (1984): Agro-forestry. Forest Industry Organization Bul., 6. (In Thai).
- 13) Peerapong, R. (1982): Data on cattle raising under the Eucalyptus plantation at Klongtorm. Extension information. Forestry Industry Organization Bul. (In Thai).
- 14) Prasart, S. (1979): Cattle raising to control weedy cogon in forest plantation. Forestry Jour. 2.

### Discussion

**Jayawardana, A. B. P.** (Sri Lanka): What is the spacing of the trees in the system?

**Answer:** The spacing depends on several factors but in general it is 8m between rows and 2m between plants. The economic return from both the trees and pastures is an important

consideration.

**Siregar, M. E.** (Indonesia): Could you give us an example of successful achievement in the field of agro-forestry in Thailand?

**Answer:** We cannot draw conclusions yet. Research is needed but is difficult since we are dealing with small farmers. In some areas by growing cash crops such as garlic, kenaf, upland rice, farmers can derive a good income.

**Siregar, M. E.** (Indonesia): In the agro-forestry schemes, what are the inputs from the farmers? Who manages the land?

**Answer:** The government manages the land (Department of Forestry). Groups of farmers are being organized to cultivate crops and grow trees while grazing cattle. Marketing of the products is also supervised by the government. Income is derived primarily from the crops since it takes a long time for the trees to grow (about 20 years).