



# APANews

ASIA-PACIFIC AGROFORESTRY NEWSLETTER

NO. 29 ● MARCH 2007 ● ISSN 0859-9742



SEANAFE  
**News**



# Dear readers

Once again, we welcome you to another issue of the Asia-Pacific Agroforestry Newsletter (APANews) - a collaboration among the Food and Agriculture Organization of the United Nations, the Southeast Asian Network for Agroforestry Education (SEANAPE), and the World Agroforestry Centre (ICRAF). This issue presents several researches on the use of specific crops and tree species in various agroforestry systems, including their impacts on productivity, regeneration, and farmers' income.

The article on the integration of *Khejri* (*Prosopis cineraria*) with various crops outlines its use as a fodder tree and source of high quality wood. It describes how *Khejri* contributes to increased soil fertility and sand dune stabilization. More importantly, it highlights how the three-year lopping rotation of *Khejri* maximizes fodder production and ensures seed supply for regeneration.

Developments in agrisilvopastoral systems are featured in an article from Nepal. The article highlights the research results from planting trial of various fodder crops in terraces. This is an innovative way of addressing

the continuous need of upland farmers for fodder to sustain livestock production, while minimizing the shading effect of fodder trees on crops.

You will be interested in the article featuring the integration of walnut in an agroforestry system in Chile. Walnut (*Juglans regia*) produces high-quality timber and nuts. The article discusses the growth of walnut trees under various planting designs.

Another article presents the research results from implementing taungya system using *Khaya anthoteca* in a mixed cropping model.

Other articles in this issue deal with the adoption of horti-silvicultural models and their effect on increased productivity in India, and the impacts of participatory agroforestry practices in northeastern Bangladesh. The adoption of horti-silvicultural models has helped increase farmers' incomes, although substantial effort is still needed to sustain this initiative. Meanwhile, participatory agroforestry practices have proven their potential to contribute to

poverty alleviation, and increased women's involvement in forestry activities.

As always, there are announcements, information resources, and websites that may be useful in the implementation of your various agroforestry projects.

Meanwhile, SEANAPE News discusses about the project on marketing of agroforestry tree products (AFTPs). Results of two case studies are presented: the market chains of cashew nuts in Vietnam, and the marketing of bamboo in Laos. Other articles in this issue of SEANAPE News highlight the activities of the Vietnam Network for Agroforestry Education, and the Philippine Agroforestry Education and Research Network.

Again, thank you to all the contributors for this issues of APANews and SEANAPE News. We look forward to more of your contributions. Let us continue to share and practice agroforestry, and further contribute to its promotion and development. – *The Editors*

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**COVER PHOTO.** Coconut-based agroforestry systems are common in Philippine rural areas. In this photo, coconut-based agroforestry systems have helped farmers in the province of Quezon make use of large tracts of arable, sloping and mountainous areas. Farmers are cultivating pineapple, papaya, root crops, vegetables, and fruit trees underneath coconut trees. This type of system also provides farmers with other coconut products such as husks, oil, wine, copra, and others. (Photo courtesy of IAF)

**PRINTER.** Thammada Press Co. Ltd., 86 Soi 5011 Charansanitwong Road, Bangplad, Bangkok 10700 Thailand

# Three-year lopping rotation of *Prosopis cineraria* maximizes fodder production, ensures sustainable regeneration

Kulvir S Bangarwa and M.S.Hooda ([kulvirsb@yahoo.com](mailto:kulvirsb@yahoo.com))

*Prosopis cineraria*, commonly known as *Khejri*, occurs naturally in dry and arid regions of India (southwest Haryana and Rajasthan), Pakistan, Afghanistan, Iran, and Arabia. *Khejri* is extremely drought-tolerant, growing in areas with as little as 75 mm of annual rainfall (but generally 150-400 mm) with dry seasons of eight months or more. It is slightly frost-hardy and tolerant to temperatures of up to 50°C. The tree is found in alluvial, coarse, and sandy, often alkaline soils where the pH may reach 9.8.

*Khejri* is much valued as a fodder tree. Its leaves provide excellent and nutritious fodder that are readily eaten by animals such as camels, goats, and donkeys. The tree produces leaves during the extremely dry summer months when most other trees are leafless. Its leaves contain 13.8 percent crude protein, 20 percent crude fiber, and 18 per cent calcium (FFN, 1991).

*Khejri* pods, containing a dry sweet pulp, also provide good fodder. Green pods, called *sangar*, are boiled and dried for human consumption. Its flowers, during March and April, are valuable for honey production. *Khejri* bark, meanwhile, can also be used in leather tanning and yields an edible gum. Its bark and flowers are also used for medicinal purposes.

The wood of *Khejri* is used for agricultural implements, house buildings, posts, carts, tools, handles, and boat frames. It is also an excellent source of firewood for cooking and domestic heating.

*Khejri* is considered one of the best species for soil improvement and

sand dune stabilization. The *Khejri* tree has a deep tap root system; therefore, it does not compete for moisture and nutrients with crops grown close to its trunk. It casts only a light shade, a desirable characteristic for agro-forestry species.

Farmers in arid and semi-arid regions of India and Pakistan have long believed it to increase soil fertility in crop fields. Yields of sorghum (*Jowar*) and pearl millet (*Bajra*) increased when grown under *Khejri* because of the higher organic matter content, total nitrogen, available phosphorus, and soluble calcium, as well as lower pH of the soil.

The leaves and pods of *Khejri* constitute a major source of

fodder. Maximum yield of fodder is obtained when trees are pollarded on a three-year rotation. Bhimaya *et al.* (1964) reported that if trees of *Khejri* are lopped at a three-year interval, they produce 172-242 percent more leaf fodder by weight than those recurrently lopped. Lopping at shorter intervals not only decreases the yield but also causes the mortality of trees.

Farmers usually lop their trees during the winter every year. Lopping starts in mid-November and continues up to January, with most of the lopping carried out in the last week of November and first week of December. Dried leaves (*loong* or *loom*) are stored for use in drier seasons.

Because completely lopped trees do not produce seeds (Toky and Harris, 2004), balancing the production of fodder and seeds is an important consideration. The shortage of seeds is a major limiting factor in ensuring the regeneration of this wonder tree.

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*Leguminous crop with Prosopis cineraria.*



*Pods of Prosopis cineraria.*



*Cotton crop with Prosopis cineraria.*



High quality wood of *Prosopis cineraria*.

*Prosopis cineraria* produces good forage.



### Three-year lopping rotation...

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The recommended three-year rotation in lopping maximizes fodder production while ensuring an adequate supply of seeds for sustainable regeneration. To implement the three-year lopping rotation, farmers are advised to equally divide the total number of trees into three groups. The trees are marked with the group number and each group of trees is lopped completely in November-December each year. The use of green pods (*sangar*) is also discouraged in order to conserve the seeds for use in propagation.

*References: 1) Bhimaya, C.P., Kaul, R.N. and Ganguli, B.N. 1964. Studies on lopping intensities of Prosopis spicigera. Indian Forester, 90: 19-23; 2) FFN. 1991. Spotlight on species: Prosopis cineraria. Farm Forestry News, Vol.4, No.3; 3) Toky, O.P. and Harris, P.J.C. 2004. Socioeconomic and ecological niche of khejri (Prosopis cineraria) in traditional farming systems of arid India. Asian Agri-History 8 (3): 215-233. ■ The author works at the Department of Forestry, CCS Haryana Agricultural University, Hisar – 125 004 India.*



Fodder crop with *Prosopis cineraria*.

## Cultivation of fodder in terrace riser: a new model of agrisilvopastoral system in Nepal

Tanka Prasad Barakoti

In Nepal, more than 80 percent of the population is involved in agriculture, which contributes to about 45 percent of the total gross domestic product of the country. Large farming areas lie in the hills (68%) along a range of reliefs and altitudes (100-3 000 m asl). Integration of agriculture and forestry is common and rural communities are highly dependent on forest resources (Amatya, 1999). Farmlands in the hills are comprised of terraces and risers, with the latter occupying approximately one-third of the total land area (Barakoti, 2004).

Livestock is an integral part of crop production, which, in turn, depends

highly on livestock. Farmers collect manure from livestock to fertilize crops. They are aware that manure plays a vital role in adding nutrients to the soil. In addition, livestock provides food and income. Thus, agriculture development through livestock may be a better approach to advance agriculture in the country than the application of chemical fertilizers which most farmers cannot afford.

Lack of productive grazing lands and nutritious fodder have been the major limiting factors in livestock production. A fodder deficit of about 1 kg/animal/day (Maharjan, 1987) has been estimated. Farmers face fodder scarcity for more than

seven months during the winter and summer up to the monsoon period. As land areas are limited, smallholding farmers cannot afford to grow fodder and forage on croplands. Hence, there is a need to explore the potential of fodder planting in terrace risers.

On-farm research was carried out by the Agricultural Research Station (ARS) at two locations in Belhara, Pakhribas command area, of Dhankuta district, east Nepal (mid hill condition, 1 200 and 1 500 m asl). The studies examined the feasibility of utilizing marginal terrace risers for fodder production without reducing cropland to and sustain both

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## Cultivation of fodder...

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livestock and crop production in the hills. Fodder trees were planted at a spacing of 1-1.5m. Felling/lopping was done at breast height, not allowing the fodder trees to grow taller and branch out.

This was the first time that the riser-based agrisilvopastoral study was conducted in Nepal. The study aimed at:

- cultivating and evaluating forage crop and fodder tree species in the terrace risers;
- quantifying the effect of fodder trees on agronomic parameters of forage crops, and examining the combined effect on major crops (maize and finger millet);
- enabling farmers to meet the demand for livestock fodder throughout the year and produce more livestock manure; and
- enhancing crop yield through the application of manure.

The recommended fodder species were planted in two locations from June-August in 2002 and 2003 (Table 1).

Fodder trees were planted at a spacing of 1.5m in the terrace ridges, while forage crops were planted at 30 x 50cm spacing. The plots were 1.5-2m x 3m in the risers. The research involved 18 and 32 treatments, respectively, with 2-3 replications.

Various data on maize, millet, fodder trees, and forage crops were recorded. However, only the results from one site are presented.

### Survival and growth of fodder and forage species

The survival of the fodder trees ranged from good to excellent, except *Litsea polyantha* which were

Table 1. Fodder and forage species planted in two locations in Belhara Pakhribas, Dhankuta district, east Nepal.

Fodder tree species		Forage crop species	
Local name	Scientific name	Local name	Scientific name
Nebaro	<i>Ficus auriculata</i>	Amriso	<i>Thysalonaema maxima</i>
Dudhilo	<i>Ficus nemoralis</i>	Napier	<i>Pennisetum purpureum</i>
Raikhanyu	<i>Ficus semicordata</i> var. <i>Montana Amatyia</i>	Dhus	<i>Pennisetum spp</i>
Bhimal	<i>Grewia oppositifolia</i>	Setaria	<i>Setaria anceps</i>
Tanki	<i>Bauhinia purpurea</i>	Stylo	<i>Stylosanthes guianensis</i>
Kutmiro	<i>Litsea polyantha</i>	Desmodium	<i>Desmodium intortum</i>
Badahar	<i>Artocarpus lakoocha</i>		
Khari	<i>Seltis australis</i>		
Rato Siris	<i>Albizia jullibrissin</i>		

Table 2. Survival and growth of fodder trees in the terrace risers.

Fodder trees	Survival (%)	Plant height (cm)	Girth at knee height (cm)	No. of branches	Leaf		
					Number	Length (cm)	Breadth (cm)
Nebaro	100	53.5	5.4	4.1	9.5	18.1	13.5
Dudhilo	92.5	51.4	3.5	6.6	5.7	11.6	3.7
Rai Khanyu	82.5	87.5	5.3	11.4	30.0	21.5	6.8
Kutmiro	57.5	44.5	3.6	2.2	4.5	7.0	3.7
Tanki	75.0	39.5	3.0	5.4	16.4	6.0	6.0
Bhimal (Ghotli)	92.5	93.8	5.2	14.1	43.0	12.4	7.3
<b>Mean</b>	<b>83.3</b>	<b>61.7</b>	<b>4.3</b>	<b>7.1</b>	<b>18.2</b>	<b>12.8</b>	<b>6.8</b>

Table 3. Mean growth parameters of forage crops in the terrace riser.

Forage species	Plant height (cm)	Tillar No.	Leaf size	Ground cover (%)
<i>Thysanolaena maxima</i>	80.8	17	40x7	95
<i>Pennisetum purpureum</i>	56.9	18	132x41	100
<i>Pennisetum sp.</i>	78.3	17	149x44	100
<i>Setaria anceps</i>	97.5	28	50x1	90
<i>Stylosanthes guianensis</i>	95.3	Branch	.9x.8	75
<i>Desmodium intortum</i>	93.3	Branch	6x5	100

transplanted wildings. Plant height varied significantly by species. The tallest was *Grewia oppositifolia*, followed by *Ficus semicordata*. Both species bore high numbers of branches. The leaf number and breadth, and therefore leaf area, varied significantly among the tree species. The overall fodder tree growth in the riser edge after the first year was encouraging (Table 2).

All tested forage species had vigorous growth from the first year onwards. They also had almost full

ground coverage in the terrace riser, except *Stylosanthes*, which did not have spreading branches. *Setaria* had the most number of tillers while *Pennisetum spp.* had the largest leaves (Table 3).

### Dry and fresh matter production of forage crops

The mean dry matter percentage, and fresh matter and dry matter (DM) yields were monitored. The

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data varied significantly by species and seasons. *Pennisetum* species, with high DM percent, yielded the greatest forage biomass, followed by *Setaria* and Amriso, broom grass (Table 4). Analysis of variance performed for the fresh matter data gave highly significant result ( $P < 0.01$ ) among the forage crops.

Effect on maize of fodder grown in terrace riser

The fodder trees and forage species affected terrace-planted maize differently. Of the various parameters observed, grain and stover yields, height, and number of stands are presented (Table 5). The yields and number of stands differed significantly by treatment ( $P < 0.05$ ). *Ficus semicordata*, combined with broom grass, Napier, and Dhus, had a noticeable negative impact on maize, whereas *Ficus nemoralis* and *Litsea polyantha* showed less effect on crop yields compared to other species. *F. nemoralis* and *Grewia oppositifolia* had reduced plant height. The number of stands was severely reduced under *Ficus semicordata*.

The results indicated that all tested fodder and forage species could survive and grow in terrace risers. Most of the species were found to be promising. They were found to be adaptable and could successfully be cultivated in the un-utilized risers of cropping land terraces.

It was observed that *Ficus semicordata*, *Grewia oppositifolia* and *Albizia jullibrissin* make fast-growing fodder trees. Napier and Dhus (*Pennisetum spp.*), *Seteria*, *Desmodium*, and broom grass grow vigorously in the T-riser. Also, fodder trees and forage crops tested were compatible, and grew well together with minimal effects on maize and finger millet production. They may be more suitable than the tall trees grown traditionally in the risers.

Table 4. Mean fresh and dry matter yields of forage crops (2002-2003).

Forage crop	DM (%)	FM yield (t/ha)	DM yield (t/ha)
<i>Thysanolaena maxima</i>	21.2	24.44	10.28
<i>Pennisetum purpureum</i>	45.1	40.44	21.78
<i>Pennisetum sp.</i>	33.4	37.15	15.14
<i>Seteria anceps</i>	20.6	24.89	12.94
<i>Stylosanthes guianensis</i>	16.9	7.11	8.69
<i>Desmodium intortum</i>	18.4	23.21	9.08

Table 5. Mean grain and stover yields, plant height and number of stands of maize (2005).

Treatment	Grain yield (kg/ha)*	Stover yield (t/ha)*	Plant height (cm)	Plant stand per ha
<b>Tanki:</b> Dhus/ <i>Seteria</i> / <i>Stylo</i>	2852	2422	190	37184
<b>Kutmiro:</b> <i>Stylo</i> / <i>Napier</i> / <i>Amriso</i>	2719	1808	180	40444
<b>Raikhanyu:</b> <i>Amriso</i> / <i>Dhus</i> / <i>Napier</i>	1976	1539	187	30666
<b>Nebaro:</b> <i>Seteria</i> / <i>Stylo</i> / <i>Desmodium</i>	3200	2683	188	39703
<b>Bhimal:</b> <i>Desmodium</i> / <i>Amriso</i> / <i>Dhus</i>	3300	2778	173	42443
<b>Dudhilo:</b> <i>Napier</i> / <i>Desmodium</i> / <i>Seteria</i>	2406	2222	163	39036
<b>Control:</b> Open	3371	1988	189	39999

Meanwhile, the shade effect of *Ficus semicordata* on maize, combined with broom grass, Napier and Dhus, was more noticeable. *Ficus nemoralis* and *Litsea polyantha* were intermediate compared to other species. Among the forages, Napier and Dhus had dominating effects on the growth and yield of maize. *Albizia jullibrissin*, *Leucaena diversifolia*, *Bauhinia purpurea*, *Celtis australis*, and *Artocarpus lakoocha* normally favored the growth and yield of maize crop.

Dry matter percentage and yield of forage crops depended on the species and harvesting season. *Pennisetum* species had high dry matter percent and corresponding fodder yields.

The study has shown that farmers can benefit from the forage crops. They were impressed by the terrace riser-based cultivation (agrisilvopastoral) of fodder and forage species. Thus, replication and promotion of this agroforestry model in hills of the region with similar agroclimatic conditions will contribute to improving livestock and crop production.

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# Agroforestry systems with walnut in South America: an alternative for temperate areas

Verónica Loewe M ([vloewe@infor.cl](mailto:vloewe@infor.cl))

Forestry in Chile is characterized by monoculture plantations of pine and eucalyptus that potentially cause phyto-sanitary and other environmental problems. The agriculture sector is facing a crisis due to the low productivity of traditional farming practices, market fluctuations and unfavorable international treaties on agricultural products trade.

Diversification of crop species and cultivation techniques thus have important social (by inclusion of new actors), economic (high-value products with greater economic returns), and environmental (higher diversity reduces the risk of biotic and non-biotic damages) benefits.

The production of high-value timber may offer one innovative solution to the agricultural crisis as this can be integrated with other agricultural



*Fifteen-year old walnut orchard for timber and nut production established using the high grafting technique to produce high value timber and nuts simultaneously*

products. It is thus imperative to develop an agroforestry system with high-value timber species and establish appropriate techniques to improve its growth and quality.

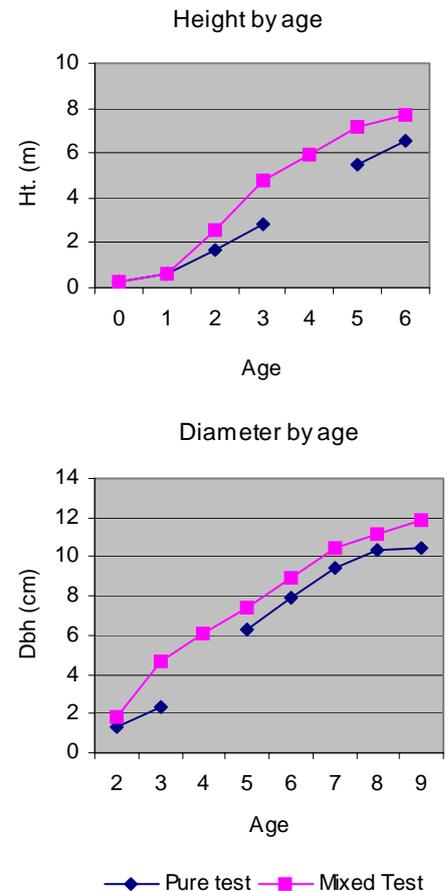
In this context, the use of common walnut or other fruit-bearing species with valuable wood constitutes a promising alternative to be incorporated into the rural agricultural systems.

Walnut (*Juglans regia*) offers good productive, economic and social potential in Chile. It is one of the most studied and successfully planted species in the country.

Walnut is a vigorous tree that can reach a height of 24-31 m and trunk diameter of 60-90 cm. It is sturdy and has a wide and leafy crown. Its timber is compact with a beautiful grain. It grows fast and is well known for its edible fruits (US\$1,5-2,5/kg) and high-value timber (US\$300-2.500/m<sup>3</sup> standing). In fact, it is one of the most demanded timbers in the European market, with a stable and exclusive market for several centuries.

Yields from experimental and productive plantations of walnut are promising. These plantations encompassed a range of designs (pure, mixed), objectives (fruit and timber production, timber production only, fruit and timber in agroforestry systems), site characteristics (valleys, mountains), and management intensity (low, medium, high).

*Growth comparison of walnut trees between pure and mixed planting*



In recent years, the walnut market has become sophisticated and more exigent, giving preference to uniformity of fruit color. This makes the propagation of trees from seeds unsuitable for nut production, because walnut fruits are characterized by high variability. Thus, the use of high grafting has emerged as the solution.

High grafting allows a walnut tree to be used for both timber and nut production. Timber markets demand logs 3-4 m long, straight, without defects, and with regular growth rings. Normal grafting made at the lower parts of the tree is considered a defect because it causes timber discoloration, thereby lowering its wood value.

The technique of high grafting consists of planting a rootstock or sapling reproduced from seeds

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## Agroforestry systems...

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without grafting, and using a specialized pruning technique that improves the form of the tree.

Grafting is applied at the top once the log length has reached 3-4 m high at about 2-4 years. The sprouts that appear after grafting provide the foundation to a specialized fruit-bearing crown.

Using this method, an individual walnut tree produces quality fruits for 20-40 years, after which it can be harvested for the high-value timber. This allows for increased profitability and ensures income flow throughout the life cycle of the tree.

Walnut has been cultivated traditionally for nut production in the country. However, innovative combinations are becoming popular. These include:

- Pure walnut plantations;
- Pure walnut plantations with crops (such as maize, beans, others) underneath;
- Mixed walnut plantations with other commercial trees or shrubs; and
- Mixed walnut plantations with other commercial trees or shrubs and fodder.

These combinations make the walnut agroforestry an adaptable system that can meet various needs and realities. Capital availability, management objectives, capacity of the farmers, as well as the local and international market situation, should be taken into consideration in designing the appropriate walnut-based agroforestry system. ■ *The author works at the Chilean Forest Institute (INFOR), Huérfanos 554, Santiago, Chile, Tel :56-2-6930780, 56-9-8831858 ; Fax 56-2-6381286*

# Maximizing production from *Khaya anthoteca* plantation forest through *taungya* system

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Like other agroforestry systems, *taungya* optimizes land use in order to increase productivity. In the *taungya* system, nutrients are utilized efficiently through proper spacing and arrangement of crops, structure and design of canopies, rooting system, and timing of planting and harvesting activities. Proper planning ensures that these components complement each other.

Another critical consideration in the *taungya* system is the land-use pattern under tree stands. Most often, local people utilize the space between trees to plant paddy and other seasonal food crops. However, this mixed cropping system is possible only during the rainy season.

Rainfall has proved to be a major constraint in the cultivation of food crops in forestland. In addition, the mixed cropping system can only be implemented during the first two years of tree growth when the canopy shade does not yet reduce the growth of the crops grown underneath.

In the last few years, modification of the conventional short-duration mixed cropping systems towards long-life mixed crop cultivation has been widely adapted. In Central Java, local communities have developed several long-life cropping patterns under *Khaya anthoteca* plantation forests. Research done at the BKPH Cimanggu, Perum Perhutani in Central Java described the various modifications of the *taungya* system being practiced in the area.

## Long-life intercropping models

People living near the *Khaya anthoteca* plantation forests employed various types and models of the mixed cropping system depending on the interests, resources and capacities of the farmers. Models that were applied include: 1) Model A: paddy-maize-bean-juici tuber, 2) Model B: paddy-maize-bean, and 3) Model C: juici tuber.

Model A can be started at the onset of the rainy season (September-October) for harvesting in December-January. During February-March, farmers plant less water-demanding crops like maize and peanut for harvesting in April-May. Farmers with enough capital continue on with Model C for harvesting in July-August.

Aside from making efficient use of the land, the *taungya* system provides continuous food production, improves soil fertility, helps protect the natural resources, and eventually increases land productivity.

## Impacts on productivity and farmers' income

In the research site, results showed that the average production of food crops had not reached optimal levels yet. The average production of paddy was only 1 050 kg/ha, maize at 1 300 kg/ha, and peanut at 800 kg/ha. This is relatively low compared to the average national production of 2 170 kg/ha for paddy, and 1 500 kg/ha for peanut (Harahap, *et al*, 1995).

These results may be due to improper cultivation techniques, inappropriate use of fertilizers and pesticides, decreasing soil fertility, and lack of knowledge on tree-crop genetics. Moreover, the continuous use of inorganic fertilizers, inefficient irrigation and high post-harvest losses (15-20%) may have reduced productivity.

Because of these factors, the farmers' income in the research area remained relatively low. Each farmer practicing Models A, B and C was earning an average of Rp3 368 000/ha/year, Rp531 000/ha/year, and Rp2 968 000/ha/year, respectively. These amounts are still considered below the poverty line.

However, with continuous practice and improvement, these *taungya* system models could increase farmers' income in the research area by more than 500 percent for Model B, and 13.5 percent for Model C. Research results also imply that Model A has the highest potential for providing farmers with continuous income and at the same time address the goals of maximum land utilization, and resource protection.

**Taungya in the *Khaya anthoteca* plantation forests**

The adoption of the mixed cropping method has resulted in accelerated growth of *Khaya anthoteca*. Their average annual height growth was 62.72cm, with annual diameter growth averaging 3.1cm. Average height and diameter growth of a monoculture *Khaya anthoteca*, which served as the control of the research, was only 25.88cm and 0.59cm, respectively.

The following regression equation between tree height and time of observation was used:

In the *taungya* system:  $Y = 7,9525 X^2 - 14,864 X + 297,02$ , with coefficient of correlation  $r = 0,98$  (Figure 1)

In the monoculture system:  $Y = 8,09 X + 240,73$ , with coefficient of correlation  $r = 0,97$  (Figure 1)

Meanwhile, the regression equation used between stem diameter growth and time of observation was the following:

In the *taungya* system:  $Y = 0,332 X + 4,0459$  with coefficient of correlation  $r = 0,98$  (Figure 2)

In the monoculture system:  $Y = 0,192 X + 3,215$ , with coefficient of correlation  $r = 0,96$  (Figure 2)



Taungya model A



Taungya model B

The following conclusions can be drawn from the results:

1. Various models of taungya system can indeed maximize land utilization. However, it should be complemented with soil conservation measures such as the planting of *Leucaena leucocephala* and *Gliricidia sepium* along contour lines.

Continued on page 10

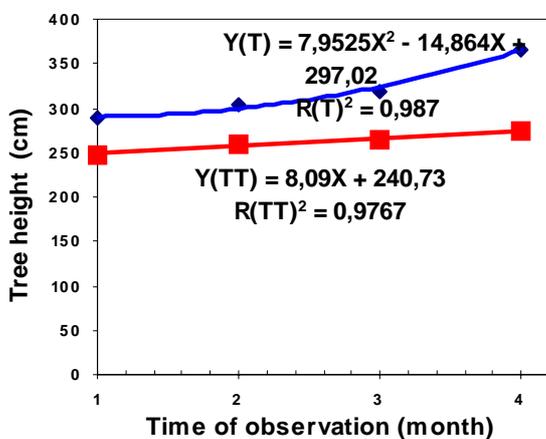


Figure 1. Regression between tree height and time of observation

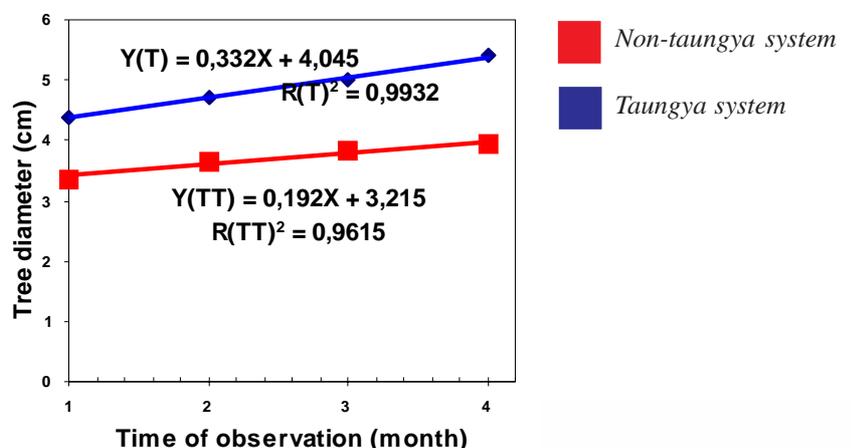


Figure 2. Regression between stem diameter growth and time of observation.



### Agroforestry systems...

*Continued from page 9*

2. The *taungya* system can provide for the daily needs of farmers and their families.
3. The *taungya* system requires the appropriate combination of trees and food crops.
4. The *taungya* model which combines *Khaya anotheca*, paddy, peanut, and juicy tuber has a potential to increase farmers' income as it provides continuous harvest throughout the year.

**References:** 1) Adiningsih S, J., M. Soepartini, A. Kusno, Mulyadi, dan W. Hartati. 1994. *Teknologi untuk Meningkatkan Produktivitas Lahan Sawah dan Lahan Kering. Prosiding Temu Konsultasi Sumberdaya Lahan Untuk Pembangunan Kawasan Timur Indonesia di Palu 17 – 20 Januari 1994*; 2) Amir, B., S., Punarto., Suyanto dan Supriyatini. 1995. *Padi Gogo. Pusat Penelitian dan Pengembangan Tanaman Pangan. Badan Penelitian dan Pengembangan Pertanian, Bogor*; 3) Harahap, Z., Suwarno., E Hubis and Santo. 1995. *Padi Unggul Toleran Kekeringan dan Naungan. Pusat Penelitian dan Pengembangan Tanaman Pangan. Badan Penelitian dan Pengembangan Pertanian, Bogor*; 4) Hutapea, J dan A. Z. Mashar. 2006. *Ketahanan Pangan dan Teknologi Produktivitas menuju Kemandirian Pertanian Indonesia.* (<http://www.kompas.com/kompas-cetak/0605/29/Jabar/2418.htm> - 44k , diakses 2 Agustus 2006); <http://www-suara-pembaharuan.com/News/2005/06/03/index.html>, diakses 1 Februari 2007; 5) Gurdev S. Khush. 2002. *Food Security By Design: Improving The Rice Plant in Partnership With NARS.* Makalah disampaikan Pada Seminar IPTEK padi Pekan Padi Nasional di Sukamandi 22 Maret 2002. ■ The author works at the Department of Forestry and Natural Resources, PAU Ludhiana 141 004 (India).

## Impacts of participatory agroforestry practices in northeastern Bangladesh

Md. Abdul Latif Mia ([nibir@bttb.net.bd](mailto:nibir@bttb.net.bd))

Bangladesh, being a densely-populated country, has never had abundance of forest resources. The total forestland is only 2.46 M ha, which covers 17.5 percent of the country's total land area. The actual forest cover does not exceed 6 percent. Per capita forestland in Bangladesh is 0.022 ha, the lowest in the world.

In the northeastern part of Bangladesh, 9 465 ha (32.93%) of the total 28 740 ha forest area has been encroached upon. Degraded areas constitute 16 400 ha (57.05%). Only 10 percent of the total forest area is still intact.

This deterioration has been caused by high population pressure, acute demand for forest products, lack of public awareness, conversion of forestland into other land uses, and the inadequate manpower of the Forest Department (FD).

Prior to 1980s, the FD practically had no interest in involving the people living near forests in forest resource management and development. However, studies have suggested that the deterioration of the forest could be halted by ensuring people's participation in forest management. Accordingly, the provision for people's involvement in protecting the natural stands and afforesting degraded and encroached forestlands, with benefit-sharing mechanism, was developed.

The FD of Bangladesh introduced the Community Forestry Project in 1981 in 23 northern districts of the country. The Program was financed and technically assisted by the Asian Development Bank (ADB). A similar participatory forestry program, the

Thana Aforestation and Nursery Development Project (TANDP), also funded by the ADB, was implemented nationwide from 1988 to 1996. These projects aimed to increase timber production, reduce poverty, and enhance the FD's institutional capacity. Short-rotation plantations that provide early financial returns to the participants were the projects' prominent feature. It aimed to gain the confidence of the participants and attract new members to be involved in forestry activities.

This study on participatory agroforestry practices evaluated the impacts of benefit-sharing and the distribution scheme among the participants in northeastern Bangladesh.

### Participatory forestry program

The participatory forestry programs were implemented in the area from 1988 to 1996. Major components of the project were to establish woodlots, agroforestry, and strip plantations on degraded and encroached forestlands and marginal strips. Each participant was given a maximum of 1 ha of land for woodlot and agroforestry plantation establishment. Every five participants were given a one-kilometer strip plantation. Fast-growing exotic species such as *Acacia auriculiformis* and *Eucalyptus* spp. were planted to provide quick biomass production.

As a special incentive, participants were allowed to grow food and agricultural crops on un-utilized parts of the land until the area was shaded by the planted trees. They

maintained the plantations as hired laborers.

Moreover, participants received full benefits from the intermediate products (leaves, twigs, branches, fruits and seeds), by-products of thinning, and 45-55 percent of the wood harvested at the end of the rotation period (10 yrs). The FD acquired 45 percent of the final products from woodlots and agroforestry, and 10 percent from strip plantations. Ten percent of the final harvest in all plantations were deposited to the Tree Farming Fund (TFF) for future plantation development and management purposes.

A total of 5 901 ha of woodlots, 1 800 ha of agro-forestry, and 1 383 km of strip plantations have been established in the study area.

### Participants' initial response

Many participants did not trust the agreement signed between them and FD because of their past experiences in traditional forest management. During the first rotation, many participants did not sign any agreements. Even the participants who signed never really protected the plantations. Many of them even suspected that they would be victims of forest cases, and would not benefit from participating in the forestry activities.

### Benefit-sharing and distribution schemes

With the assistance of ADB, FD implemented the third phase of the project – the Forestry Sector Project (FSP) from 1997-2006. Mature plantations were harvested, felled areas were reforested, and new plantations in encroached and denuded areas were established involving encroachers and poor

people living in the surrounding areas.

FD started selling the plantations sequentially in 2001, and due shares of benefits were distributed among the participants. There were 513 participants who received benefit shares of 7.705 M taka in 2001. In 2002, 2 062 participants received total benefit shares of 19.929 M taka, and 1 376 participants received total benefit shares of 22.120 M taka in 2003. In addition, participants who cultivated agricultural crops earned an average of 84 600 taka during the rotation period.

### Poverty alleviation

In the participatory forestry program, a total of 3 974 participants received benefit shares of 49.79 M taka, reducing poverty in the area and increasing people's living standards. The participants spent their money on building and repairing their houses, installing sanitary latrines, paying for the education and marriage of their children, and buying cultivable land and poultry items, among others.

### People's acceptance and participation

The impacts of the benefit-sharing and distribution schemes have been substantial. Community members showed interest in getting involved in woodlot establishment, agroforestry and strip plantations. It was reported that when encroachers saw the success of the first rotation plantation, many of them offered their lands to FD for plantation establishment. This could mean an additional 650 ha of new plantation areas, involving 650 new families as participants.

Initially, participants had doubts about the success of exotic species (*Eucalyptus* and *Acacia* sp.) in both woodlot and agroforestry plantations. However, they were convinced of the growth

performance and yield from the final felling of trees in the plantations.

### Women involvement

In 2001, there were 19 female participants, which rose to 1 183 in 2002. An additional 435 women joined in 2003. They participated in various forestry activities such as nursery raising, agroforestry, vegetable gardening and maintaining plantations.

The participatory forestry approach brought a significant change in the decision-making role of women in the production system. About one-third of the women involved in the project area sold the products and controlled the sale proceeds themselves, with or without the consent of their male partners. A total of 1 639 women received shares worth 9.678 M taka from woodlot, agroforestry, and strip plantations from 2001 to 2003.

The study presented a successful case of benefit sharing among the participants, with early distribution of dividends. Its success can be replicated in other parts of the country with similar situations. The involvement of local communities in forest management could also be achieved through discussions and training, aside from simple benefit sharing schemes.

However, results also showed that the benefits were not properly utilized by many of the participants. It may be appropriate to assist in the organization of formal or informal groups to help to start and manage productive enterprises. ■*The author is the Divisional Forest Officer of the Dhaka Forest Division in Ban Bhaban, Mahakhali, Dhaka-1212.*

1 US\$ = 70 Bangladeshi taka.



# Adoption of horti-silvicultural models in Punjab, India

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Increases in production costs and loss of land productivity warrant urgent actions to raise the production efficiency and to improve the livelihoods of rural farmers. The sluggish agricultural sector has become a concern in India, for it has an overarching impact on the overall economic growth of the state.

After a period of high growth, the agriculture sector has been showing signs of fatigue for almost a decade. The agro-ecosystem of the state has deteriorated under the pressure to increase production and because of the industrial revolution. Soils have become highly deficient of organic carbon and most of micro and macro nutrients. The water table is

lowering at the rate of 42cm per annum in the central zone.

The excessive use of agro-chemicals has further worsened the conditions of humans, animals, the soil, and the environmental health. A prudent approach in rationalizing the use of natural resources has been long due.

In the context of today's global economy, farmers have to look for markets and shift their mindsets from traditional to commercial agriculture. There is often a mismatch between what is being produced and what the market is demanding. Farmers have tried substitutes to rice-wheat rotation (e.g., poultry and fish), but without success. The only possible option for raising productivity from a given area of land is the integration of crops with other types of products – more specifically, fruit trees and fast growing timber species on farm lands.

The horti-silvicultural models (integration of fruit trees and short-rotation forest trees) remain the most appropriate alternative for sustainable management of a land unit. It will improve the profitability and make a more sustainable use of the natural resource base.

Fruit tree-based (mango, citrus, litchi, ber, pear, guava, etc.) agroforestry models with fast-growing timber species are becoming popular, as the timber tree component can be harvested when the fruit trees start bearing fruits. As a result, farmers would be able to exploit both the domestic and international fruit and wood markets. It has caught the attention of the farmers not only in Punjab, but also in other adjoining states of Haryana, lower areas of Himachal and the terai area of Uttaranchal. Short-rotation species like Poplar (*Populus deltoides*), Eucalyptus (*Eucalyptus tereticornis*), and Kadam (*Anthocephalus cadamba*) can effectively be included under this agroforestry system.

In general, the objective of farmers in adopting agroforestry models is to improve the economics of agricultural production. Some progressive farmers have earned more income through the adoption of horti-silvicultural models. The financial returns from such systems are better than from traditional agricultural rotation and cereal/pulses based agroforestry models.



1) Poplar block plantation with citrus

2) Eucalyptus boundary plantation with citrus



Poplar block plantation with guava.

Continuous research efforts are needed to come up with appropriate solutions to the present problems and challenges in agriculture. Anon-farm survey indicated that fruit-based agroforestry practices are more suitable for farmers with large land holdings. The inability of small farmers to meet their basic food needs limits the adoption of the fruit-timber combinations. Demonstration of its effectiveness through research and dissemination of information is needed to gain the interest of farmers and widen the application of this promising agroforestry model.

To realize the full potential of the horti-silvicultural model, a complete package of technology needs to be developed for adoption in various agroclimatic zones. It should consider the needs, customs, and traditions of the local people. India will witness the real green revolution only when it is clothed with greenery.

■ *The authors work at the Department of Forestry & Natural Resources, PAU Ludhiana 141 004 (India)*

*1) Poplar block plantation with mango*

*2) Teak block plantation with citrus*



Associer arbres et cultures  
When Trees and Crops Get Together

## 10th North American Agroforestry Conference to be held in Quebec, Canada

The Association for Temperate Agroforestry (AFTA) will be sponsoring the 10<sup>th</sup> North American Agroforestry Conference, 10-13 June 2007, at the Université Laval in Quebec City, Canada.

The conference aims to stimulate the development and adoption of sustainable rural land management practices centered on the integration of trees into the landscape. Discussions will focus on the following:

- Examples of temperate agroforestry systems and practices
- Cultural, sociological and economic aspects of temperate agroforestry

- Agroforestry crops and products, and market development
- Policy issues and agroforestry adoption
- Education, training and outreach in agroforestry
- Ecophysiological aspects of plant production in agroforestry systems
- Soil conservation, water quality and wildlife habitat in agroforestry systems
- Agroforestry for ecological goods and services delivery
- Multiple use landscape management through agroforestry
- Modelling of agroforestry systems
- Decision support systems for agroforestry

The conference hopes to target representatives from private companies, advisory groups, municipalities, government departments, educational institutions or research centers that specialize in the fields of agriculture, forestry, environment and land-use planning. Conference participants will gain access to new, state-of-the-art knowledge on rural land management practices beneficial to the agricultural environment, including the methods that will implement and monitor these practices.

For those interested, visit <http://www.agrofor2007.ca> or send inquiries to [info@agrofor2007.ca](mailto:info@agrofor2007.ca). ■  
(Press Release)



## New agroforestry information materials from FAO

FAO has released the following information materials related to agroforestry:

**Conservation of natural resources for sustainable agriculture: training modules.** FAO Land and Water Digital Media Series No. 27

Available on a CD-ROM, these training modules aim to increase awareness of the benefits of sustainable agriculture. They provide practical information on the principles of sustainable agriculture for natural resources conservation. The modules consist of: concepts and principles of conservation agriculture; cover crops; organic matter and biological activity in the soil including soil quality assessment, compaction, fertility, moisture; tools and equipment; weeds; pests and diseases; livestock; and economic benefits. The modules also contain exercises. For more information, visit <http://www.fao.org/ag/agl/lwdms.stm>

**Global Forest Resources Assessment 2005: Progress towards sustainable forestry management.** FAO Forestry Paper 147

FAO released a reprint of the results of the *Global Forest Resources Assessment 2005*, implemented in 2003-2005. It presents the current status and trends of the world's forest resources in six thematic elements of sustainable forest management. *Global Forest Resources Assessment 2005* was the most comprehensive survey of forests to date and involved more than 800 people including 172 officially nominated national correspondents and their colleagues, an Advisory Group, international experts, FAO staff, consultants and volunteers from various countries. For more information, visit <http://www.fao.org/docrep/008/a0400e/a0400e00.htm>

<http://www.fao.org/docrep/008/a0400e/a0400e00.htm>

**Better forestry, less poverty: a practitioner's guide.** FAO Forestry Paper 149

Through this guide, FAO suggests ways of designing and implementing forest-based interventions that have the greatest potential of reducing poverty. Topics discussed include timber production in both natural and planted forests, non-wood forest products, woodfuel, bushmeat, agroforestry, and payment for environmental services. Under each topic, key issues are outlined, successful case studies are presented, and sources of additional information are identified.

The guide also emphasizes the critical role of participatory approaches and the importance of implementing activities in terms of local conditions. It also focused on interventions that will improve the livelihoods of communities living within or near forests, efforts to educate people on the forms of rural poverty, and ways to improve decision making at the local level. For more information, visit <http://www.fao.org/docrep/009/a0645e/a0645e00.htm>

**State of Food Insecurity in the World 2006: Eradicating world hunger-taking stock 10 years after the World Food Summit (WFS).**

The eighth edition of the *State of Food Insecurity in the World* reports on the progress and setbacks in the various regions towards attaining the WFS targets. It discusses the constraints to efforts aimed at reducing world hunger, the challenges, the need to broaden the areas of actions, and lessons learned. The report also presents a

broad agenda to accelerate efforts and highlights the need to harness political will in achieving the WFS targets. For more information, visit <http://www.fao.org/docrep/009/a0750e/a0750e00.htm>

**Properties and management of drylands, FAO Land and Water Digital Media Series No. 31**

This DVD serves as an information base of more than 1 000 documents, articles, hyperlinks, maps, statistics, photos and data sets on the different aspects of drylands.

It provides comprehensive information on drylands, particularly its natural resources and ecosystems, their conditions, and status of degradation, techniques and practices to manage dryland resources, and the socio-economic situation of the communities living in drylands. For more information, visit <http://www.fao.org/ag/agl/lwdms.stm> ■

## Information sources for agroforesters

The following information materials were compiled from Springer Publications, CABI Publishing, The World Agroforestry Centre (ICRAF), among others.

### Agroecosystems in a changing climate

Written by Paul Newton, R. Andrew Carran, Grant Edwards and Pascal Niklaus, this book considers the ecological and agricultural perspectives on the consequences of changes in the atmosphere and climate on the integrity, stability and productivity of agroecosystems. Topics include the resource supply to sustain agriculture, incidence and control of pests, weeds and

diseases, changes in the population biology of organisms, plant breeding solutions, plant capacity for adaptation, and climate change effects on agricultural production. For more information, visit <http://www.agiculturenetbase.com/>.

### AgroForesTree Database Version 2.0

Produced by the World Agroforestry Centre (ICRAF), this database contains detailed information of more than 350 species of fruit and timber trees, rattan, and bamboo that are used in agroforestry systems in Southeast Asia. Information presented includes taxonomy, botanic description, geographic

distribution, habitat characteristics, biophysical limits, products and services, pest and disease, propagation, tree management, growth and yield, harvesting aspects, marketing and future prospects. For more information, visit <http://www.worldagroforestrycentre.org/>.

### Bioproducts from Canada's forests – new partnerships in the bioeconomy

Edited by Suzanne Wetzel, Luc Duchesne and Michael Laporte, this book provides information on various innovative, nontimber

*Continued on page 16*



## New Forests Project offers seeds, training materials

The New Forests Project (NFP) based in Washington, DC, USA is offering tree seeds, technical information, and training materials free of charge to farmers' groups and civil society groups worldwide who are interested in starting reforestation projects using nitrogen-fixing trees. Through its World Seed Program, NFP has assisted more than 4 400 villages in over 120 countries since 1982, with the aim of curbing deforestation in developing countries.

The following high quality seeds are available for distribution:

1. *Acacia auriculiformis*
2. *Acacia mearnsii* (Black wattle, tan wattle)
3. *Acacia nilotica* (Egyptian thorn, redheat, barbar)
4. *Acacia tortilis* (Umbrella thorn, Israeli babool, seyal)
5. *Albizia lebbek* (East India walnut, kokko, woman's tongue)
6. *Cajanus cajan* (pigeon pea, gandul)
7. *Cassia siamea* (Bombay, blackwood, yellow cassia)
8. *Dalbergia sisoo* (sisu, nelkar, shewa, yette)
9. *Grevillea robusta* (Silky Oak, Silver Oak)
10. *Gliricidia sepium* (Madre de cacao)
11. *Gleditsia tricanthos inermis* (honey locust)
12. *Leucaena leucocephala* (ipil-ipil, leadtree)
13. *Prosopis juliflora* (mesquite)
14. *Robinia pseudoacacia* (black locust)
15. *Sesbania sesban* (Sesban, Egyptian rattle pod, suriminta)
16. *Moringa oleifera*

Some of the species are suited for temperate climates and higher elevations. These nitrogen-fixing trees can be used for firewood, charcoal, furniture, and shipbuilding. They can also provide fodder and serve as living barrier against shifting soil.

Those who are interested may submit their requests containing the environmental description of the area, including elevation, average annual rainfall, length of rainy and dry seasons, average temperatures. Include also a brief explanation of how the seeds will be used (i.e. fuelwood, lumber, forage, soil conservation, soil enhancement, etc.).

For more information or to receive a reforestation packet, contact:

The New Forests Project, 731 Eighth Street, SE, Washington, DC 20003, USA, Tel 1-202-547-3800 ext 110 Fax 1-202-546-4784, E-mail: [newforestseeds@newforests.org](mailto:newforestseeds@newforests.org) Website: <http://www.newforestsproject.com> ■

*(NFP Press Release)*



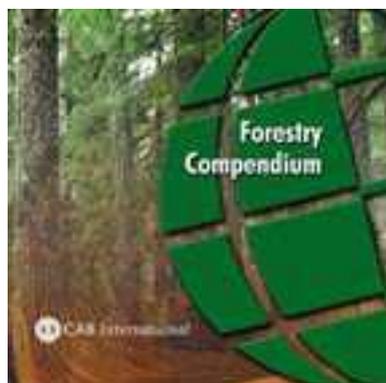
### Information sources for...

*Continued from page 15*

bioproducts that can be derived from Canada's forests. The discussion highlights their potential economic, social and environmental impacts. It also discusses the technological, policy, and regulatory issues surrounding the emerging global bioeconomy. Topics include biofuels and bioenergy, biochemicals, agroforestry, foods, nutraceuticals, and pharmaceuticals, decorative and aesthetic products, recreation, other innovative products and technology, forests and pests, and carbon credits. For more information, visit <http://www.cplbookshop.com/>.

#### CABI global forestry compendium

Published by CABI and updated every two years, this compendium is a reference tool on silviculture. It provides detailed data and illustrations for more than 1 200 species that are economically important worldwide, and some that are of local importance. Other features include basic data on over 20 000 forestry species, a species selection module, a multilingual glossary, ICRAF's Tree Seed Suppliers Directory, and forestry information from FAO, CIFOR, ITTO and INBAR. For



more information, visit <http://www.cabicompendium.org/fc>.

#### Environmental services of agroforestry systems

Edited by Florencia Montagnini, this book presents how agroforestry systems and tree plantations can help mitigate climate change and degradation of biodiversity, which are issues that were highlighted at the First World Congress of Agroforestry in Orlando, Florida in 2004. The book discusses the advantages of mixed-species plantations, tropical pasture and silvopastoral systems, tropical forest ecosystem management, research on the economic feasibility of various land use systems, socioeconomic considerations of coffee-growing, and agroforestry systems in Costa Rica. There are also discussions on the latest research and concepts in agroforestry, reforestation, soils, agriculture, natural resource economics, and incentives for reforestation and agroforestry. For more information, visit <http://www.barnesandnoble.com/>.

#### Forest restoration in landscapes: beyond planting trees

Edited by Stephanie Mansourian, Daniel Vallauri, and Nigel Dudley, this book presents the evolution of forest restoration as it has integrated into landscape conservation plans. It compiles the experiences of the World Wildlife Fund and its partners in forest restoration, and presents future research areas. For more information, visit <http://www.cplbookshop.com/>.

#### ForestScience.Info

This is an online service of CABI Publishing which provides access to its abstract journals: *Forestry Abstracts* cover researches on land use and conservation; *Agroforestry*

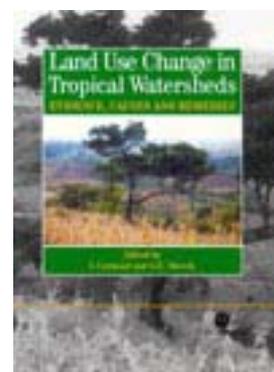
*Abstracts* cover agroforestry systems, components and processes; *Forest Products Abstracts* cover all aspects of wood process – from logging to marketing. It also includes researches on non-timber forest products. For more information, visit <http://www.forestsience.info/>.

#### Global development of agriculture: challenges and prospects

Edited by N. Halbert, H. F. Alroe, and M. T. Knudsen of the Danish Centre for Organic Farming, Denmark, this book provides an overview of the potential role of organic agriculture in terms of ecology, economics and free trade. It also presents insights into the challenges of organic agriculture and its potential role in improving soil fertility, nutrient cycling and food security, as well as the reduction of veterinary medicine use. It also highlights research needs and the importance of non-certified organic agriculture. For more information, visit <http://cabi-publishing.org/>.

#### Land use changes in tropical watersheds: evidence, causes and remedies

Edited by G. E. Shively of Purdue University and University of Wisconsin, USA, this book examines land-use change in the tropics. It focuses on the economic processes influencing the rates of land degradation and forest clearing. Lessons and insights were drawn from the Manupali upland watershed in southern Philippines. It documents the factors that led to land-use changes, particularly the impacts of institutional and policy reforms. It also highlights the interrelationships between



biological, economic, and social phenomena. The book is a result of a project implemented by the Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program (SANREM CRSP), funded by the United States Agency for International Development (USAID). For more information, visit <http://cabi-publishing.org/>.

### **No tillage seeding in conservation agriculture**

Written by C. J. Baker and W. R. Ritchie of the Centre for International No-Tillage Research and Engineering (CINTRE), New Zealand, K.E. Saxton who was formerly with the USDA, W. C. T. Chamen of the 4Seasons Agriculture and Environment, UK, D.C. Reicosky of the USDA, ARS, F. Ribeiro of the Instituto Agronomico do Parana, Brazil, S.E. Justice of the National Agriculture and Environment Forum, Nepal, and P. R. Hobbs of Cornell University, USA. It is the second and most recent edition of the volume which was released in 1996. It presents the results of experiments on the causes of successes and failures in no-tillage agriculture. It also discusses soil carbon and how its retention or sequestration interacts with tillage and no-tillage, controlled traffic farming as an adjunct to no-tillage, the economics of no-tillage, small-scale equipment used by poor farmers, and forage cropping by no-tillage. For more information, visit <http://cabi-publishing.org/>.

### **Silvicultural basis for agroforestry systems**

Written by Mark Ashton and Florencia Montagnini, this guide provides a silvicultural framework on the design and practice of agroforestry systems. It emphasizes research and thoughts from a forestry rather than the agricultural perspective. The guide also provides examples and knowledge gained on

the ecology theory of forests that concern the competition for resources of plant-plant and plant-animal mixtures, and the temporal and spatial dynamic productivity of forests as basis for silvicultural applications in agroforestry systems. For more information, visit <http://www.agriculturenetbase.com/>.

### **Sustainable forestry: from monitoring and modeling to knowledge management and policy science**

This book examines the issues of global climate change and biodiversity conservation. It highlights four methodologies and their contributions in overcoming ecological challenges, including practical experiences in implementing successful sustainable forestry policies. This book is edited by K. Reynolds of the USDA Forest Service, USA, A. Thomson of the Canadian Forest Service, Canada, M. Shannon of the State University of New York, USA, M. Kohl of the University of Hamburg, Germany, D. Ray of the Forest Research, UK, and K. Rennolls of the University of Greenwich, UK. For more information, visit <http://cabi-publishing.org/>.

### **The agricultural groundwater revolution: comprehensive assessment of water management in agriculture**

Written by M. Giordano and K. G. Villholth of the International Water Management Institute, Sri Lanka, this book addresses the issues of using groundwater for irrigation in the developing world. It also presents problems related to the degradation and overexploitation of groundwater, and discusses methods for its improved management. For more information, visit <http://cabi-publishing.org/>.

### **The encyclopedia of seeds: science, technology and uses**

Edited by M. Black of Kings College London, UK, J. D. Bewley of the University of Guelph, Canada, and P. Halmer of Germain's Technology Group, Kings Lynn, UK, this book outlines the latest biological knowledge on seeds, including the principles of agricultural seed processing, storage and sowing, food and industrial uses of seeds, and their roles in history, economies and cultures. For more information, visit <http://cabi-publishing.org/>.

### **Trees of change**

This book summarizes the current directions, vision and mission of the World Agroforestry Centre (ICRAF). It aims to project how the Centre has evolved, presents the organization's priorities, and communicates its research findings and a description of its development-support and education work. Discussions focus on how ICRAF aligned its vision with the Millennium Development Goals to strengthen relationships with national governments, and research and development partners. The book also emphasizes ICRAF's beliefs on cross-sector linkages in the areas of gender, health and nutrition. For more information, visit <http://www.worldagroforestrycentre.org/>.

### **Way out of woods: learning how to manage trees and forests**

Edited by P. Van Mele, this book presents the success of forestry and agroforestry projects in Nepal, Kenya and Bolivia. Through case studies, the book discusses possible solutions to the sustainable management of natural resources, taking into account the biological, social, and cultural diversity of rural communities. For more information, visit <http://www.cabi-commodities.org/Acc/ACCrc/ACCrc.htm>. ■



# Useful Websites

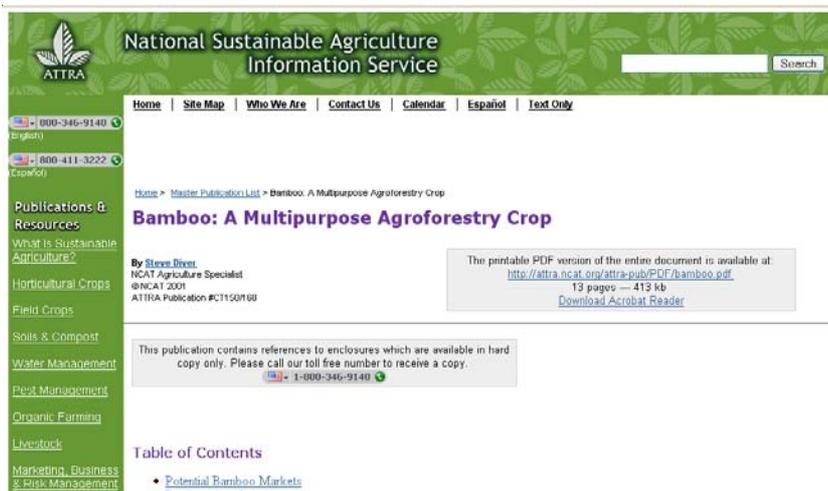
## Agriculture netBase

Maintained by Taylor and Francis CPC Press, the Agriculture netBase website offers information on various books, handbooks, encyclopedias, and many other information materials in the areas of agriculture and agronomy, animal science, botany, crop science, entomology, forestry, genetics, molecular biology, social science, and veterinary science. For more information, visit <http://www.agriculturenetbase.com/>.



## National Sustainable Agriculture Information Service

Managed by the National Center for Appropriate Technology, this website offers publications and resources on sustainable agriculture, horticultural crops, field crops, soil and compost, water management, pest management, organic farming, livestock, marketing, farm energy and education, among others. For more information, visit <http://attra.ncat.org/>.



## Food and Fertilizer Technology Center

FFTC is a regional information center in the Asia-Pacific region that disseminates information on a wide range of modern and practical technologies relevant to the needs of small farms. The website offers publications such as annual reports, books, newsletters, Asian agricultural reviews, extension bulletins, technical bulletins, technical notes, practical technology and research highlights. Topics include food processing, postharvest technologies, grain and root crop production, institutional support, livestock, plant propagation, soil and fertilizers, vegetables and fruits. For more information, visit <http://www.ffc.agnet.org/>.



## International Center for Underutilized Crops

This website offers articles, books, manuals, databases, posters, newsletters, and monographs, among others, on underutilized crops. It also provides expertise and acts as a knowledge hub for tropical, subtropical, and temperate plant development. For more information, visit <http://www.icuc-iwmi.org/>.

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The International Center for Underutilized Crops

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We promote the use of underutilized crops for the benefit of humankind and the environment.

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**Factsheets (Fruits for the Future):**

*Pouteria*. International Centre for Underutilised Crops, Southampton, UK. Factsheet No. 11 (PDF 1.9 Mb), October 2004.

*Njansang*. International Centre for Underutilised Crops, Southampton, UK. Factsheet No. 10 (PDF 400 kb), April 2004.

*Monkey Orange*. International Centre for Underutilised Crops, Southampton, UK. Factsheet No. 9 (PDF 1.6Mb), April 2004.

*Mangosteen*. International Centre for Underutilised Crops, Southampton, UK. Factsheet No. 8 (PDF 570 kb), March 2003.

*Rummelo*. International Centre for Underutilised Crops, Southampton, UK. Factsheet No. 7, March 2003.

*Jackfruit*. International Centre for Underutilised Crops, Southampton, UK. Factsheet No. 6 (PDF 670 kb), March 2003.

## Educational Concerns for Hunger Organization (ECHO)

ECHO is a nonprofit Christian organization located in Fort Myers, Florida, USA. Its website offers books, training, links and good references on seeds of various species. It features a Seed Bank where information on legumes, nutrition and income, trees, and forage can be found. For more information, visit <http://www.echotech.org/>.

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**Nitrogen Fixing Agroforestry Trees**

Written by ECHO  
Thursday, 12 January 2006

**LEGUMINOUS AGROFORESTRY TREES**

In addition to the more conventional crops, many trees are used around the small farm for a wide variety of purposes. Leguminous trees are exceptionally valuable for the nitrogen they add when their leaves fall off, or their roots die back. A single species of tree often serves multiple purposes. The potential uses of trees on the small farm are many, including the production of food, feed, industrial raw materials, lumber, and fuel, living fences, alley cropping, shade, source of nutrients for the soil, and erosion control. Altitude ranges are given as a guide. We have an Agroforestry Principles Technical Note if you are interested in this area. A caution on weediness: we heartily agree with the caution printed on the Agroforester order form, "By their nature many nitrogen fixing species are well adapted to harsh conditions, grow vigorously, and can seed prolifically. They are pioneers of degraded, disturbed, and ruined land, and will proliferate freely in such conditions."

*Acacia* | *Acrocarpus* | *Alfelia quanzensis* | *Albizia lebbeck* | *A. lucida* | *Calliandra* | *Erythrina berteroana* | *E. poeppigiana* | *Faidherbia albida* | *Flemingia* | *Glicicidia* | *Leucaena* | *Prosopis* | *Robinia* | *Senna* | *Sesbania* | Tamarind | *Tephrosia*

**Acacia spp.**

**Acacia**

*Acacia angustissima*-**Prairie Acacia**: Large shrub; provides fuel wood, organic matter; used in tanning; nitrogen fixing; tolerates acid soils; needs >1000 mm annual rainfall; can survive periodic waterlogging; some potential as a fodder crop. Matures to 3 feet in height and spreads from roots.

H, LL.

## International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

The ICRISAT website contains research briefs on agroecosystems, biotechnology, crop improvements, market policy and impacts. It features information on its flagship programs: Global Agricultural Research-for-Development Against Desertification (OASIS), Agri-Science Park, Desert Margins Program, and the Virtual Academy for the Semi-Arid Tropics (VASAT). Its website also offers online resources, including an e-library with online databases, agricultural sites on the web, and publications. ICRISAT also promotes key crops of chickpea, pigeonpea, groundnut, pearl millet, and sorghum. For more information, visit <http://www.icrisat.org/>.

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**Science with a Human Face**

ICRISAT is a non-profit and non-political research organization that serves the poorest of the poor in the semi-arid areas of the developing world. We use science as a means to serve the poor, not as an end in itself. This is the human face of science and agricultural research that we do with our partners =>More

Biography

ICRISAT strengthens relationship with Israel (More>>)  
ICRISAT adopts implementation of SMTA effective 1 Jan 2007

**ICRISAT's locations in the semi-arid tropics**

Nairobi, Kenya  
Nairobi, Kenya  
Lilongwe, Malawi  
Maputo, Mozambique  
Bulawayo, Zimbabwe  
Nijmegen, India  
Patancheru, India  
Bamako, Mali

ICRISAT belongs to the Alliance of Centers supported by the  
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- Online Resources
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# Call for contributions

We are inviting contributions to the 30<sup>th</sup> and 31<sup>st</sup> issue of the Asia-Pacific Agroforestry Newsletter (*APANews*) on or before 30 April and 13 July 2007. Let us help you share the relevant programs and projects that you are doing in the areas of agroforestry research, promotion and development, and education and training.

Contributions for agroforestry research may contain results of short- and long-term studies on agroforestry.

Contributions for agroforestry promotion and development may contain information on various extension services aimed at promoting and developing agroforestry among communities.

Contributions for agroforestry education and training may contain announcements on conferences, symposiums, training opportunities and other news on the various efforts being made toward generating more agroforestry professionals and practitioners, and providing venues for interpersonal sharing of agroforestry information, and networking opportunities.

We will also help you announce new information sources and useful websites.

For several years now, *APANews* has continued to reach out to people from various sectors. Hence, we

would like to request interested contributors to adopt a simple and straightforward style in writing the articles. By adopting the popular writing style, your articles can better reach farmers, development agents, researchers, practitioners and other interested individuals, to help them in coping with the challenges of promoting and developing agroforestry in their respective countries.

In addition, the FAO and IAF editors would like to accommodate as many articles as possible in every issue. Hence, kindly limit your contributions to 1 000 words, and include good-quality photographs (scanned at 300 dpi) that are properly labeled and referred to in the text. Please don't forget to include your complete contact details, especially your e-mail address, so that readers can contact you with questions or requests for further information.

Please send contributions by e-mail attachment or via snail mail in diskettes/CD-ROM or in printed form to the FAO/RAP Office or to the UPLB Institute of Agroforestry, 2/F Tamesis Hall, College of Forestry and Natural Resources, UP Los Baños, PO Box 35023, College, 4031 Laguna, Philippines; Fax +63 49 5363809; E-mail [fao\\_apanews@yahoo.com](mailto:fao_apanews@yahoo.com), [apanews0718@gmail.com](mailto:apanews0718@gmail.com). ■