

APANews

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Dear Readers

Welcome to the 40th issue of APANews! This issue presents interesting articles on poplar-based agroforestry systems, biofuel production in agroforestry systems and rubber-based agroforestry systems.

We feature one article that highlights the need to establish a balance between intercropping shade-loving species and high-value crops in a multistorey system. The article presents the findings of a study on the performance and economic returns of intercropping fruit crops (Kinnow, guava, peach and plum), spices (onion, garlic and pepper), rice, wheat and poplar trees in a multistorey system. Find out the performance of each crop under three- and four-year-old poplar trees and which among the crop combinations offer high net returns to the farmer.

Another article highlights an innovative partnership between two farmers who ventured in the intercropping of agricultural crops (wheat and sugarcane) with poplar trees. One farmer managed the agricultural crops grown in between poplar trees while another farmer took care of the poplar trees. Read

more about this unique business model that allows both farmers to earn income without having to own the land and at the same time offers an easier way of managing the farm's day-to-day operations.

In our continuing search for alternative sources of energy, research has revealed several species that can be tapped as biofuel—*Pongamia pinnata*, *Garcinia indica*, *Azadirachta indica*, *Calophyllum mophyllum*, *Simarouba glauc* and *Jatropha curcas*. You might find interesting one article that identifies *Madhuca latifolia* or *mahua* as another source of biofuel. Read more on the characteristics, distribution, propagation and economic value of *mahua*. Find out why *mahua* has been added to the list of potential sources of biofuel and how it can offer additional income when integrated in agroforestry systems.

Rubber is another species that offers high income to farmers. One article describes the existing rubber-based agroforestry systems in Viet Nam and how these are offering high income to farmers. Read more on the different crop combinations that have proven successful in

rubber-based agroforestry systems. You might also find interesting the different benefits offered by rubber trees, one of which is to act as windbreaks, especially when planted in downstream areas.

We continue to feature upcoming events that you might want to participate to enhance your networking and promotion of agroforestry projects and activities. We also researched websites and information resources on agroforestry that you might find useful in implementing your agroforestry research, and agroforestry promotion and development initiatives.

As always, thank you to all the contributors! Your continued support affirms the role of APANews in providing relevant information in agroforestry research, promotion and development, and education. Let us continue strengthening connections, creating innovations, and sharing knowledge to further promote agroforestry for sustainable development.

—The Editors

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COVER. An innovative partnership in India enables farmers to divide the management of agricultural crops intercropped with poplar trees. The arrangement provides high income to the farmers and at the same time offers an easier way to daily farm management (see *story on page 4*).

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Intercropping of fruit crops, spices and poplar trees pose high profits for farmers

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Multistorey agroforestry systems offer production of various crops under different shade conditions thereby maximizing photosynthetic active radiation. In the northwestern states of India, most multistorey systems are poplar-based where a number of agricultural crops (wheat, mustard, turmeric, ginger, garlic, onion, sugarcane, fodders, etc.), and fruit crops (citrus, guava, mango, peach, etc.) are profitably raised under poplar trees.

Studies have shown the potential of integrating shade-loving species and high-value crops (i.e., spices, vegetables and medicinal plants) in poplar-based agroforestry systems. Intercropping reduces nutrient leaching and promotes recycling of subsoil nutrients thereby increasing nutrient availability and reducing negative environmental impacts.

The intensive management of poplar-based agroforestry systems in India is providing farmers with improved incomes as compared to venturing into other seasonal cropping rotations. Increased incomes mean improved local employment and sustained supply of wood for construction and other purposes.

Further, poplar-based agroforestry systems in India are promoting the cultivation of onion (*Allium cepa*) and garlic (*Allium sativum*), which are important cash crops and spices in India. India is the second largest producer of onion and garlic after China and a traditional exporter of both crops. Onion and garlic mature faster and are thereby providing substantial income to small and marginal farmers.

A study was conducted on the intercropping of four fruit species (Kinnow, guava, peach and plum at 6 m X 6 m spacing) with poplar trees (G-48 clone). The poplar trees were cultivated alternately between the fruit trees. The study aims to evaluate performance and economic returns of growing onion and garlic under poplar-based multistorey systems.

Figure 1 shows a yield reduction of 25.80 and 10.87 percent in garlic, and 22.14 and 14.22 percent in onion under four- and three-year-old poplar trees. Poplar canopies showed a marked effect on growth

and yield of both onion and garlic. However, the reduction in yield of both crops under poplar trees was less sharp as compared to other agricultural crops. This may be due to timing—the plantation season of onion and garlic coincided with the leaf-less stage in the growth of poplar trees. Yield was reduced because of the shade provided by the poplar trees at the time onion and garlic reached maturity.

The economics of different crop combinations was calculated. The results were compared on a per acre basis (0.4 ha) for all crops including rice and wheat (Figure

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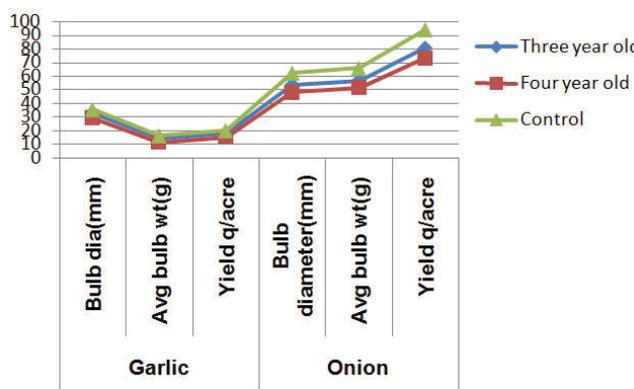


Fig. 1. Yield (0.4ha) of onion and garlic influenced by poplar canopy.

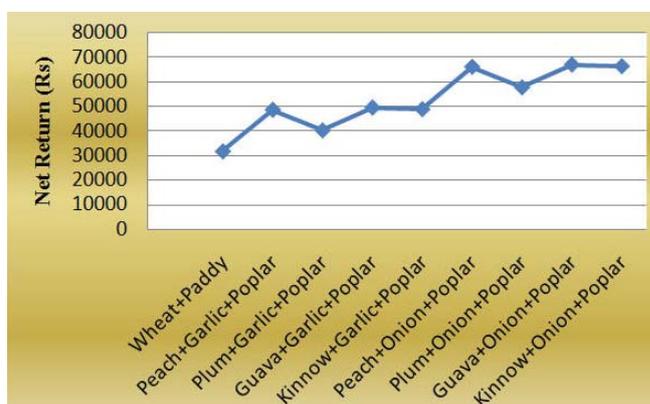


Fig. 2. Comparison of net returns of cropping sequences on a per acre basis (0.4ha).



Intercropping of fruit...

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2). The gross income obtained from different crop combinations ranged from Rs.42 185 (US\$917) to Rs.94 117 (US\$2 046). The highest net return of Rs. 31 835 (US\$692) was obtained from guava + onion + poplar, while the lowest net return was obtained from wheat + rice (traditional crop rotation). The total yield of the multistorey system was economically profitable. The system also maximized the use of land and nutrients and improved microclimate conditions.

Multistorey agroforestry systems help generate local employment on a per unit area basis as compared to the traditional rice-wheat rotation or other cropping sequences. Such systems also produce multiple sources of income for the farmer. The study thus recommends the promotion and adoption of guava + onion + poplar trees multistorey system (Figure 3) to provide farmers with the highest economic returns when intercropping fruit trees, spices and poplar trees. •

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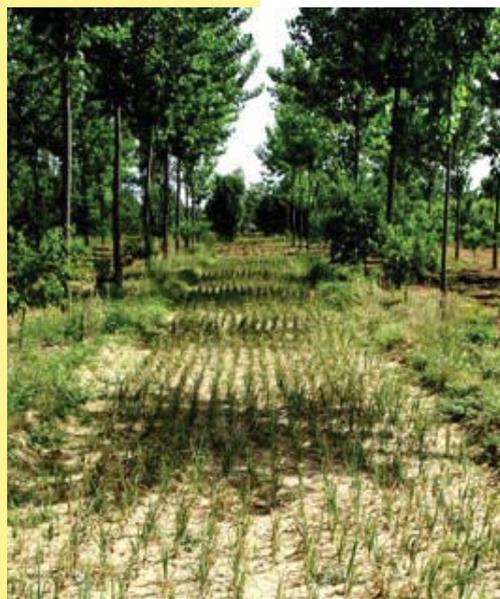


Fig. 3. A poplar-based multistorey agroforestry system.

An innovative partnership arrangement for poplar-based agroforestry systems in India

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Poplar trees in agroforestry systems enable intercropping of other crops thereby maximizing use of the land. They are grown solely to produce logs, while the lops, tops and roots are used as fuelwood.

Public-private partnership in poplar farming

Poplar farming was introduced and promoted in the 1980s and 1990s in northern India by WIMCO Ltd, a match-making company, under public-private partnership (PPP) arrangements.

The company supplied quality planting stock, provided technical know-how for its growth and maintenance, and assured the market of trees upon maturity. National banks provided long-term loans to the growers which contributed to the wide acceptance of poplar farming even after completion of the PPP arrangements.

Poplar farming has expanded to new locations with an estimated 30 million saplings planted on farm lands during the planting season 2012. Around 2 000 small-, medium- and large-scale industrial units are directly dependent on poplar wood in the manufacture of three dozen products.

Because of its numerous benefits, poplar farming has been recognized as a viable business opportunity. A lot of entrepreneurs invest money on establishing and maintaining nurseries and poplar plantations—i.e., from nursery sapling production to establishment of field plantations, each having different levels of engagements, investments and earnings. One such case was that of Rakesh Singh,

a retired Agricultural Technician from the Government Agriculture Department. R. Singh used his retirement money to invest in a 2-acre poplar farm in Pilibhit District, Uttar Pradesh in 2004.

Innovative arrangements in poplar-based agroforestry

Bhanu Pratap Singh, has been a regular poplar grower for the last two decades. In 2004, poplar wood was priced low in local markets. It was this reason that B. P. Singh was hesitant to continue with his poplar farm.

R. Singh persuaded B. P. Singh to take part in a business venture. R. Singh would continue the growth of the poplar trees for 6-7 years and pay B. P. Singh Rs. 15 000 (US\$270) per acre every year until the trees are harvested in March/April 2011. B. P. Singh, meanwhile, would take care of managing the intercrops in between the poplar trees at his own expense, taking all earnings from it. Accordingly, R. Singh planted 500 saplings of WSL 32 clone at 4.5 m x 4.5 m spacing in February 2004 which could attain 95 percent survival during harvest in April 2011.

B. P. Singh grew sugarcane in the first two years with 180 qtl and 175 qtl sugarcane yield/acre in the first and second year, respectively. Wheat was grown from the second to the sixth winter seasons with grain yields of 19-15 qtl/ha depending on the age of the trees. Crops were not planted during the first two years after cultivation of sugarcane. Wheat was also not planted in the seventh year which was the scheduled harvest of the poplar trees.

Meanwhile, R. Singh pruned the poplar trees during the second, fourth, and fifth year as practiced in the area. There was no cost involved in pruning the trees. Laborers got the prunings for free for use as fuelwood.

After the fifth year, R. Singh monitored market prices of poplar wood, and consulted with WIMCO staff, WIMCO Match Factory and other plywood factories in the area. He got a free assessment of his plantation from the WIMCO Wood Team and decided to push through with the harvest of the trees when they reached seven years old in March/April 2011. He paid Rs.117 400 (US\$2 114) from the harvest and transportation of wood to the factory/trading centers and received a total of Rs.1 150 472 (US\$20 721) from the sale of the logs and firewood. R. Singh earned a net Rs.878 920 (US\$15 832), approximately Rs.1.25 (US\$2 250) lakhs/yr with 7 percent inflation and Rs.1.27 lakhs/yr (US\$2 286) without considering inflation. This amount, if transformed on a per acre basis, obtained Rs.62 780/acre/yr (US\$1 134) with 7 percent inflation and Rs.63 500/acre/yr (US\$1 147) without inflation. The cost-benefit ratio is calculated to be Rs.1:3.24 with 7% inflation and Rs.1:3.40 without inflation with the present land-use value and without returns from the agricultural crops



Wheat grown between rows of two-year-old poplar trees.

intercropped with the poplar trees. The returns from poplar trees were found higher than the returns from the intercrops.

R. Singh planted 250 saplings/acre at a spacing of 4.5 m X 4.5 m. The closely grown trees produced less knotty wood and attracted good market prices but the yield per tree was lower. Because of better wood quality, R. Singh got Rs. 10/qtl (US\$0.18) extra from the WIMCO Match Factory during that period.

Benefits of the partnership arrangement

This innovative partnership arrangement of establishing and maintaining poplar-based agroforestry system is being replicated in other areas of India. This type of arrangement may also be considered a business model for poplar-based agroforestry systems. It is simple, does not require a person to own a land, and the entrepreneur does not have to be concerned with

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Table. Poplar-based agroforestry system business model based on partial leasing* of land.

Year	Cost of sapling	Cost of planting	Land lease	Total cost	Cumulative costs	Computed cost**	Cost of harvesting and transportation	Total computed cost	Returns from sale of tree products	Net returns
1	8 000 (US\$144)	1 500 (US\$27)	15 000 (US\$270)	24 500 (US\$441)	24 500 (US\$441)	26 215 (US\$472)				
2			15 000 (US\$270)	15 000 (US\$270)	41 215 (US\$741)	44 100 (US\$795)				
3			15 000 (US\$270)	15 000 (US\$270)	59 100 (US\$1 065)	63 237 (US\$1 139)				
4			15 000 (US\$270)	15 000 (US\$270)	78 237 (US\$1 410)	83 714 (US\$1 508)				
5			15 000 (US\$270)	15 000 (US\$270)	98 714 (US\$1 779)	105 624 (US\$1 903)				
6			15 000 (US\$270)	15 000 (US\$270)	120 624 (US\$2 174)	129 067 (US\$2 325)				
7			15 000 (US\$270)	15 000 (US\$270)	144 067 (US\$2 596)	154 152 (US\$2 776)	117 400 (US\$2 114)	271 552 (US\$4 891)	1 150 472 (US\$20 721)	878 920 (US\$15 832)

* Partial leasing assumes that both lessee (R. Singh) and lesser (B. Pratap) have equal ownership of the land in terms of land use.

** The amount considered an annual compounding interest of 7 percent.

An innovative partnership...

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day-to-day farm operations. The success of this initial undertaking has encouraged R. Singh to book 2 000 more poplar saplings with WIMCO to hopefully increase his profits four times (without considering inflation) his initial investment and at the same time affirm that this type of innovative partnership can work in poplar-based agroforestry systems. •

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UNCCD Second Scientific Conference

The UN Convention to Combat Desertification Second Scientific Conference will be held on 4-7 February 2013 in Fortaleza, Brazil, during the third special session of the Committee for Science and Technology (CST S-3).

The scientific conference will be the main part of the CST session. It will consider the theme "Economic assessment of desertification, sustainable land management and resilience of arid, semiarid and dry subhumid areas." The conference will focus on economic and social impacts, and costs and benefits of policies and practices addressing desertification, land degradation and drought.

For more information, visit <http://2sc.unccd.int/home/>. •



Madhuca latifolia—a viable option for biofuel production in agroforestry systems

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India's energy consumption has been increasing at a relatively fast rate due to population growth and economic development. In the last six decades, India's energy use has increased by 16 times while installed energy capacity increased by 84 times.

In 2008, India's energy use was the fifth highest in the world. However, India still suffers from pervasive electricity deficits. With an economy projected to grow at 8-9 percent per year, supported by rapid urbanization and improved standards of living for millions of Indian households, the demand is likely to grow significantly. In recent years, demand has indeed consistently outstripped supply. Substantial energy and peak shortages of 10.1 percent and 12.7 percent prevailed in 2009 and 2010, respectively. In 2008-2009, fossil fuels (coal, gas and diesel) provided around 80 percent of India's electricity but contributed 42 percent of carbon emission.

The situation illustrates India's need for secure, affordable and environmentally sustainable energy. While energy conservation and energy efficiency play an important role in the national energy strategy, renewable energy, through biofuel, will become a key part in finding solutions or ways to augment the country's current energy crisis, reduce consumption of fossil fuels and help India pursue low carbon initiatives.

Biofuel

Biofuel is an eco-friendly, alternative diesel fuel prepared from domestic renewable resources such as vegetable oils (edible or non-

edible oil) and animal fats. India is intent in promoting the production of biodiesel. With the country's vast wastelands, and the global community increasingly rooting for alternative fuel source, India is in a good position to become the global sourcing hub for both feed stock and processed bio-diesel.

The country has hundreds of species which could yield oil seeds with enough potential for use in biodiesel production. However, India is deficient in edible oils. It is therefore looking into non-edible oils as the primary source of bio-diesel. In such case, tree-borne oil seeds can be the key to achieving self-sufficiency in oil seed production. Further, cultivation of tree-borne oil seeds in marginal lands/wastelands can help expand forest cover.

The potential species identified so far as sources of biofuel are *Jatropha curcas*, *Pongamia pinnata*, *Madhuca latifolia*, *Garcinia indica*, *Azadirachta indica*, *Calophyllum inophyllum* and *Simarouba glauc.* Besides *Jatropha*, *Madhuca latifolia* (*mahua*) is another versatile species and a good source of biofuel.

Madhuca latifolia

The *mahua* tree is indigenous to India. The species belongs to the family Sapotaceae and was introduced from India to Australia and Polynesia (Troup 1921; Anon 1988). Also called the Indian butter tree, *mahua* is a medium- to large-sized deciduous tree with a short bole attaining a height of 12-18 m and girth of up to 12.4 m in 60-80 years. It can grow in a wide range of edapho-climatic condition. *Mahua* is considered one of the

most important multipurpose forest trees in the country.

Characteristics. *Madhuca latifolia* is a deciduous species. Leaves are shed in February-April. Flowering starts in March-April (Brandis 1906). The fruits develop rapidly and ripen in June-August. The ripe fruit is hardy and yields one to four seeds (Talbot 1902; Hanies 1916). Fruits start 10 years after planting.

Madhuca latifolia wood is hard, heavy, strong and durable but liable to split. It is used as raw material for furniture, turnery, sporting goods, musical instruments, oil and sugar presses, ship building, agricultural implement, carving, etc. It is also a good fuel wood with a calorific value of 5 005-5 223 K cal/kg of dried wood (Forest Research Institute 1972).

Economic value. *Mahua* is tapped for the fleshy corollas of its flowers. These are succulent and rich sources of sugars and vitamins. They are consumed raw or cooked and used as a major ingredient in sweets. The flowers are often used to manufacture liquor, potable spirit and vinegar (Waheed Khan 1972). The outer part of the fruit is also edible. It is eaten raw, cooked, or used to refresh drinks. The flowers

were also found to have anti-bacterial properties (Anon 1988).

Mahua leaves are used as astringent and embrocations. They are used as fodder for cattle and green leaf manure in agriculture (Singh 1982). Latex from bark yields rubber. Bark tannin is also used in medicine, dyeing and tanning (Anon 1988; Banerji and Mitra 1996).

Mahua is best suited for wasteland afforestation programs because they are hardy in nature (Gupta 1993). The tree is well suited to agroforestry farms especially along the bunds of paddy fields where trees get the advantage of irrigation, manure and fertilizers. Pure plantations of *mahua* have already been tried in Madhya Pradesh, Maharashtra, Tamilnadu and Punjab by planting stump. Ramprasad (1993) reported that plantations of *mahua* made in 1948 in Madhya Pradesh through seeds recorded a maximum 273 dbh and maximum height of 16.80 m in a span of 36 years.

Oil properties. The most valuable part of *mahua's* seeds is the kernel which contains 30-40 percent fatty oil, commonly known as *mahua* oil or butter of commerce. The oil is used by indigenous tribes in

cooking or sold to manufacture margarine, soap, glycerine and lubricating grease. It is also used as batching oil in the jute industry, an ingredient in the adulteration of ghee, and several other chemical or industrial uses (Waheed Khan 1972; Anon 1988; Suri and Mathur 1988).

The oil cake, meanwhile, is profitably utilized as biofertilizers or organic manure and biocide (with insecticide and herbicide properties) in different crops. After detoxification, the seed cake is used as a concentrate feed for cattle and fish (Banerji and Mitra 1996).

Distribution. *Mahua* grows from the north Himalayan foothills to the extreme southern part of India. It is common to Madhya Pradesh (Hanies 1916), Maharashtra and Gujarat (Talbot 1902) in central India and Orissa, Western Ghats from Konkan to the south. The tree is often found along river banks and streams (Troup 1921).

Madhuca latifolia grows well in dry tropical and sub-tropical climate. It is commonly found scattered in pasture and uncultivated fields all over central and southern India. *Mahua* grows on a variety of soils but prefers sandy soil (Talbot 1902). It can grow on shallow rocky soils and thrives in the Deccan tract. It also grows well in alluvial soil in the Indo-gangetic plain and has been found with Sal forest in stiff clay and calcareous soil. In natural forests, *mahua* is seldom gregarious in nature and grows well in areas with temperatures of 41-48°C and rainfall of 750-1 875 mm (Troup 1921). It is not affected by excessive monsoon. In fact, it is found in water-logged and low-lying clay soil in southern India (Troup 1921).

Mahua is also planted as an avenue tree in many old gardens of Mughals. It is tolerant to smoke and dust. It is also found suitable to combat noise pollution (Khosla 1996). Coppice



Trees of *Madhuca latifolia*.

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Madhuca latifolia—a viable...

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regeneration is reported to be more reliable and faster than growth of planted ones (Troup 1921).

Propagation. Propagating *mahua* through conventional means is difficult due to pest infestation and short-term viability. Hence, propagation is done through cleft grafting.

Upon collection of seeds from a viable mother tree, root stocks are established in polybags containing standard nursery mixture of soil:sand:FYM (1:1:1). Rootstocks that are 8-12 months old and with pencil-sized thickness of stems are used. Scions, measuring 15 cm long are collected from the leading shoots of the tree. They are grown in a green house using a water-holding compound (commercially known as Jalshakthi).

The top portion of the root stock is cut and a wedge is made on the stock using a knife. The leaves in the scion are trimmed and the basal portion of the scion is cut into v-shape. The scion is then injected into the wedge made on the root stock. The connecting parts are tied with a polythene film to prevent the entry of air. The grafts are then kept inside a mistless polytunnel system. After 45-50 days, the grafted plant is then tested. Results revealed a success rate of 70 percent

Table 1. Seed characters of *mahua* germplasm.

Accession no.	100 seed weight (g)	Seed length (cm)	Seed width (cm)	Seed coat thickness (cm)
TNML* 1	153.19	2.74	1.36	0.052
TNML 2	126.92	2.74	1.22	0.053
TNML 3	121.26	3.44	1.42	0.052
TNML 4	92.62	2.96	1.04	0.053
TNML 5	134.23	3.38	0.96	0.052
TNML 6	141.61	3.38	1.36	0.054
TNML 7	145.25	3.26	1.3	0.052
TNML 8	151.03	3.26	1.18	0.052
TNML 9	142.64	3.1	1.36	0.052
TNML 10	153.35	3.5	1.22	0.053
TNML 11	162.61	2.88	1.36	0.052
TNML 12	98.43	2.86	1.04	0.051
TNML 13	114.73	3.34	1.1	0.052
TNML 14	224.11	3.88	1.24	0.052
TNML 15	173.23	3.46	1.34	0.051
TNML 16	117.69	2.92	1.28	0.052
TNML 17	131.65	3.18	1.28	0.053
TNML 18	109.7	3.08	1.14	0.052
TNML 19	249.34	3.58	1.66	0.052
Mean	144.39	3.21	1.26	0.052
SED	2.43	0.22	0.09	0
CD (p=0.05)	4.92	0.44	0.17	0

*Tamil Nadu Mettupalayam location

Table 2. Germination percentage and oil content of *mahua* germplasm.

Accession no.	Germination percentage	Kernel oil content (%)
TNML 1	55	40.26
TNML 2	33	41.71
TNML 3	35.67	40.3
TNML 4	58.67	44.09
TNML 5	57.33	46.51
TNML 6	51	47.88
TNML 7	67.33	47.68
TNML 8	59.67	49.74
TNML 9	41.67	48.09
TNML 10	50	53.59
TNML 11	44	54.08
TNML 12	54	53.8
TNML 13	31.67	48.16
TNML 14	29	45.64
TNML 15	36	52.38
TNML 16	51.67	39.33
TNML 17	43.67	42.24
TNML 18	43.33	37.62
TNML 19	50.67	52.68
Mean	47.02	46.62
SED	1.35	1.36
CD (p=0.05)	2.75	2.76



Seeds of *Madhuca latifolia*.

Table 3. Variation of seed characters and oil content of mahua.

S. No	Accession no.	Weight of 100 seeds	Seed length	Seed width	Oil content
1	TNML20	56.48	3.32	1.14	16.7
2	TNML21	78.56	3.26	1.14	29.5
3	TNML22	47.15	2.82	0.94	16.8
4	TNML23	71.66	3.4	0.92	25.7
5	TNML24	46.99	3	1	25.5
6	TNML25	55.82	2.46	1	26.6
7	TNML26	58.87	3.2	1.1	11.06
8	TNML27	72.05	3.8	1.1	10.1
9	TNML28	54.11	3.3	1.04	10.46
10	TNML29	62.74	3.24	1.12	9.06
11	TNML30	78.31	3.4	1.02	25.8
12	TNML31	69.72	3.02	0.96	23.2
13	TNML32	75.24	3.38	1.08	26.6
14	TNML33	83.72	3.2	1.16	11.76
MEAN		65.1	3.2	1.05	19.2
SED		0.74	0.12	0.19	1.14
CD (0.05%)		1.5	0.23	0.38	0.85



Grafted seedlings of Madhuca latifolia.

especially when grafting is done in August-February.

Germplasm management. One kilogram of seeds contains about 450 oil seeds. Production of seeds is high every second or third year. However, they lose viability within a short period. The oily fruit should be sown directly in the field as the seeds become available. Mahua germplasms collected from various places of Tamilnadu were assembled and maintained at the Forest College and Research Institute, Mettupalayam, Tamilnadu, India. The seed characters of the mahua germplasms are presented in Tables 1-3.●

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*References: (1) Anonymous, 1988. Wealth of India - a dictionary of Indian raw material and industrial products. Vol.VI. L-M. CSIR, New Delhi, pp.207-216; (2) Banerjee, R. and R. Mitra. 1996. Mahua (*Madhuca sp.*) uses and potential in India. *Applied botany abstracts*. 1996. 16 (4) : 260-277; (3) Brandis. 1906. *Indian trees*. Pub. Bishen Singh and Mahendrapal Singh, Dehradun. pp.426-42;7; (4) FRI, 1972. *Indian Forest Utilization Pub: Forest Res. Inst., Dehradun. Vol.II. FRI. 470-498*; (5) Gupta, K. 1993. *Multipurpose trees for agroforestry and wasteland utilization Oxford and IBM Co. pp.335-338*; (6) Haines, H. H. 1916. *Descriptive list of trees, shrubs and economic herbs of Southern Circle Central province Pioneer press, Allahabad (U.P)*; (7) Khosla, P. K. 1996. In : *Ecofriendly trees for urban beautification*. pp.60-63; (8) Ramprasad, 1993. In : *Mahua the tree of poor*. Pub: IBD, Dehradun; (9) Singh, R. V. 1982. *Fodder trees of India. Oxford and IBD Publishing Co. New Delhi. pp.213-220*; (10) Suri, R. K. and K. C. Mathur. 1988. *Oil seeds and their Utilization, IBD, Dehradun*; (11) Talbot. 1902. *The trees, climber and woody shrubs of Bombay Presidency. Central Government Press, Bombay*; (12) Troup, R. S. 1921. *The silviculture of Indian Trees: Vol. II Oxford University Press, Oxford. pp.640-646*; (13) Waheed khan, M.A. 1972. *Assessment of Mahua flower and seed for industrial use. Indian Forester* 98 (5): 319-322.*

Exploring different models of rubber-based agroforestry systems in Viet Nam

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Rubber (*Hevea brasiliensis* Muell. Arg.) is one of the economically exotic timber trees in Viet Nam. Rubber is planted primarily for latex. Dry latex is a raw material called *krep*.

Originally from Brazil, rubber or *cao su*, was introduced in Viet Nam in the beginning of the 20th century. Rubber trees are planted on basalt or medium-texture soils of schist-clays and feralite which occupy soil layers A-B. They are planted 1-1.5 m deep or more and are suitable at slopes of 510 degrees. It survives at an average temperature of 22-25°C with an annual rainfall of 1 700 mm–2 700 mm or more. Rubber trees grow well in areas with an altitude of 7-700 m.

Since 1975, rubber is now predominantly grown in the central highlands, southeastern and northcentral provinces of the country. Since 2000, rubber has spread in northwestern and

northeastern provinces. Data in 2010 revealed that rubber has occupied 670 000-700 000 ha.

Morphology

On the average, rubber trees measures 15-20 m high or more with a DBH of 20-30 cm. The leaves are palmate, straight-veined and measures 6-10 cm x 15-30 cm. The flowers grow in panicles, are small, monoecious and yellowish-white. A deciduous timber tree, rubber replaces its leaves during November to January.

The average growth and trunk diameter increment of rubber each year measures 1.2-1.5 cm up to 2 cm within the first 10 years of plantation establishment. Latex can be extracted on the eighth year of plantation establishment.

Propagation

Rubber trees can be propagated through grafting of budwood or seedlings. Propagation uses

10-month-old grafted budwood, grafted budwood in plastic bags with pruned trunk and dormant buds, and rubber plantlets with either single or 2-3 leaves. In Viet Nam, rubber clones (RRIM 600, PB 260, PB 235 or GT1) are being used.

Planting techniques

In establishing rubber farm plantations, land preparation is done during the rainy season in May-June in the central highlands and August-September in northcentral Viet Nam. Rubber trees could be planted along the contour lines of sloping areas.

A basal application of manure (about 10-15 kg per hole) and phosphorous or NPK fertilizer should be done 10-15 days prior to planting. The hole should be 70 cm x 70 cm, and 60 cm deep. Around 0.3-0.5 or 1 kg of NPK fertilizer is applied per hole.

Rubber trees are grown at a spacing of 6 m x 3 m or 512-525 trees per hectare. Weeding is done 4-6 times a year, especially while the trees are small. Weeds should be cleared in a diameter of 1.5 m around each tree.

Mortality rate

Rubber trees, when grown in monoculture, suffer from 10-



Fig. 1. Rubber trees felled or damaged by storms.

Table 1. Number of felled and broken rubber trees in the research sites.

	Site 1	Site 2	Remarks
Rubber trees/ha	525 trees	525 trees	
With windbreaks	Yes	None	
Number of felled trees from 40 km per hour wind speed	0	0-6	1%
Number of felled trees from 60 km per hour wind speed	1-3	35	4-7%
Total	2/525 trees	20/525 trees	4%

20 percent mortality rate during the rainy season of September-December. The high mortality rate affects the production of dry latex. On an average, latex is produced at a range of 1.2-1.5 tonnes to 2.0-2.5 tonnes per hectare per year. Mortality is reduced if rubber trees are planted in rows in downstream areas, usually 1 km from the shoreline, to act as windbreaks.

A study explored the different rubber-based agroforestry systems in Viet Nam to find out alternative ways of minimizing the high mortality rate of rubber trees and at the same time sustain and/or increase the production of latex. Aside from literature reviews, field research was conducted in eight sites in Vinh Linh, Gio Linh and Cam Lo districts, and 10 sites in Thua Thien Hua, Dak Lak and Gia Lai provinces.

Economic benefits

Income can be earned when rubber trees are harvested for *krep* during the seventh and eight year of plantation establishment. During this period, 1.2-1.5 tonnes or 2.0-2.5 tonnes of *krep* per hectare is produced. Milky latex is often harvested early in the morning during the rainy months which lasts for 10 months in Viet Nam.

Fig. 2. Cows are herded by people under the extracted rubber farm established in an area with 5-10 percent slope.



The first seven years of rubber tree plantation establishment can cost about USD3 500-4 000. From the eighth year onwards, farmers can earn an average income of about USD1 000-1 700 per ton of dry latex per hectare per year.

Aside from latex, rubber wood can be cut to be used as building materials for furniture. Rubber wood is priced at USD200-400 per cubic meter. Producers can get 60-100 cubic meters of rubber wood or more per hectare after 30-35 years of plantation establishment.

Rubber-based agroforestry systems

The study revealed the following common rubber-based agroforestry systems:

- Acacia, jackfruit or mahogany are often grown as windbreaks for rubber trees to reduce mortality rate and/or damages during storms;
- Elephant grass is often integrated with rubber when the farm is established in marginal soils to provide fodder for cattle, cow, buffalo, goat or rabbit;
- Peanut, beans, sweet potato, taro, maize, or cassava are always integrated with rubber during the first four years of establishing rubber farm plantation to provide farmers with additional 10-30 percent income; and
- Cattle (cow or buffalo) can be herded by people under rubber farms (Figure 2).

Peanut (or beans) integrated with rubber trees in the first four years of farm establishment can produce 500 kg of nuts and earn USD200-400 per hectare. Aside from providing income to the farmers, peanut and beans enrich the nitrogen content of soils.

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Table 2. Rate of felled and broken rubber trees planted downstream.

	Site 3	Site 4	Remarks
Rubber trees/ha	525 trees	525 trees	
Rubber trees planted downstream	Yes	None	
Number of felled trees from 40 km per hour wind speed	0	0-5	1%
Number of felled trees from 60 km per hour wind speed	2	25-42	5-8%
Total	1/525 trees	15/525 trees	2-4%

Exploring differing models...

Continued from page 11

The integration of cassava with rubber in the first three years of farm establishment, meanwhile, can produce 14-18 tons of root-tubers per hectare per year. This amount can provide an income of USD700-900 (or more) per hectare per year.

The integration of agricultural crops with rubber trees can provide farmers 10-30 percent of extra income (or USD200-900) per year per hectare.

Aside from agricultural crops, elephant grass (*Pennisetum purpureum Schum.*) can also be intercropped with rubber trees. This will provide an estimated daily

fodder for 2-3 cows or more per hectare.

Tables 3-4 provides data on the yields produced and the income that can be earned from intercropping cassava and taro with rubber trees.

With a planting density of 525 trees per hectare, rubber trees are considered irrigation constructions with just the use of 525 tubes per hectare. Rubber trees can facilitate absorption of a year's worth of rainfall into the soil layers equivalent of one-third to one-fifth of protection efficiency as compared to plantation and natural forests comprising 2-5 forest layers.

Rubber wood is considered hard wood. It has 45-50 percent wood density which can absorb 260-300 kg carbon dioxide per cubic meter of wood or about 18.6 tonnes of carbon dioxide per hectare per year on the 21st year of rubber plantation.

Conclusions and recommendations

Results revealed the following:

- Agricultural crops can be integrated in the first four years of rubber farm establishment to provide additional income of 10-30 percent (USD600-800) to the farmers;
- The yield of cassava and taro is gradually reduced by 10-30 percent in the first three years as rubber trees compete with soil nutrients;
- The number of felled trees due to storms are lower than what has been reported;
- Planting rubber trees as windbreaks and in downstream areas can minimize felling and damage from sea storms especially at 40-60 km per hour wind speed;
- Suitable sites must be selected in establishing rubber farms;
- Rubber may be grown on basalt and schist at soil layers A-B at



Fig. 3. Cassava intercropped with rubber trees in the first year of farm establishment.



Fig. 4. Intercropping of rubber + cassava + taro in the first year of farm establishment.

Table 3. Yields and income from cassava + rubber in the first three years.

	First year	Second year	Third year	Total
Rubber trees/ha	525 trees	525 trees	525 trees	
Cassava/ha	8 000 plants	7 000 plants	6 000 plants	
Yield	14 tons	12 tons	10 tons	
Income	USD800	USD700	USD500	USD2 000

Table 4. Yields and income from cassava + taro + rubber in the first three years.

	First year	Second year	Third year	Total
Rubber trees/ha	525 trees	525 trees	525 trees	
Cassava/ha	5 000 plants	4 000 plants	4 000 plants	
Yield	8 tons	7 tons	6 tons	
Income A	USD400	USD350	USD300	USD1 050
Taro	1 000 plants	1 000 plants	1 000 plants	
Yield	0.6 ton	0.5 ton	0.4 ton	
Income B	USD240	USD200	USD160	USD600
Total Income (A+B)	USD640	USD550	USD460	USD1 650

- 1-1.5 m deep and at altitudes 7-700 m asl;
- Cows can be herded under the canopies of rubber trees from the eight year onwards; and
- Plantations of acacia on basalt, schist and feralite soils can be considered to replace rubber farms in Viet Nam after 1-2 plantation cycles.

From these results, the study recommends the following:

- Rubber trees can be used to replace acacia plantations after two plantation cycles;
- Coffee and pepper can be intercropped with rubber trees in the early years of farm establishment to provide additional income to the farmers;
- To minimize felling and damages, acacia and jackfruit can be intercropped with rubber trees and rubber trees can be planted in rows in downstream areas; and

- Additional research is needed to explore carbon dioxide sequestration capabilities of rubber trees in Viet Nam. •

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References: (1) Bailey, L., H., 1963. The Standard Cyclopedia of Horticulture, Volume II, PP. 1482-1483, The Macmillan Company, New York, Chicago, the U.S.A.; (2) Department of Agriculture and Rural Development (Quang Tri Provincial DARD), 2000. Techniques and Investments for Small Plantation of Rubber, WB Source, Viet Nam; (3) Gordon R. Conway, 1986. Agroecosystem Analysis for Research and Development, Winrock International Institute for Agricultural Development, Bangkok, Thailand; (4) Ha, Hoang Quang and Hop, Tran, 1997. 100 Native Timber Trees in Viet Nam, Agricultural Publisher, Ho Chi Minh City, Viet Nam; (5) Ha, Hoang Quang, 2006. Project Management, Household Economics and Rural Livelihoods, Lecture Note and Reader, Swedish Sharing Program, Quang Tri province, Viet Nam; (6) Ha, Hoang Quang, 2010. Carbon Trading Opportunities (Translation and Compilation), Journal of Quang Tri Provincial Union of Technical and Science

Associations, Quang Tri Province, Viet Nam; (7) Hoa, Tran Thuy, 2010. Area of Growing Rubber Trees reach to 700,000 Ha in 2010, Viet Nam's Rubber Association, Hanoi, Viet Nam; (8) Lam, Lai Van, 2011. Director of Rubber Research Institute's Report, Chu Pa District, Gia Lai Province, Viet Nam; (9) May, B. M. and Attiwill, P. M., 2003. Nitrogen-fixation by Acacia dealbata, School of Botany, University of Melbourne, Australia; (10) Peter H. Calkins, Dennis D. DiPietre, 1983. Farm Business Management, Successful Decisions in a Changing Environment, Macmillan Publishing Co., Inc., New York, the U.S.A.; (11) Quan, Le Vo Son, 2011. Natural Rubber Processing, Viet Nam's Rubber Research Institute; (12) Thanh, Do Kim, 2011. Tapping Schedule and Sustainably Tapped Bark Planning, Viet Nam's Rubber Research Institute, Hanoi, Viet Nam; (13) Quyen, Do 2012. Losses by Felt-Down Rubber Tree, Viet Nam's Agricultural Newspaper, Hanoi, Viet Nam; (14) Raintree, J. B., 1987. D & D User's Manual (An Introduction to Agroforestry Diagnosis and Design), International Council for Research in Agroforestry, Nairobi, Kenya; (15) Yogaratnam, N., 2008. Carbon Trading: Options and Opportunities for Natural Rubber, Daily Mirror, Sri Lanka.

International Conference on Forests for Food Security and Nutrition

The "International Conference on Forests for Food Security and Nutrition" aims to enhance the benefits for rural people from forests, trees on farms and agroforestry. It is being organized by the FAO Forestry Department and partners and will take place 13-15 May in Rome, Italy. The objectives of the conference are:

- To highlight the different ways in which forests, trees on farms and agroforestry systems contribute to food security and nutrition;
- To identify key challenges and bottlenecks hindering the contribution of forests, trees on farms and agroforestry systems to food security; and
- To explore policy options, innovative approaches and opportunities to increase recognition of the importance

of forests and trees in reducing the number of food-insecure and malnourished people, improve the availability of information and appropriate technology and increase access to forests by the rural poor.

The conference will emphasize broad-based interdisciplinary approaches that support access to resources, participatory decision-making and equity as a way of improving livelihoods, food security and nutrition, especially among the rural poor.

For more information please visit <http://www.fao.org/orestry/events/en/>

World Teak Conference 2013

In the context of world-wide depletion of forest resources, many countries took to forest conservation, sustainable forest management and timber certification leading to reduced supply of hardwoods. Coupled with the high demand for such woods, the gap between production and consumption grew disproportionately which almost led to a crisis. The global demand for tropical hardwoods is estimated to be 136 million cubic meters by 2050. The consensus is that teak has an important role to play in meeting this global hardwood crisis on account of the superior quality and durability of its wood and the wide adaptability of the species to grow in varying environments.

For additional information, visit the conference website: <http://www.worldteak2013.org>



Decision support systems for sustainable forest management: FORSYS 2013 conference

Sustainable forest management is commonly regarded as the most effective way to achieve sustainable resource use, and satisfy social, economical and environmental objectives. It brings together different stakeholders and should account for the needs of current as well as future generations. The need for enhanced forest decision support systems (DSSs) is crucial in realizing sustainable forest management due to the multitude of purposes and different, often conflicting, goals that forests should satisfy.

Forest DSSs make possible the use of advanced tools from different areas, such as knowledge management, multicriteria analysis, visualization, and mathematical programming. However, to be an efficient instrument for sustainable forest management, forest DSSs need to consider the broader context. The scope of the conference will thereby encompass themes that stress the role of DSSs in participatory processes, for forest policy analysis, and in coupling models at various levels.

The conference will be held on 24-26 April 2013 and is the final event of the Forest Management Decision Support Systems (FORSYS) Cooperation in Science and Technology (COST) Action. FORSYS has brought together developers and users of forest DSSs from more than 30 countries. The 2013 international conference will gather expertise from different areas related to forest DSSs to form a comprehensive picture of problems and opportunities. For more information, visit <http://www-conference.slu.se/forsys2013/>. •

Third international congress on planted forests

Demand toward the forest sector is expected to increase in the next decades not only for the traditional sector but also for bio-energy, biochemical and by-products. Lessening the pressure for wood production, tree planting has released natural forests to be managed for other purposes—carbon sinks, soil and water protection, conservation of biological diversity, recreation and amenities. Representing a complement, but not an alternative, to natural forests, planted forests have become increasingly important in reducing worldwide deforestation, loss of forest ecosystems and forest degradation (FAO 2009).

Planted forests are composed of trees established through planting and/or through deliberate seeding of native or introduced species. Establishment is either through afforestation on land that until then was not classified as forest, or by reforestation of land classified as forest, for instance after a fire or a storm or following clear felling (FAO 2010).

Planted forests yield a diverse range of wood, fiber, fuel and non-wood forest products for corporate and smallholder investors pursuing commercial or subsistence purposes. They can also provide a number of social and environmental services, ranging from rehabilitation of degraded lands, combating desertification, soil and water protection, sequestering and storing carbon, recreation and landscape amenity.

Planted forests conserve genetic resources and provide shelter, shade and fodder for livestock. They deliver valuable services to urban populations, particularly in arid zones, by mitigating sandstorms, preventing sand-drift and recycling waste water.

Responsible management of planted forests can reduce pressures on indigenous forests for forest products and allow them to be designated for other protective and conservation purposes. They can also complement and supplement the REDD and REDD + initiatives to reduce greenhouse gas

emissions from deforestation and forest degradation in developing countries. As such, planted forests have multiple values, many of which cannot be provided by other types of land use.

Planted forests are long-term investments that require awareness and diligence in policy and planning, but particularly in management practices in order to avoid negative impacts. This relates to the selection of germplasm, nursery production, site preparation, establishment, tending, weeding, silviculture, protection and harvesting interventions. Unfortunately, planted forests have not always lived up to their potential. The causes for failures of planted forests in the past include inappropriate governance frameworks and insufficient application of established knowledge, technology and techniques. The lack of capacity and capability in providing enabling policies, laws, regulations, plans and technical support systems have led to controversy and poor management of planted forests.



Some planted forest investments have produced land-use, social, cultural and environmental conflicts, as well as unsustainable management practices.

The Third International Congress on Planted Forests will be held on 16-21 May 2013 to discuss the sustainability of planted forests in the context of changing climates and the future role of planted forests in environmental protection and REDD+. The congress aims to address issues surrounding planted forests today, their productive, environmental and social functions and the challenges they present. For more information, visit http://www.efiatlantic.efi.int/portal/2013_icpf/.

Impacts world 2013

To be held on 27-30 May 2013 in Potsdam, Germany, the conference will bring together for the first time climate change research and researchers from around the world to set a state-of-the-art agenda for climate impact research. It will lay the foundation for regular, community-driven syntheses of climate change impact analyses.

The conference will discuss the developments of comprehensive impact assessments, covering all scales and sectors; uncertainty in impact modeling; the role of intelligent regional case studies; and communication of climate impacts to decision makers from the local to the international level. Four key questions will be answered:

- Do the pieces fit together?—How can we improve our understanding of interactions and feedbacks between sectors and of cascading effects across sector boundaries? Which mechanisms, sectors and regions have not been the subject of significant research

2013 national outdoor recreation conference and the IUFRO conference on forests for people

These two educational programs will be held on 19-23 May 2013 in Michigan, USA. The National Outdoor Recreation Conference will highlight and showcase best practices and case studies on how the outdoor recreation profession (planning, management, research and policy) is a bridge, connector and catalyst for prosperity through tourism, jobs, health and wellness, education, environmental stewardship, and sustainable communities.

The international conference on forests and people, organized by the International Union of Forest Organizations, will help build a systematic body of knowledge about “forests for people” and its various facets, including possible future trends and challenges. This conference aims to integrate knowledge from various disciplines inside and outside of forestry such as tourism, recreation, education,

urban planning and many others. The following themes will be discussed:

- livelihoods—issues of agroforestry, food security, fuels, poverty alleviation, and human dislocation;
- Health, recreation and tourism—issues of human health, recreation and nature-based tourism;
- Urban and rural landscapes—issues of ecosystem services, economic benefit and development, spaces and places for living, urban forestry; and
- Culture and education—issues of perceptions of forests, spiritual character, education, historical tradition and practice, communication and governance.

For more information, visit <http://www.recpro.org/2013-sorp-ffp-conference/>.

efforts so far? How do we close these research gaps?

- Can we be sure? —How can we improve the observational basis for impacts already being experienced? How can we ensure a rigorous validation and quality-check of impacts models and quantify the various contributions to uncertainty?
- Do we need a million case studies?— How can we establish representative sets of comparative regional case studies? What are appropriate metrics to compare the same sector across different regions

or different sectors in the same region?

- Is anybody listening? —How can we make our research results intelligible and concise, especially for policy and decision makers and the wider public?

For more information, visit <http://www.climate-impacts-2013.org/>.

New Publications

Agrobiodiversity management for food security: a critical review

Agrobiodiversity provides most of our food through our interaction with crops and domestic animals. Future global food security is firmly anchored in sound, science-based management of agrobiodiversity.

Written by J. M. Lenné and D. Wood, this book presents key concepts of agrobiodiversity management, critically reviewing important current and emerging issues including agricultural development, crop introduction, practical diversity in farming systems, impact of modern crop varieties and genetically modified crops, conservation, climate change, food sovereignty and policies. It also addresses claims and misinformation in the subject based on sound scientific principles. For more information, visit <http://bookshop.cabi.org/default.aspx?site=191&page=2633&pid=2333>.

Agroforestry for ecosystem services and environmental benefits (advances in agroforestry)

Agroforestry systems are believed to provide a number of ecosystem services. Until recently, however, evidence in the agroforestry literature supporting these perceived benefits has been lacking.

Edited by Shibu Jose, this volume brings together a series of papers from around the globe to address recent findings on the ecosystem services and environmental benefits provided by agroforestry. Specifically, this volume examines four major ecosystem services and environmental benefits: carbon sequestration, biodiversity conservation, soil enrichment and air and water quality. Past and present evidence clearly indicates that agroforestry, as part of a multifunctional working

landscape, can be a viable land-use option that, in addition to alleviating poverty, offers a number of ecosystem services and environmental benefits. This realization should help promote agroforestry and its role as an integral part of a multifunctional working landscape the world over. For more information, visit www.amazon.com.

Agroforestry: an ecological tool

Agroforestry is a system of land management that integrates trees and shrub planting with crops and livestock in order to generate economic, environmental and social benefits.

Written by P. S. Ranade, this book shows how agroforestry systems contribute in a variety of ways to ecological, social and economic functions. It includes technologies to improve soil fertility, provide fodder fruits, medicines, timber and fuel wood under agroforestry and shows how the knowledge and skills in agroforestry are updated. It helps one to understand the primary motivations that influence farmers to adopt certain agroforestry systems such as food security and improved livelihood.

Agroforestry plays a distinct role in providing the farm household stable and ready source of food. The various agroforestry practices which help conserve and rehabilitate ecosystem and support integrated management of farmlands and rural spaces are discussed. It shows how agroforestry is a way of mitigating poverty in low-income countries like Africa as it provides social and economic well-being to the people. Jathropa, the green fuel for income generation and cleaner environment is grown under agroforestry.

The book covers a wide range of articles dealing with agroforestry for improved livelihood, agroforestry for food security, and agroforestry for environmental

conservation. The articles highlight how agroforestry contributes to biodiversity conservation, helps farm diversification while protecting the environment, yields goods and services to society and enhance the fertility of the soil thereby preventing land degradation. Agroforestry system also acts as carbon sinks and help augment the carbon storage in agro-ecosystem. For more information, visit www.amazon.com.

Agroforestry—the future of global land use (advances in agroforestry)

Edited by P.K. Ramachandran Nair and Dennis Garrity, this volume contains information on the current state of knowledge on the various themes and activities in agroforestry worldwide. It is organized into three sections: the Introduction consists of the summaries of six keynote speeches at the Second world congress of agroforestry held in Nairobi, Kenya, in 2009, followed by two sections of peer-reviewed thematic chapters grouped as “Global perspectives” (7 chapters) and “Regional perspectives” (11 chapters), authored by professional leaders in their respective agroforestry-related fields worldwide.

A total of 130 professionals from institutions in 33 countries in both developing and the industrialized temperate regions of the world contributed to the book as chapter authors and/or reviewers. Thus, the book presents a comprehensive and authoritative account of the global picture of agroforestry today. For more information, visit http://www.amazon.com/Agroforestry-Future-Global-Land-Advances/dp/940074675X/ref=sr_1_1?s=books&ie=UTF8&qid=1353669900&sr=1-1&keywords=agroforestry+2012.

Bamboo-based agroforestry system in tropics: bamboo for livelihood and environmental protection

Although the role of bamboo has not been well documented as an



integral part of the economy of Ethiopia, it plays a very important role economically and ecologically in areas where it occurs naturally and as plantation.

The study was conducted with the main objective of assessing and exploring the role of bamboo agroforestry system in rural livelihoods and environmental protection. Formal survey was carried out on a total of 90 households were selected using stratified random sampling. The experimental design of Randomized Complete Block Design was used to examine barley yield at different distance from the bamboo line.

The results indicate that the income from bamboo accounted for about 17 percent of the total household annual income. Moreover, the role of bamboo in environmental protection was assessed from farmer's perception and almost about 82 percent of the respondents believed that bamboo increases soil fertility.

In general, bamboo-based agroforestry systems have a great role in tropical countries. Written by Oukula Obsa, the book may help countries in Asia and Africa for further scientific research purpose. For more information, visit www.amazon.com.

Climate change mitigation and agriculture

Edited by Eva Wollenberg, Marja-Liisa Tapio-Bistrom, Maryanne Grieg-Gran, Alison Nihart, this book reviews the state of agricultural climate change mitigation globally, with a focus on identifying the feasibility, opportunities and challenges for achieving mitigation among smallholder farmers. The purpose is ultimately to accelerate efforts towards mitigating land-based climate change. While much attention has been focused on forestry for its reputed cost-effectiveness, the agricultural sector contributes about 10-12 percent of emissions and has a large technical

and economic potential for reducing greenhouse gases.

The book includes chapters about experiences in developed countries, such as Canada and Australia, where these efforts also have lessons for mitigation options for smallholders in poorer nations, as well as industrializing countries such as Brazil and China. A wide range of agroecological zones and of aspects or types of farming, including livestock, crops, fish farming, fertilizer use and agroforestry, as well as economics and finance, is included. For more information, visit <http://www.routledge.com/books/details/9781849713931/>.

Conservation buffers: design guidelines for buffers, corridors and greenways

This book provides over 80 illustrated design guidelines synthesized and developed from a review of over 1 400 research publications. Each guideline describes a specific way that a vegetative buffer can be applied to protect soil, improve air and water quality, enhance fish and wildlife habitat, produce economic products, provide recreation opportunities, or beautify the landscape. For more information, visit <http://nac.unl.edu/bufferguidelines/index.html>.

Ecological basis of agroforestry

Faced with the growing problems of climate change, ecosystem degradation, declining agricultural productivity, and uncertain food security, modern agricultural scientists look for potential relief in an ancient practice.

Agroforestry, if properly designed, can mitigate greenhouse effects, maintain ecosystem health and biodiversity, provide food security, and reduce poverty. Poorly implemented agroforestry, however, can not only exacerbate existing problems, but also contribute in its own right to the overall negative effects of our depleted and failing ecosystems.

With a diminishing margin for error, a thorough understanding of the ecological processes that govern these complex systems is, therefore, crucial.

Drawing on the collective expertise of world authorities, the book employs extensive use of tables and figures to demonstrate how ecologically sustainable agroecosystems can meet the challenges of enhancing crop productivity, soil fertility, and environmental sustainability.

Written by Batish and Daizy Rani and edited by Daizy Rani Batish, Ravinder Kumar Kohli, Shibu Jose and Harminder Pal Singh, this book begins with a study of tree-crop interaction in tropical and temperate climates. Contributions cover above and below ground interactions, alley cropping, tri-trophic interactions, ecologically based pest management, and the chemistry and practical potential of chemically mediated plant interactions.

The second section investigates root-mediated below ground interactions and their role in enhancing productivity, soil fertility, and sustainability. It includes an extensive study on litter dynamics and factors affecting nutrient release.

Applying ecological modeling of complex agroforestry systems, section three demonstrates the use of computer-based designs to ensure profitability. The final section addresses the socio-economic aspects of agroforestry, supplying in-depth knowledge of various farming systems and discussing the technological tools that benefit society in different eco-regions around the world. For more information, visit www.amazon.com.

Useful websites

Agricultural Marketing Resource Center

<http://www.agmrc.org/>

The Agricultural Marketing Resource Center offers resources for producers interested in value-added agriculture. The website presents information on commodities and products, market and industry trends, business creation and operation, research results and other value-added resources.

Agriculture Network Information Center

<http://www.agnic.org/>

AgNIC is a voluntary alliance of members based on the concept of "centers of excellence." The member institutions are dedicated to enhancing collective information and services among the members and their partners for all those seeking agricultural information over the Internet.



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University of Nebraska Lincoln Extension

http://www.extension.org/forest_farming

eXtension is an interactive learning environment delivering the best, most researched knowledge on animal manure management; climate, forests and woodlands; forest farming, organic agriculture, pest management, and many others.

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Forest Farming

Here are some of our featured articles and activities...



Forest Farming and Non-Timber Forest Products Defined

Forest farming involves the cultivation or management of understory crops within an established or developing forest. These systems represent integrated management...

[More...](#)

This resource area was created by the Forest Farming community



In The News...

November 09, 2012
A new Asheville business based on foraging wild foods, mushrooms, and medicinal herbs

October 18, 2012
Archived Webinar: Agroforestry for Ecosystem Services and Environmental Benefits

September 19, 2012
Fires in West Changing Ecosystems

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In This Resource Area

More Forest Farming information will be coming soon but in the meantime we are available to field your questions. Please ask your questions or visit our growing FAQ area:

Answers from our Experts

October 22, 2012
Can forests with steep gradients be used for forest farming?



CROPS FOR THE FUTURE

Diversifying Agriculture for Better Lives

Supported by: 



Helping poor rural producers to increase income through processing and value adding

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Crop of the Week



Njangsa (*Ricinodendron heudelotii*, Euphorbiaceae)

Njangsa is a fast-growing, buttressed tree of the Euphorbiaceae that is of common

The Latest



International Seminar 2012

"old" and new crops to meet the challenges of the XXI century
10 - 13 December 2012
Córdoba, Spain

International Seminar "Old and new crops to meet the challenges of the XXI century", Córdoba, Spain, 10-13 December 2012. Click to go to the seminar's web site in English

Newsletter Sign Up

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We invite you to join our NUS Expert Database

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Upcoming Events and Opportunities

2 December 2012

Crops for the Future

<http://www.cropsforthefuture.org/>

Crops for the Future is an organization that seeks to promote greater consumption and production of neglected and underutilised crops, increase income for agricultural producers and processors, and enhance nutrition through dietary diversity. CFF is hosted by Bioversity International in a joint venture with the University of Nottingham's Malaysia Campus and located in Serdang, Malaysia.



Call for Contributions

We are inviting contributions for the 42nd and 43rd issues of the Asia-Pacific Agroforestry Newsletter (APANews) on or before 28 February and 30 June 2013, respectively.

Contributions may focus on activities that highlight agroforestry research, promotion and development, and education and training.

Topics of particular interest are on:

- agroforestry and poverty alleviation;
- agroforestry and rainfed agriculture;
- agroforestry, organic farming, soil and water conservation practices/measures;
- agroforestry and livelihood;
- agroforestry and farmers' income and livelihood;
- agroforestry enterprises and/or marketing
- agroforestry and mining area rehabilitation;
- agroforestry and climate change;
- agroforestry and biodiversity conservation;

- agroforestry and desertification; and
- other key development issues in agroforestry.

Announcements on new information resources, useful websites, and upcoming relevant events are also welcome.

Interested contributors must keep the articles straight and simple to cater to as many audiences as possible. Limit your contributions to 1 000 to 1 500 words. Include good-quality photographs (scanned at 300 dpi) that are properly labeled and referred to in the text. Indicate your complete contact details, especially your E-mail address in the article, for readers to contact you should they have further inquiries about your article.

Send your contributions through E-mail 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 and apanews0718@gmail.com.

Asia-Pacific Agroforestry Newsletter

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