APANews

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Featuring

SEANAFE News

Dear readers

2009 was an interesting year in the field of agroforestry. We witnessed and experienced the Second World Congress on Agroforestry in Nairobi, Kenya, which successfully provided the venue for participants to share new findings, lessons, experiences, and ideas on 'Agroforestry—the future of land use.' The outcomes and inspirations arising from such international events continue to motivate researchers and practitioners around the world to continue undertaking initiatives on agroforestry research, promotion and development, education and training, and awareness raising and advocacy work.

We thus continue to bring you updates on these particular areas of agroforestry in the 35th issue of APANews. This issue features contributions from India, and Papua New Guinea—presenting results of studies on various integrated agroforestry systems, tree canopy closure on understorey crops, hybrid production, fuelwood production systems, and the use of indigenous tree species for multiple benefits.

An article from Northern India investigates the returns from using exotic popular trees in agroforestry systems. This system is shown to be valuable especially when popular are grown to larger diameters.

Similarly, another article from Northern India discusses the effects of growing popular on the performance of turmeric, especially photosynthesis, stomatal conductance, transpiration, yield and resource competition.

Another article from India explores the carbon sequestration in popular-wheat-based integrated cropping; showing it to store more carbon in above and below ground biomass than sole crop cultivation.

An interesting article discusses the production of Jatropha hybrids. *Jatropha curcas* L. has been identified as a potential source of biofuel. Find out the problems in producing and establishing Jatropha plantations, the process and outcomes of producing Jatropha hybrids, the different variations in the F1 generation, the use of hybrid clones, how the clones can be replicated, and ways of promoting the clones.

In Papua New Guinea, fuelwood is a critical part of the country's economy. Read more on how people use and gain access to fuelwood, and the corresponding challenges they face. Find out how a project, jointly implemented by a government research agency, and local and international NGOs, is exploring the possibility of growing fuelwood for sale, including it as part of the farmers' current farming practices, and exploring ways to widen adoption. The article also discusses how the project assesses other indigenous species that could be developed as fuelwood.

Celtis australis is discussed in another article as a multipurpose and indigenous tree crop, usually grown in traditional agroforestry systems in India. Read more about this crop's various uses, flowering and fruiting behavior, means of propagation, and nutritive content.

As always, we continue to bring you the latest information sources and references for your agroforestry research and development projects, including useful websites.

We also feature the last issue of SEANAFE News on print. In this issue, SEANAFE is formally declared as an international nongovernmental organization. Find out how this new status will guide SEANAFE's operations in 2010. Read more SEANAFE updates from www.worldagroforestry.org/sea/networks/Seanafe/ and their upcoming e-newsletter.

We appreciate your continued support to APANews. Thank you to all the contributors and we hope to receive more articles from you for upcoming issues of APANews! – ***The Editors***

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COVER PHOTOS. (Main photo) Patrick Barkri, a farmer in Mt. Hagen, Papua New Guinea, stands beside an "Indoyar," local name for *Casuarina junghuhniana*, a tree indigenous to Indonesia, but is being monitored as highly suitable for firewood and charcoal. "Indoyar" grows well in Papua New Guinea exceeding that of upland and coastal "Yar" or *Casuarina equisitfolia* (see story on p.11). (Left photo) Exotic poplar (*Populus deltoides*) is successfuly integrated with sugarcane in northern India resulting in maximum returns in terms of profit and environmental benefits (see story on p. 3). (Top photo) The F1 hybrids of *Jatropha curcas* and *Jatropha integerrima* exhibiting various fruit colors (see story on p. 7). (Right photo). Turmeric is integrated with Poplar to determine the effects of tree canopy closure on understorey crops (see story on p. 5).

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Using exotic poplar in Northern India for higher returns in agroforestry

Kulvir S. Bangarwa (kulvirsb@yahoo.com) and G. von Wuehlisch

The natural and plantation forests of India are 678 333 km^2 and 99 896 km^2, respectively and represent 23.68 percent of its total geographic area (NFC 2006). The total growing stock of wood in the country was estimated at 6 098 million m^3, which includes 4 782 million m^3 inside the forest area, and 1 632 million m^3 outside the forest area (NFC 2006). Per capita forest and tree cover in the country is 0.08 ha/person, and the average stock volume per hectare within the recorded forest area measured 61.72 m^3 /ha.

Forest-based industries in India show significant deficits between wood requirements and supply (Table 1). The rapid loss of natural forests in the country implies insufficient supply of forest resources to meet future needs. As a result, timber plantations, agroforestry and wood imports are supplementing India's demand for forest raw materials (Table 1).

The potential of agroforestry

Large-scale farm forestry/agroforestry plantations are being promoted in India through social forestry. The National Commission on Agriculture, Government of India, first used the term 'social forestry' in 1976. It was then that India embarked upon a social forestry project to take the pressure off the forests and make use of all unused and fallow land. Government forest areas that are close to human settlements and have been degraded over the years due to human activities needed to be afforested. Trees were to be planted in and around agricultural fields. Plantating of trees along railway lines and roadsides, and river and canal banks was carried out. They were planted in village common lands, government wastelands and Panchayat lands.

Large-scale farm forestry/agroforestry plantations have been promoted in India since 1988 after the implementation of the National Forest Policy (1988). But it was the buy-back arrangement of the Farm Forestry Project, which was implemented by the Western India Match Company Ltd. (WIMCO) from 1984 to 1990 that promoted the poplar agroforestry plantations.

In this project, WIMCO used to enter into a buy-back agreement with the farmers to purchase the harvest of poplars with girths above 90 cm at breast height. The company also supplied quality planting stocks of poplar and provided technical know-how at a reasonable cost. In this agreement, the company provided farmers with the option to sell their produce in the open market. At that time, the majority of the farmers sold their produce in the open market because of the high price of wood. But the agreement was used only to build farmers' confidence during plantation establishment.

This buy-back agreement was approved by the National Bank for Agricultural and Rural Development (NABARD).Because of this agreement and the trees' multiple uses, farmers in northern India maintained the plantations of exotic poplar (*Populus deltoides)*.

At present, agroforestry is being promoted by the government's forest and agriculture departments, NGOs and wood-based industries. These agencies provide quality planting stock and technical know-how, but not in terms of the buy-back agreement done by WIMCO.

Integrating exotic poplar in agroforestry

The poplar tree, native to the USA, was introduced in India in the 1950s. Poplar is widely grown in northern India on a rotation of 6-8 years. It thrives in well-drained, irrigated, deep and fertile soils (Chandra 1986).

Transplanting one-year-old bare rooted poplar saplings, measuring 4-5 m in height, during the months of January to February with spacing of 8 × 3 m, 7 × 3.5 m, 6 × 4 m, and 5 × 4 m is a common practice. Plantation rows are usually aligned to provide maximum sunlight to agricultural crops. Potential clones viz., G_3, G_{48}, L_{34}, S_7C_{15}, Uday and Kranti of *Populus deltoides* are

Continued on page 4

Table 1. Demand and supply of wood (million m^3).

Particulars	1985	1996	2001	2006	2010	2020
Wood demand for domestic, furniture, agriculture, industries	50	64	73	82	95	153
Output from forests	24	12	12	12	12	12
Output from plantations, (social and farm forestry)		41	47	53	58.5	88.7
Deficit	26	11	14	17	25.7	52.3

(Source: NFC 2006)

Using exotic poplar...

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available for agroforestry plantations. Besides, WIMCO Seedlings Ltd., Rudrapur (Uttranchal) registered six new clones of *Populus deltoids* (viz WSL-22, WSL-27, WSL-32, WSL-39, WSL-A26 and WSL-A49) with the International Poplar Commission of FAO (Anon 2004). The clones were released for commercial planting during 2002. All these clones were given greater volume than G48.

Poplar plantations at commercial scale have been expanding since WIMCO sponsored the Farm Forestry Project in 1984. Maximum production potential of poplar plantations was set at 65 m^3/ha per year, while average production of poplar wood was 35-40 m^3/ha per year in northern India. The deciduous nature of poplar allows the growth of agricultural crops underneath with less adverse effects on yield.

In the first two years of the study, maximum returns were obtained from sugarcane + poplar plantations (Figure 1). From the third year onwards, shade-loving crops like turmeric were successfully integrated into the plantation. Wheat was integrated in the plantation during winter, while fodder crops were planted during summer.

In the 1990s, poplar replaced eucalyptus because of the latter's decline in market price. Poplar was preferred because of its:

- faster biomass growth;
- high compatibility with agricultural crops;
- faster leaf decomposition which maintains soil fertility;
- high market price; and
- ability to easily propagate.

Fig. 1. Sugarcane with poplar.

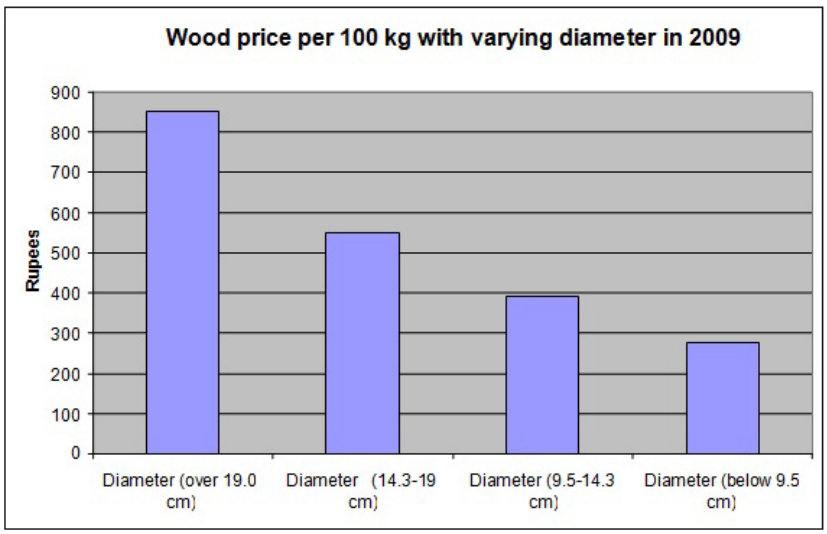

Fig. 2. Highest price of wood with varying girth (Personal Survey 2008).

Marketing of poplar

Poplar is harvested when it attains a diameter of approximately 1 m at breast height. Poplar wood is used for peeling by making wood pieces measured at 1-2 m. Poplar wood pieces, measuring 60 cm and are free from any knots, usually fetch a higher price. The price of poplar wood decreases as girth decreases. Figure 2 shows the prices of wood for 2009 at different diameters.

Figure 2 clearly indicates the larger the girth/diameter, the greter the price per kilogram. This relates to the point of harvest. Trees at 1 m girth at breast height should thus be harvested not only to yield more wood, but also to fetch higher prices, usually at Rs. 850 (US$19) per 100 kg. Figure 3 shows the price fluctuations of poplar wood from 1980 to 2007.

Poplar-based agroforestry has been very profitable. About 10 million trees have been planted every year since 1980 until 2000. In total, 0.02 million ha (20 000 ha) of polar plantations were established with an average density of 400-500 trees per hectare.

In 2003-2004, poplar was not as widespread as expected due to the low wood price. Farmers resorted to selling their produce at Rs70 (US$1.5) and Rs155 (US$3.3) as compared to Rs350-550 (US$7.5-11.8) per 100 kilo during 1980-1998. Farmers were thus compelled to cut their young poplar trees to earn income. Six to eight-year old poplar trees, with girths measuring 1 m, were priced at Rs500-600 (US$10.7-12.9) each in 2004 (Personal market survey in Yamuna Nagar (Haryana) in Northern India 2008).

Current market prices

Seven-year old poplar trees, with girths measuring 1 m at breast height (1.37 m), fetch an average of Rs2 000 (US$43.0) per 100kg (Personal market survey in Yamuna Nagar (Haryana), Northern India 2008). ■

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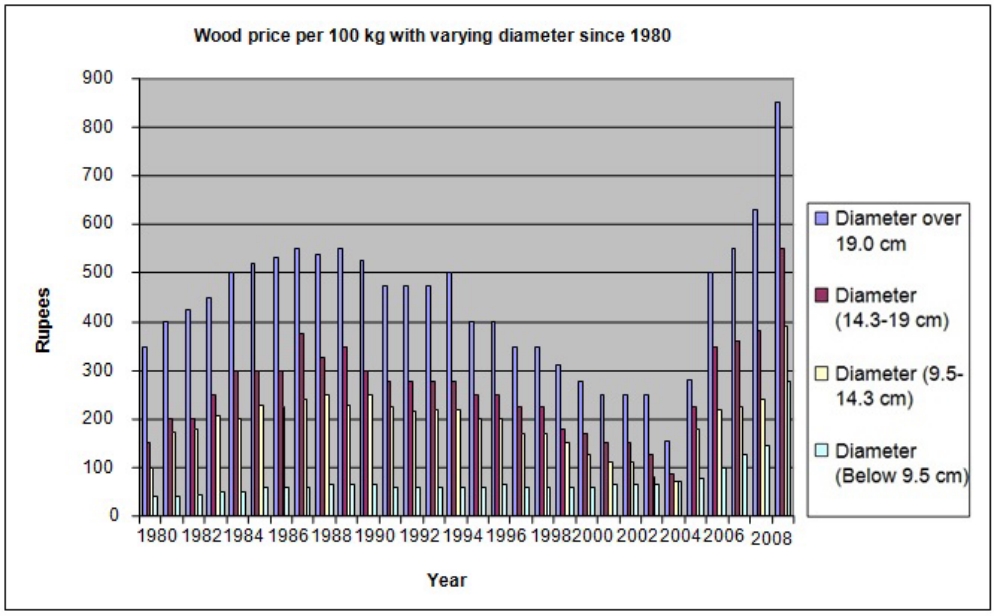

Fig. 3. Price per kilogram of poplar wood with varying girth measurements (1980-2007).

Physiology and yield of turmeric under poplar canopy

W.S. Dhillon, Sanjeev K. Chauhan (chauhanpau@rediffmail.com) and Navtej Singh

Populus deltoides (Poplar) has emerged as one of the promising species in agroforestry plantations in the northwestern states of India. Despite its advantages, poplar attains crown closure within three to four years, which causes severe competition with crops for resource sharing. It has been shown that crop productivity is drastically reduced from the third year onwards.

Describing effects of tree canopy closure

The poplar tree canopy modifies the microclimate and influences the physiological processes of understorey crops. As the tree canopy becomes wider, the Photosynthetic Active Radiations (PAR) and temperatures decrease while humidity under the canopy increases. PAR under the canopy is crucial in producing grains. However, some rhizomatous crops may be more suitable. One such crop is turmeric (*Curcuma domestica*). Turmeric is grown widely in India as a spice crop. A study was conducted to explore the performance of turmeric under three- and four-year old poplar canopy.

Measuring leaf area index

To record the canopy closure of poplar at 6 x6 m^2, leaf area index (LAI) was measured from March to November using a digital canopy imager. LAI increased from March to June and decreased thereafter. Maximum LAI of 0.52 and 0.44 was observed under the three- and four-year-old poplar trees, respectively. Trees that were regularly pruned to provide sufficient light for the crops resulted in a lower LAI.

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Poplar and turmeric intercropping.

Physiology and yield...

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Determining photosynthesis rate

Photosynthesis is a physiological process affected by environmental factors particularly light. Using the USA-made portable photosynthesis system, photosynthesis, transpiration and stomatal conductance were studied.

In turmeric, the rate of photosynthesis under poplar canopy was maximum at noon, whereas, the rate of photosynthesis in the open areas reached maximum at 9:00 am. Under the canopy, photosynthesis rate was proportional to available PAR (Table 1).

The same was not observed in open areas—photosynthesis and stomatal conductance was at a minimum at noon. This indicates that photosynthesis occurs more during noon than morning and evening.

Net photosynthesis, stomatal conductance, and transpiration in turmeric were higher in open areas than in shaded areas. However, the yield of turmeric under the canopy, though reduced, was not drastic. Yield was 16 and 24 percent under three- and four-year poplar plantations, respectively, which was proportionately related to micro-environmental changes in light, temperature and humidity under canopy (Table 2).

To minimize resource competition and improve physiological processes of crops, such as turmeric, canopy management is essential to ensure better yield under poplar-based agrisilvicutural system. While it has been shown that the yield of many cereals, pulses and other crops is substantially reduced under canopy, it is necessary to explore other suitable crops under canopy such as turmeric to achieve improved profits. ■

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Table 1. Diurnal variation in eco-physiological parameters of turmeric crop.

	PAR (μmolm-^{2}s-^{1})	Photosynthesis rate (μmolm-^{2}s-^{1})2	Transpiration rate (μmolm-^{2}s-^{1})	Stomatal conductance (μmolm-^{2}s-^{1})	Temp. air (^{0}C)	Temp. leaf (^{0}C)	Internal CO_2 (ppm)
Turmeric under canopy							
9AM	240.27	3.30	0.91	112.92	31.10	32.00	373.23
12 Noon	487.06	5.20	2.71	239.16	33.20	35.17	321.27
4PM	119.40	2.02	1.54	149.48	32.27	33.00	404.77
Turmeric without canopy							
9AM		11.19	1.19	154.21	36.42	39.76	264.90
12 Noon		3.69	3.69	220.25	34.70	39.40	313.67
4PM		1.61	1.69	27.71	38.57	44.60	372.13

Table 2. Physiological parameters and yield of turmeric in open and under poplar canopy.

Canopy	PAR (μmolm-^{2}s-^{1})	Photosynthesis rate (μmolm-^{2}s-^{1})	Air Temp. (^{0}C)	Relative humidity (%)	Yield (q/ha)
4th year poplar plantation	497.88	2.31	32.19	81.99	129.72
3rd year poplar plantation	654.07	3.50	33.15	72.25	143.55
Open/without canopy	875.59	5.50	36.56	69.88	171.27

Jatropha hybrids: a promising development in biofuel research

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Jatropha curcas L., commonly called *Ratanjyot* in Hindi, and *Kattamanakku* in Tamil, is a shrub with multiple uses, including the potential for biofuel. Jatropha is found throughout the tropics, and is known by nearly 200 different names. It adapts well to semi-arid marginal to fertile lands. All parts of the jatropha shrub are used as traditional medicines, and raw materials for pharmaceutical and cosmetic products.

The biofuel potential of *jatropha curcas* has been widely recognized recently because of the global energy crisis. Large-scale cultivation of jatropha on wastelands was done in the hope of providing regular employment and quick income, and improving the living conditions of the local communities.

The potential of jatropha as a bio-diesel product is seen in the way local people use it to operate engines and small machinery, and generate electricity. However, the availability of elite genotypes, quality planting materials and precise silvicultural technologies are seen as major constraints in the successful promotion of jatropha. Hence, studies were carried out to develop new varieties through intensive hybridization programs and methods for mass multiplication of the elite genotypes.

Problems of *Jatropha curcas*

Plantations of the jatropha hybrids were established at the Forest College and Research Institute, Mettupalayam, Tamil Nadu, India. The site has an average annual rainfall of 800 mm and the soil type is red laterite. The site is degraded and thus suitable for the establishment of jatropha plantations.

The jatropha plantations exhibited varying degrees of success. In most cases, however, low yields were achieved, often between 0.5 and 1.2 tonne per hectare, even under intensively managed conditions. These low yields might be due to the lack of quality genetic materials, coupled with lack of site-specific management systems.

A limited understanding of the reproductive biology of *Jatropha curcas*, coupled with the lack of quality genetic material, may also have contributed to the poor yield. The flowering behavior of *Jatropha curcas* is also complex. The female to male ratio ranged between 1:16 and 1:160. Hence, attempts were made to develop new varieties through an intensive hybridization program. The program used identified superior genetic resources from the germplasm bank established at the Institute (11°19′N, 76°56′E).

Development of a jatropha hybrid

Inter- and intra-specific hybridization techniques were initiated between and within *Jatropha curcas* clones and related jatropha species.

The cultivated species of *Jatropha curcas* was used as the female parent, and the wild species of *J. integerrima, J. podagrica, J. villosa, J. tanjorensis, J. gossypifolia, J. glandulifera, J. multifeda, and J. maheshwarii* were used as pollen donors. Pollen grains of the identified jatropha species were collected at the time of anthesis and dusted on the stigmatic surface of the female flowers of the *Jatropha curcas* clones.

Among the crosses that were attempted, the cross between *Jatropha curcas* and *Jatropha integerrima* produced hyrbrids that exhibited favorable fruit characters and seed yield.

However, the cross between *Jatropha curcas* and the other Jatropha species was either partly successful or failed due to the presence of pre- and post-zygotic barriers. Success was measured in terms of fertilization and seed production. Partial success or total

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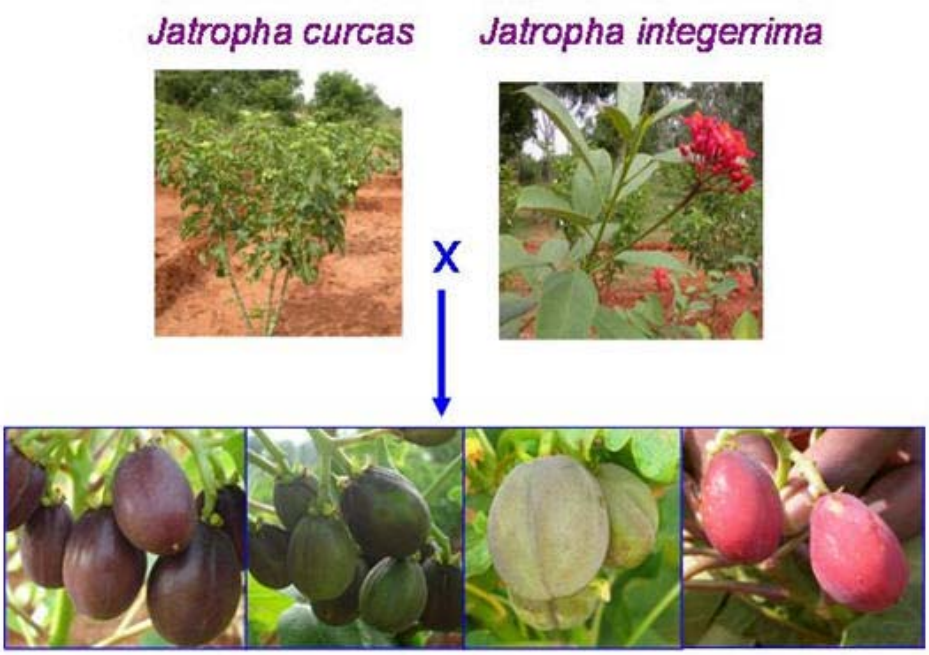

F1 hybrids with variation in fruit colors.

Jatropha hybrids...

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failure resulted in poor seed production or absence of seed set in other crosses.

The pre-zygotic barriers are caused by the abnormal behavior of the pollen tube prior to reaching the ovary. The post-zygotic embryo behavior might be due to the dormancy existing in the crossed seeds. The F1 seeds of the cross were raised in the field and analyzed for yield characters.

Variations in the F1 generation

The F1 plants exhibited wider variations in terms of stem characters (semi hardwood stems), flower color (pink, white, and yellow) and fruit size (small and round). The size of the seeds and the yield exhibited the poor traits of *Jatropha integerrima*. However, this hybrid exhibited robust growth, particularly in terms of stem characters.

The promising F1 plants were then back crossed with *Jatropha curcas* clones to increase seed size. The BC1F1 progenies were raised in the second generation field, and screened for flowering and fruiting characters. This BC1F1 plants exhibited different results in terms of morphological features, fruit characteristics, seed size, and oil content. Among the back crosses derivatives, 27 distinct clones were identified for their superiority in terms of growth, distinctness, seed size, and oil yield.

Significance of the jatropha hybrid clones

All the identified hybrid clones exhibited distinct morphological features and high seed yields (700 g to 1.4 kg per plant) in less than a year. The oil content of the hybrid clones ranged between 17.95- 48.5 percent. Except for a few hybrid clones, the other clones exhibited oil content of more than 25 percent.

The fruiting behavior of some clones was unique as they produced fruits with different sizes, shapes and color. Five hybrid clones viz., FCRI HC 2, 11, 21, 32 and 33 exhibited distinct variations such as oblong-shaped seeds and colored fruit coats.

Hybrid clone 21 exhibited oblong-shaped seeds and fruited continuously from the base to the top of the plant. In each branch, two to three bunches of fruits were seen from the base to the top. In each bunch, a minimum of 15 fruits was observed.

Meanwhile, three hybrid clones viz., FCRI HC 20, 21 and 22 recorded an average yield of 1.4 kg of seeds per tree during two fruiting seasons. This yield is 300 percent higher than the yield of local jatropha plants of the same age.

Multiplication of hybrid clones

The new jatropha hybrid clones could be multiplied through vegetative cuttings. A separate clonal multiplication area (CMA) was established for the identified clones.

From the CMA, cuttings from individual clones were collected and directly rooted on polythene containers that contained soil, sand and farmyard manure (3:1:1). Rooting started within three weeks after planting 90-120 day-old cuttings (ramets). Since jatropha is a cross-pollinating species, propagation, through clonal multiplication, could help exploit maximum genetic gains.

Evaluation and promotion of hybrid clones

Systematic testing trials were established, and all the hybrid clones exhibited early flowering and fruiting within three months after planting. Within five months, three hybrid clones viz., FCRI HC 20, 21 and 22 recorded excellent growth, including fruiting characteristics and seed yield. Such yield improvement in jatropha, through hybrid development, is currently not available for utilization. These hybrids exhibited promising potentials when integrated in agroforestry programs. However, these hybrids are limited to the use of clones for multiplication. This ensures clonal fidelity for commercial deployment.

All hybrid clones exhibited early flowering and fruiting three months after planting.

Summary

This is a pioneering study which aims to introduce the potential and prospects of using jatropha hybrid clones to all agencies involved in biofuel initiatives. The new hybrid clones developed in this study will indeed inspire biofuel promoters and farmers across the world.

However, further studies are needed to test the performance of the jatropha hybrid clones at different locations, and screen and promote potential high yielders in the farm and agroforestry systems.■

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Exploring carbon sequestration in poplar-wheat-based integrated cropping system

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The world's climate is changing and will continue to change in the coming years at rates projected to be unprecedented in human history due to the greenhouse gases emitted from human activities. The exact effects of climate change are unclear, however it is predicted that evaporation and precipitation will increase in some regions, whereas other regions will become drier by the end of the present century (Innes 2005).

Climate change predictions are not certain with respect to sites/ locations. However, it is predicted that rainfall patterns will vary and be unpredictable. Some sites will receive more rain whereas others may experience lack of it.

Carbon dioxide accumulation in the atmosphere

Carbon dioxide (CO_2) is the largest single greenhouse gas in the atmosphere. It is currently trapping about half of the total heat that contributes to global warming. Removing atmospheric carbon and storing it in the terrestrial biosphere, such as through planting trees, has been one of the methods stated under the Kyoto Protocol for countries to meet their national carbon reduction targets.

Agroforestry farms as carbon sinks

The practice of agroforestry is an alternative way of addressing poverty, hunger, malnutrition, and deterioration of the environment in areas bypassed by the Green Revolution. The emerging carbon market may provide a new agroforestry option for land owners provided that carbon prices are high enough to make growing trees a more worthwhile investment than existing land uses.

Several studies have shown that integrating trees in agricultural lands often improves productivity of the systems and provides opportunities to create carbon sinks. However, data is insufficient, and an understanding of plant/climate relationships is essential in guiding future policies. A study was thus conducted to explore the carbon sequestration potential of agroforestry systems specifically poplar-wheat-based system.

Poplar-wheat-based agroforestry as carbon sinks

To quantify carbon storage in different pools in poplar-wheat-based agroforestry systems, the carbon content of the different tree-crop components (above- and below-ground) was estimated. For poplar, carbon content was obtained from the stem, branch, bark, leaves and roots. The straw, grain, and roots of wheat were also measured for carbon content.

Total carbon storage was computed from the carbon content values of the respective component, and multiplying the same with the dry biomass of each component. The total carbon storage was then multiplied with the CO_2 factor of 3.67 to convert carbon stored into CO_2.

Carbon content in the stems, branches, roots, leaves, and bark of poplar was estimated at 45.67, 46.56, 47.82, 44.08 and 46.93 percent, respectively. Mean carbon content (%) was very close to 50 percent, which was often used to estimate carbon storage from dry biomass. The contribution of timber

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Poplar-wheat-based agrisilvicultural system.

Exploring carbon...

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was nearly 72 percent, while branches + small wood (those that were not used by the industry for durable products and used as fuel) was at 10 percent, and roots + leaves + bark at 18 percent. The accumulation of carbon increased with the age of plantation.

After seven years, the timber carbon content was estimated at 23.57 t/ha, whereas the carbon content of the roots, leaves, and bark was at 23.9 t/ha, and branches at 15.01 t/ha. Hence, the total biomass carbon storage after seven years was equivalent to 62.48 t/ha (8.92 t/ha/year).

In wheat, the carbon contribution of straw and grain components was found to be substantially higher (97.3%) than the roots, which contributed only 2.67 percent of the total carbon.

Carbon contribution of poplar and wheat

The combined contribution of poplar and wheat was substantially high within the intercropping system. This may be due to the additional carbon pool in the trees and the increased soil carbon pool as a result of litterfall and fine root turnover. The high carbon storage may also be due to the increased growth and assimilation rates of intercropped components as compared to monocropping systems. Moreover, poplar timber locks up carbon in its wood products for long periods, thereby making it the major carbon assimilator of this type of agroforestry system. The poplar-wheat-based agroforestry system thus fared better than traditional agricultural systems, providing the best land-use option for increased carbon sequestration.

Total CO_2 assimilation by the biomass in the poplar-wheat-based agroforestry system and monocropping of poplar and wheat was estimated at 28.6, 17.2 and 17.8 t/ha/yr, respectively (Figure 1). Therefore, even when only the accumulation of biomass carbon is considered, an agrisilvicultural system is very efficient in terms of carbon sequestration. However, these figures hold true if harvested products are transformed into durable products. Litter (leaves, branches and bark) and roots are added and allowed to decompose in the soil to better sequester carbon. This, however, requires further investigation.

Carbon sequestration payments will encourage landholders to adopt less intensive practices. However, the price of carbon must be high enough to encourage farmers to invest in growing trees than continue practicing traditional land use. At present, poplar-based agroforestry systems are becoming very popular amongst farmers due to substantially higher economic returns than the traditional crop rotation of rice and wheat.

This study demonstrated that agroforestry in irrigated agro-ecosystems, such as the poplar-wheat integrated cropping system, store more carbon in above- and below-ground biomass than sole crop cultivation.■

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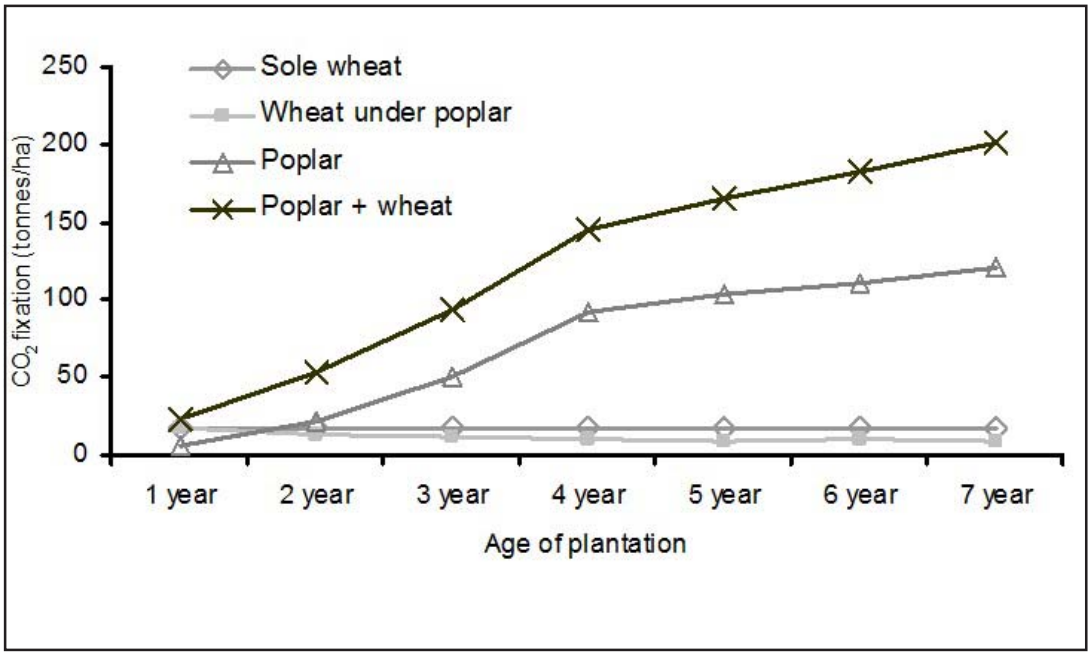

Fig. 1. Total CO^2 assimilation (t ha^{-1}) by poplar-wheat (above- and below-ground biomass) in agroforestry system and sole wheat cultivation.

December 2009

SEANAFE News

Southeast Asian Network for Agroforestry Education

SEANAFE starts operations as international NGO in 2010

Registering as an international nongovernmental organization

The Southeast Asian Network for Agroforestry Education (SEANAFE) was officially registered as a non-stock, non-profit international nongovernmental organization (INGO) at the Securities and Exchange Commission of the Philippines on 22 September 2009. With its legal personality, SEANAFE can enter into various institutional collaborations, partnerships, and funding arrangements, at both the regional and country levels. This will also help sustain Network operations after financial support from the Swedish International Cooperation Agency (Sida) ends in December 2009.

The Philippine Agroforestry Education and Research Network (PAFERN), through the Institute of Agroforestry (IAF) of the University of the Philippines Los Baños (UPLB), will host the SEANAFE Secretariat when it starts its full operation as an INGO in January 2010.

Preparing for 2010

In its 18th Board meeting, held 7-9 September 2009 in Bangkok, Thailand, Board members recognized the support of the Swedish International Development Cooperation Agency (Sida) to SEANAFE from April 1999 until December 2009. Board members also agreed on the following transition strategies:

a. Institutionalization of schemes to expand membership and improve collection of fees;
b. Formal expression of commitment from heads of member-institutions to support country network operations;
c. Regular mapping of institutional linkages for resource mobilization;
d. Expansion of subject matter coverage and strengthening of inter-country network collaborations;
e. Offering of fee-based training courses;
f. Development of proposals for Phase 3 operation for submission to donors;
g. Designation of a member-institution as SEANAFE's Secretariat from ICRAF; and
h. Establishment of a virtual Board to sustain policy and decision-making processes.

Considering these strategies, the Board members decided to:
a. Designate the Philippine Agroforestry Education and Research Network (PAFERN), particularly IAF, as temporary Secretariat of SEANAFE from six months to one year, starting January 2010;
b. List the necessary amendments to the SEANAFE Charter to conform to the network's new status as an INGO;

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Members

Indonesia
Institut Pertanian Bogor
Universitas Brawijaya, Malang
Universitas Gadjah Mada, Yogyakarta
Institut Pertanian 'Stiper', Yogyakarta
Universitas Jember, Jember
Universitas Hasanuddin, Makasar
Universitas Lambung Mangkurat, Banjarmasin
Universitas Lampung, Lampung
Institut Pertanian Malang, Malang
Universitas Mataram, Mataram
Universitas Muhammadiah, Malang
Universitas Mulawarman, Samarinda
Universitas Tadulako, Palu
Universitas Tribhuwana Tunggadewi, Malang
Universitas Udayana, Denpasar
Universitas Papua, Manokwari
Universitas Pembangunan National, Surabaya
Universitas Wangsa Manggala, Jogyayarta
Universitas Padjadjaran, Bandung
Universitas Winaya Mukti, Sumedang

Lao PDR
Dongkhamxang School of Agriculture and Forestry
Muang Mai School of Agriculture and Forestry
National University of Laos, Faculty of Forestry
National University of Laos, Faculty of Agriculture
Xieng Ngeun School of Agriculture and Forestry
Pakse School of Agriculture
Pakse University
Sepone Southern Agroforestry Training Centre
Suphanuvong University

Philippines
Abra State Institute of Science and Technology
Agusan del Sur State College of Agriculture and Technology
Aklan State University
Benguet State University
Bicol University College of Agriculture and Forestry
Camarines Norte State College
Camarines Sur State Agricultural College
Cagayan State University
Catanduanes State Colleges
Central Mindanao University
Central Visayas State College of Agriculture, Forestry and Technology
Don Mariano Marcos Memorial State University
Iloilo State College of Fisheries-Dingle Campus
Ifugao State College of Agriculture and Forestry
Isabela State University
Kalinga State College
Visayas State University
Mariano Marcos State University
Mindanao State University
Mindoro State College of Agriculture and Technology
Misamis Oriental State College of Agriculture and Technology
Mountain Province State Polytechnic College
Negros State College of Agriculture
Northern Mindanao State Institute of Science and Technology
Nueva Vizcaya State University
Occidental Mindoro National College
Pampanga Agricultural College
PROCESS-Luzon
Quirino State College
Southern Philippines Agribusiness, Marine and Aquatic School of Technology
Surigao del Norte College of Agriculture and Technology
University of Rizal System
University of the Philippines Los Baños
Wesleyan University-Philippines
West Visayas College of Science and Technology-Leon Campus
Western Mindanao State University-Tampilisan Campus

Thailand
Chiang Mai University (CMU)
Kasetsart University (KU)
Khon Kaen University
King Mongkut Institute of Technology Ladkragang
Maejo University
Naresuan University
Prince of Songkhla University
Rajamangala Institute of Technology
Sukhothai Thammathirat Open University (STOU)
Ubon Rachathani University

Vietnam
Forestry University of Vietnam
Forestry Vocational School No. 1
Hue University of Agriculture and Forestry
Lamdong Extension Center at Dalat City
Nong Lam University Hochiminh City
Tay Nguyen University
Thai Nguyen University of Agriculture and Forestry
Vietnam Agricultural Science Institute (VASI)
West Highland Forestry Technical School in Pleiku

SEANAFE starts operations...

Continued from page 1

c. Firm up basic requirements and formulate guidelines, including an organizational structure, to enable SEANAFE to operate as an INGO;
d. Develop implementing guidelines to operationalize the transition strategies;
e. Identify areas of concern for inter-country network collaboration to generate funding; and
f. Submit a proposal to Sida to use the budget balance to operate as an INGO in 2010.

Board members likewise agreed that further discussions are needed on the transition strategies.•

Jesus C. Fernandez/j.c.fernandez@cgiar.org

SEANAFE and ANAFE sponsor technical session in 2nd World Congress on Agroforestry

SEANAFE and the African Network for Agriculture, Forestry and Natural Resources Education (ANAFE), sponsored a technical session on "Integrating Disciplines through Agroforestry Education" during the Second World Congress of Agroforestry held in August 2009 in Nairobi, Kenya. The following seven papers were presented during the session:

1. "Case study approach to curriculum and teaching materials development in agroforestry education in Southeast Asia" (Jess Fernandez, SEANAFE);
2. "Encouraging students' competencies in agroforestry entrepreneurship" (Richmund Palma, Philippines);
3. "Enhancing integrated approaches in agricultural learning systems" (Per Rudebjer and August Temu, ICRAF);
4. "Implementing peri-urban agroforestry in South Africa: a case study of how upscaling agroforestry impacts on policy and curricula" (Michael Underwood, South Africa);
5. "The PIIP project innovation system approach for reinforcing agroforestry research at the University of Niamey in Niger" (Aissetou Drame Yaye, ICRAF);
6. "Opportunities and challenges of mainstreaming climate change into agriculture and natural resource education in Africa" (James Kung'u, Kenya); and
7. "Introducing agroforestry higher education programs in Iran" (Rahim Mirzaei Mola Ahmad, Iran).

Discussions focused on the need for learning institutions to be innovative in their approaches in promoting agroforestry education programs that are more relevant to current global concerns and stakeholders.•

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Three MS research fellows complete degrees

Ms. Penny Pujowati from the Institut Pertanian Bogor, Indonesia; Ms. Shierel Vallesteros from the University of the Philippines Los Baños; and Ms. Truong Thi Pinh from Hue University of Agriculture and Forestry, Vietnam completed their MS degrees in agriculture and forestry.

Ms. Pujowati completed her research on "Agroforestry landscape management plan for Karang Mumus River Basin, the downstream of Mahakam watershed, East Kalimantan" in August 2009. Ms. Vallesteros completed her research on the" Development of oil ideotypes in selected provenances of *Jatropha curcas*" in September 2009, while Ms. Thi Pinh completed her research on "Assessment of fixed carbon dioxide capability of some protection afforestation types in the upstream region of Bo River in Thua Thien, Hue Province, Vietnam" in September 2009.

They are three of six students who were granted with SEANAFE MS Research Fellowship. The other grantees are expected to complete their degrees by October 2009.•Jesus C. Fernandez/j.c.fernandez@cgiar.org

SEANAFE pilots regional training on sustainable upland development

Sixteen lecturers and extension personnel from Indonesia, Laos, Malaysia, the Philippines, Thailand, and Vietnam participated in the pilot offering of SEANAFE's "Regional training course on sustainable upland development" from 28 September to 8 October 2009. The course was developed to equip upland development workers with specialized knowledge and skills in natural and social sciences to better understand interdependent problems affecting upland areas; and highlight the roles of agroforestry science and practice in upland development in the region.The participants were able to:

1. share and learn how to effectively promote sustainable upland development;
2. explain the concepts and principles of sustainable upland development;

3. discuss and analyze recent issues, challenges, and prospects of sustainable upland development and at the same time acquire a more regional perspective;
4. acquire skills in applying appropriate tools, approaches, and strategies in mobilizing communities and other institutions towards sustainable upland development; and
5. prepare individual action plans towards sustainable upland development.

The pilot offering of this course is also intended to improve the design and development of a Master's degree on sustainable upland development.

SEANAFE implemented the course in collaboration with the Philippine Agroforestry Education and Research Network (PAFERN) and the Institute of Agroforestry (IAF) of the University of the Philippines Los Baños (UPLB), funded by the Swedish International Development Cooperation Agency (Sida). •Jesus C. Fernandez/j.c.fernandez@cgiar.org

INAFE produces agroforestry research compendium

The Indonesian Network for Agroforestry Education (INAFE) published a compendium of agroforestry researches implemented by its member-institutions and partners from 2006 to 2009. The compendium consists of 22 research papers focusing on various agroforestry systems practiced in Indonesia, and roles of agroforestry in addressing environmental degradation and climate change, among others.

Written in Bahasa Indonesia, the papers were contributed by the Forestry of Research and Development Agency (FORDA) and Gajah Mada University (UGM) from Yogyakarta province; Bogor Agriculture University (IPB) from West Java province, Lampung University (UniLa) from Lampung province, University of Tanjungpura (UnTan) from West Kalimantan Province, University of Mulawarman (UnLam) from East Kalimantan province, and University of Putra Malaysia (UPM).

Aside from helping to disseminate agroforestry researches within and outside INAFE, the compendium is also intended as a reference material for teaching and input for policy decisions. The Swedish International Development Cooperation (Sida) funded the project through SEANAFE. Request for e-copies may be sent to chs.wulandari@gmail.com. •
Jesus C. Fernandez/j.c.fernandez@cgiar.org

MAFTP teacher's guide now available in Lao

Dr. Latsamy Boupa and Mr. Phongxion Wangneng of the Faculty of Forestry, National University of Laos completed the translation of SEANAFE's "Teacher's Guide on Markets for Agroforestry Tree Products" into Lao in August 2009. This initiative is part of SEANAFE's objective to improve the teaching of agroforestry marketing among its member-institutions. Request for e-copies may be sent to l_boupha@yahoo.com. •
Jesus C. Fernandez/j.c.fernandez@cgiar.org

Philippine congress highlights agroforestry's role in climate change mitigation

With the theme "Agroforestry promotion for climate change mitigation and adaptation: building lessons from the field," the 4th Philippine Agroforestry Congress, held 18-20 November 2009 in Cagayan de Oro City, Misamis Oriental, Philippines, allowed stakeholders to share experiences in agroforestry technology development, promotion and adoption.

More than 150 participants attended the event, representing local government units, nongovernmental organizations, students, farming communities, people's organizations, academic institutions, foreign and international organizations, and national government agencies. The congress included: a) five plenary paper presentations on recent climate change research, and the roles of agroforestry in climate change mitigation and adaptation; b) 15 concurrent paper presentations on recognizing the multifunctionality of agroforestry; promoting enterprise development through agroforestry; and innovative approaches in agroforestry development and promotion; c) 16 poster paper presentations; d) agroforestry road shows; and e) a farmers' forum.

Congress delegates also signed the Congress Declaration for Agroforestry Promotion to support and express their commitment to promote agroforestry as a climate change adaptation strategy, and also work towards institutionalizing agroforestry as a development strategy in the Philippines.

The Philippine Agroforestry Education and Research Network, UPLB Institute of Agroforestry, and the Misamis Oriental State College of Agriculture and Technology co-organized the event. The congress is

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Philippine congress highlights...

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sponsored by the SEANAFE, Development Bank of the Philippines, Asia-Pacific Network for Global Change Research, and the World Agroforestry Centre - Philippines.

•Leila D. Landicho/ leila_landicho@yahoo.com

INAFE member-institutions formalize commitment to SEANAFE and INAFE

Representatives of member-institutions of the Indonesian Network for Agroforestry Education (INAFE) signed a Memorandum of Agreement formalizing their institutional commitments to SEANFAE and INAFE during the 3rd INAFE General Meeting on 5-6 May 2009 in Lampung University, Bandar Lampung. Participants also agreed to:

- Invite five universities as new members—Sumatra Utara University, Nonmensen University, Jambi University, Sebelas Maret University, and Tanjungpura University;
- Approve the INAFE Charter;
- Amend the membership policy to accept applications from education and research institutions; national and local government agencies; nongovernmental organizations; business/private sector; and community organizations;
- Approve the annual membership fee collection schedule; and
- Approve plans for 2009-2011.

During the meeting, Dr. Christine Wulandari was elected as INAFE Chair from 2009 to 2011, succeeding Dr. Suhardi.•

Jesus C. Fernandez/j.c.fernandez@cgiar.org

Increased income and absorbed carbon found in *Litsea glutinosa*-cassava agroforestry model

Absorbed CO_2 in the *Litsea glutinosa* -cassava agroforestry model varied from 25 to 84 tons per hectare, and provides profit to small farmers, ranging from US$487-1 624 (VND 9 to 30 million) per hectare, representing 20 percent of the total product value of Litsea and Cassava. This was the major finding of the recently completed research project of the Vietnam Network for Agroforestry Education (VNAFE) on "CO_2 sequestration estimation for the Litsea-Cassava agroforestry model in Mang Yang District, Gia Lai Province in the Central Highlands of Vietnam."

The research constructed a Litsea-cassava agroforestry model to estimate the biomass and CO_2 sequestration potential of *Litsea glutinosa*, and defined the amount of absorbed CO_2 and environmental values of the Litsea–cassava agroforestry model. Litsea is an indigenous, multipurpose, broadleaved species found mostly in the semi-deciduous forests of Central Highlands of Vietnam. Most of its biomass (stem, bark, leaves, and branches) can be used or sold to produce different products. Litsea is usually planted in agroforestry models together with annual crops such as cassava, rice, and coffee.

The research found that:

1. Litsea should be harvested after 10 years, instead of the usual practice of 4-6 years, to obtain the highest productivity;
2. Strong growth occurred when Litsea were 4-6 years old;
3. Stored carbon and CO_2 sequestration potential of the Litsea-cassava agroforestry model could be estimated by calculating the:
    a. Rate (%) of stored carbon compared to the dry biomass of the four components of the tree— leaves (48.7%), stem (47.7%), branches (47.6%), and bark (45.4%)—with carbon per hectare calculated based on tree density;

A research by VNAFE estimates the *Litsea glutinosa*-cassava agroforestry model's potential in sequestering and absorbing CO_2 and determines its other environmental values.

b. Carbon stored in the mean tree: C/tree = f(Dg), with carbon per hectare calculated based on tree density; and
c. Carbon stored per hectare: C/ha = f(No of shoots/stump, N/ha, Dg).

4. Two to three Litsea shoots must be left per stump in the second and third periods of the Litsea-cassava agroforestry model to produce the highest amount of biomass and optimal CO_2 absorption at 3-84 t which increases as the model becomes older.

Results also showed that calculations based on rate of stored carbon are accurate yet expensive; and those based on carbon stored in the mean tree have a relative error of 3.2 percent. Calculations based on carbon stored per hectare gave a relative error of 2.7 percent.

The research was conducted by a team of faculty members and students from the Tay Nguyen University (TNU), in partnership with the staff of the People's Committee and Department of Agricultural and Rural Development of Mang Yang District. The team was led by Dr. Bao Huy, Head of TNU's Department of Forest Resources and Environment Management and VNAFE Chair. The Swedish International Development Cooperation Agency (Sida) through SEANAFE-funded the project. For more details of the research results, visit http://www.socialforestry.org.vn. •Bao Huy/baohuy.frem@gmail.com

Conducting stem analysis and getting samples from *Litsea glutinosa* trees to measure fresh biomass and carbon pools.

Sampling of Litsea bark (left) and stem (right) to analyze carbon pools.

Transporting Litsea tree components (leaves, stem, and bark) in Mang Yang district, Gia lai province, Vietnam.

Determining the weight of fresh biomass of *Litsea glutinosa* from its bark (left), leaves (middle), and branches (right).

PAFERN expands agroforestry model documentation and assessment project

In 2008, the Philippine Agroforestry Education and Research Network (PAFERN) implemented the "Characterization and assessment of different agroforestry models in the Philippines," project with funding support from the Southeast Asian Network for Agroforestry Education (SEANAFE). Results of the six-month study revealed the varying agroforestry systems being practiced in Luzon, Visayas, and Mindanao. These included the fruit tree-based and cutflower-based agroforestry systems in Nagcarlan, Laguna; the alley cropping system in Argao, Cebu; and the integrated or complex agroforestry system in Compostella Valley in Mindanao.

Project findings validate earlier studies that agroforestry plays a multifunctional role in addressing the socioeconomic needs of farmers, and helping to improve the environmental or ecological conditions of the farm and farming community.

"Building institutional capacities on documentation and assessment of different agroforestry models in the Philippines" aims to document agroforestry models representing different land tenure schemes in the country.

Expansion of the special project

Recognizing the relevance of the project findings and its contribution to the study of agroforestry, PAFERN Board Members expressed the need to explore the potentials of other agroforestry systems that were not covered in the project. SEANAFE expressed its commitment to support the expansion of the project until 2009.

The expanded project, titled "Building institutional capacities on documentation and assessment of different agroforestry models in the Philippines," involved 15 PAFERN member-institutions. The project aimed at:

a. convening the faculty members/researchers of selected PAFERN member-institutions and training them on methodologies that can document and assess different agroforestry models in their respective areas;
b. discussing the documentation and assessment tool; and
c. documenting agroforestry models representing different land tenure schemes in the country (e.g. Community-Based Forest Management Agreement, Certificate of Ancestral Domain Claims, Protected Areas Community-Based Resource Management Agreement, and private ownership of farms).

Capacity building initiative

An initial activity of the project was the "Training-workshop on documentation and assessment of different agroforestry models in the Philippines" held 14-15 May 2009 at the University of the Philippines Los Baños. The training-workshop enabled participants to share the experiences of the Institute of Agroforestry in the initial project; review and improve the data gathering guide; enhance knowledge and skills in conducting biodiversity assessment, and carbon stock assessment; and identify other potential agroforestry models that could be documented.

Representatives from 15 PAFERN member-institutions participated in the training-workshop. They also served as the project's collaborating institutions—Benguet State University (BSU), Kalinga Apayao State College

Participants in the "Training-workshop on documentation and assessment of different agroforestry models in the Philippines"share experiences in data gathering, conducting biodiversity and carbon stock assessments, and identifying agroforestry models for potential documentation.

(KASC); Abra State Institute of Science and Technology (ASIST); Mountain Province State Polytechnic College (MPSPC); Don Mariano Marcos Memorial State University (DMMMSU); Isabela State University (ISU); Pampanga Agricultural College (PAC); Mindoro State College of Agriculture and Technology (MinSCAT); Camarines Sur State Agricultural College (CSSAC); Aklan State University (ASU); Visayas State University (VSU); Misamis Oriental State College of Agriculture and Technology (MOSCAT); Central Mindanao University (CMU); Southern Philippines Agribusiness, Marine and Aquatic School of Technology (SPAMAST); and Surigao del Norte College of Agriculture and Technology (SNCAT).

Commitment and knowledge sharing

Participants committed to supporting the outputs of the training-workshop, especially the documentation and assessment of different agroforestry models. •Leila D. Landicho/leila_landicho@yahoo.com

INAFE's national seminar highlights agroforestry as the future sustainable land use

The Indonesian Network for Agroforestry Education (INAFE) facilitated the presentation of 28 papers during the "National seminar on agroforestry as the future sustainable land use" held 7 May 2009 in Lampung University, Bandar Lampung.

The seminar shared research results that provide evidences on the benefits and potentials of agroforestry as the future sustainable land use in the world. The papers focused on: (a) agroforestry market opportunities and drivers of agroforestry land use; (b) agroforestry's contribution to agricultural productivity and environmental sustainability; (c) tree-based rehabilitation of degraded lands and watersheds; and (d) policy options and institutional innovations for agroforestry land use.

The seminar was attended by 62 participants from INAFE member-institutions, government research agencies, nongovernmental organizations, and students. Discussions attest to the role of knowledge sharing in facilitating informed decision-making to widen the application of agroforestry on livelihood, food security, poverty, and natural resource management in Indonesia.• Jesus C. Fernandez/j.c.fernandez@cgiar.org

PAFERN welcomes new board members

The Philippine Agroforestry Education and Research Network (PAFERN) elected its new Board Members last 18 November 2009 during its 5th General Assembly. They are Dr. Orlando P. Almoite, Chancellor of the Don Mariano Marcos Memorial State University and Dr. Honorio M. Soriano Jr., President of Pampanga Agricultural College for PAFERN-Luzon; Dr. Ma. Eugenita C. Capciete, Campus Administrator of Western Visayas College of Science and Technology and Dr. Elpidio T. Magante, President of Bohol Island State University for PAFERN-Visayas; and Dr. Joanna Cuenca, President of Northern Mindanao State Institute of Science and Technology and Dr. Muslim, President of Mindanao State University for PAFERN-Mindanao. The Board Members will serve their term from 2010 to 2011. Representatives of the PAFERN member-institutions re-elected Dr. Lutgarda L. Tolentino, Director of the UPLB Institute of Agroforestry, as PAFERN Chair until 2011. • Leila D. Landicho/leila_landicho@yahoo.com

LaoNAFE welcomes new chair

SEANAFE welcomes Dr. Anoulom Vilayphone as new chair of Lao Network for Agroforestry Education (LaoNAFE) and member of SEANAFE Board. He succeeds Dr. Latsamy Boupha in an election held during LaoNAFE's General Meeting on 30 July 2009 at the National University of Laos (NUoL) in Vientiane.

Dr. Anoulom is currently serving as Lecturer-cum-trainer and In-charge of the Post-Graduate Program of the Faculty of Forestry of NUoL. He obtained his PhD degree in Forest Ecology from Kyoto University, Japan. Among his current research involvements include an impact study of logging in Laos with the Food and Agriculture Organization (FAO); non-timber forest products study under the Lao-German Promotion of Forestry Education Program; and resource tenure and rural development study with the International Development Research Centre (IDRC).

Before becoming LaoNAFE chair, Dr. Anoulom already served as LaoNAFE Board member since 30 July 2009. He also served as one of LaoNAFE's country team members for SEANAFE's enhancing forest policy education project.

Among his immediate plans as LaoNAFE chair include evaluating LaoNAFE activities towards improving its operations and relevance.•
Jesus C. Fernandez/j.c.fernandez@cgiar.org

Asia-Pacific Network supports PAFERN's agroforestry and climate change mitigation research

The Asia-Pacific Network (APN) agreed to support the proposed project of the Philippine Agroforestry Education and Research Network (PAFERN), titled "Scaling-up agroforestry promotion towards climate change mitigation in Southeast Asia." The one-year project focuses on capacity-building, exchange/sharing of knowledge and technical expertise, and implementation of public awareness programs aimed at disseminating the potentials of agroforestry in mitigating climate change. The project is a regional collaboration of five country networks—PAFERN, Indonesian Network for Agroforestry Education (INAFE), Lao Network for Agroforestry Education (LaoNAFE), Vietnam Network for Agroforestry Education (VNAFE), and Thailand Network for Agroforestry Education (ThaiNAFE).

Components include: a) the conduct of organizational meetings among the Project Facilitating Team (PFT)/country network coordinators to facilitate overall project implementation; b) formation of multisectoral task forces to serve as conduits for agroforestry promotion and institutionalization in five participating countries; c) packaging of instructional and information materials on agroforestry for public awareness programs; d) implementation of agroforestry road shows to strategically promote agroforestry in the five participating countries; and e) formulation of a policy brief on the potentials of agroforestry in climate change mitigation.

The project is being spearheaded by PAFERN, with Dr. Orlando P. Almoite of the Don Mariano Marcos Memorial State University (DMMMSU), Philippines as the Project Leader. It is being implemented from June 2009 until June 2010.•Leila D. Landicho/leila_landicho@yahoo.com

SEANAFE News is a newsletter of the Southeast Asian Network for Agroforestry Education (SEANAFE). SEANAFE aims to improve the quality, availability and accessibility of agroforestry education in Southeast Asia.

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Promoting diverse fuelwood production systems in Papua New Guinea

Ian Nuberg (ian.nuberg@adelaide.edu.au) and Brian Gunn (Brian.Gunn@CSIRO.au)

Fuelwood is a crucial, but undeveloped, component of Papua New Guinea's (PNG) domestic economy. Very little is known about how much fuelwood is used, or the market flows of wood from forest to consumer. It is known, however, that most consumers in the more densely-populated regions of PNG have experienced difficulty in finding and buying fuelwood because of decreasing supply and high prices.

Use of and access to fuelwood

About 97 percent of the PNG landmass is under customary land ownership. For many people living outside traditional areas, access to fuelwood resources is limited and often leads to conflict. The alternatives of 'climbing the energy ladder' — i.e. switching to charcoal, kerosene, gas, and electricity—are limited due to their availability and/or cost. Fuelwood will remain in this country's domestic energy market for some time yet. Even industrial fuelwood users (e.g. plantation factories) seem set to continue using fuelwood.

Growing fuelwood for sale

There have been several conventional forestry efforts to establish fuelwood plantations in PNG but they have not successfully addressed the problems encountered by domestic fuelwood growers due to long rotations and a lack of access to trees which are under government management. While there is a healthy culture of tree planting among PNG landowners, planting trees for commercial fuelwood production is not practiced.

A four-year project is being implemented to encourage landowners to grow fuelwood for sale, and even add value by converting it to charcoal. The project involves:

- surveying the fuelwood market;
- developing short-rotation, coppicing (SRC) fuelwood production systems that could be easily established and maintained as part of the landowners' current farming systems;
- determining the best way of establishing extension networks for the wider adoption and long-term development of fuelwood production.

The project is being implemented by the PNG Forest Research Institute, Lae, together with two local NGOs: Peoples Action for Rural Development (PARD) and HOPE Worldwide, that work directly with participating landowners. A third NGO, Foundation for People and Community Development (FPCD), is also involved in carrying out the fuelwood survey. The project, which began in early 2008, is being funded by the Australian Centre for International Agricultural Development (ACIAR).

Areas of fuelwood stress

Fuelwood stress areas in PNG are mostly located around major urban centers such as Port Moresby and Lae, as well as several highland provinces – e.g. Western Highlands, Eastern Highlands and Simbu. These areas have relatively high population densities. Six sites were established around Mt Hagen, Western Highlands, two sites were established near Kerowagi in Simbu Province, and three sites were established around Port Moresby.

Experiment details

The project involves both densely-planted woodlots (1.5 m x 1.0 m and 1.5 m x 2.0 m) and contour-hedgerow agroforestry systems (double-row hedgerows with 0.5 m along the rows and 0.6 m between rows, distance between hedgerows varies between 5-10 m depending on slope). The experiment aims to monitor and understand how the trees grow and how landholders can use this gained knowledge to improve tree growing methods.

Currently, landowners plant trees as individuals, small clumps, or along paths and boundaries. Farmers growing sweet potato and other subsistence crops on slopes make extensive use of drains. In some cases, farmers use rudimentary and temporary contour-barricades to control soil erosion.

The project hopes to demonstrate contour hedgerows as a commercially productive alternative to incorporate into their farming systems. These nitrogen-fixing species also provide fodder to goats and to a lesser extent, pigs. The project is also training participating farmers in making charcoal for sale. The project also aims to produce poles from woodlot systems. Project implementers are looking forward to see which products the farmers choose to harvest.

Monitoring species performance

The project is monitoring the species indicated in Table 1. The species were chosen for their fast growth, proven value as firewood or charcoal, and ability to coppice. The project aims to implement as many short rotations as possible, and not just consider these crops as 'one-time-[planting] only.'

One of each of the highland and coastal sites has woodlots which are planted as replicated trials to evaluate the relative growth rates under two planting densities. Simpler systems are established in all the other sites. These systems will be more amenable to the landholders' needs. This match between the systems and the needs of the landholders addresses the project's aim of evaluating landholders' responses to the systems in the same

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Promoting diverse fuelwood...

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way that the tree species' responses to the environment are also assessed.

Farmers' choice of species

The 'species of choice' for highlanders is the local *Casuarina oligodon*, known as *Yar*. *Yar* is an excellent firewood which can be burnt very soon after harvest. Unfortunately, it does not coppice.

As an alternative, the project is monitoring *Casuarina junghuhniana,* which is indigenous to Indonesia. It is highly suitable for firewood and charcoal, and has reportedly high coppicing ability. However, it is not found in PNG. Farmers have responded well to the nickname of 'Indoyar' for this tree. They are also very pleased with its early growth which has far exceeded both the upland and coastal Yar (*C. equistifolia*) (Figure 1).

Calliandra calothyrsus prefers relatively low altitudes. Planting it in the uplands at altitudes of up to 2 000 m may be considered by some to be 'heroic.' But the project hoped that this species will still perform well given the relatively favorable rainfall (annual average ~ 2 600mm) and temperature (average range 12 – 29 °C) of this region.

Exploring indigenous species

We sought to include indigenous high-altitude (> 1500 m) species that could be developed as SRC firewood crops. Farmers around Mt. Hagen suggested *Kumbuk* (*Thyllanthus flaviflorus*). *Kumbuk* grows well and fast from cuttings in a farmer's field. However, project experiments failed to produce plants from this species.

Eucalyptus is also being evaluated. The project is considering eucalyptus species that were already evaluated in international trials and for which genetically improved seeds were used (*E. pellita, E. camaldulensis*), *E. grandis* and *E. robusta* have a track record in PNG as well as the local eucalyptus found around Port Moresby, *E. alba*. These will probably best be used in woodlot systems rather than hedgerow systems because of their known competitiveness with agricultural crops.

Initial results and future activities

Overall, the establishment and early growth rates of the species on most of the project sites have yielded results beyond expectations. Project implementers are looking forward to further reporting progress of tree growth, farmers' responses, fuelwood surveys and extension activities.

Project implementers are also exploring technical assistance with other agroforestry researchers or practitioners who have experiences on the use of these species and implementation of similar systems.■

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Fig. 1. One of the participating farmers near Mt. Hagen, Patrick Barkri, with an 'Indoyar' that is twice the height of local Yar.

Table 1. Species established as short rotation coppicing fuelwood systems in PNG.

	SRC Woodlots	Contour hedgerows and contour tree lines
Highland sites (6 in Western Highlands Province, 2 in Simbu province)	*Casuarina junghuhniana* *Casuarina oligodon**	*Calliandra calothyrsus* *Casuarina junghuhniana*
	*Eucalyptus grandis** *Eucalyptus pellita* *Eucalyptus robusta*	*Leucaena diversifolia*
Coastal sites (3 sites around Port Moresby)	*Azadirachta indica* *Casuarina equisitfolia*	Not yet established
	Casuarina junghuhniana *Calliandra calothyrsus* *Eucalyptus alba* *Eucalyptus pellita* *Eucalyptus tereticornis*	

*both local and introduced provenances

Fig. 2. The project encourages farmers to grow intercrops in the woodlot. In this particular farm, a local vegetable, *crus sago* (or choko vine), has just been planted.

Celtis australis: a multipurpose tree crop in India

Bhupendra Singh and B.P. Bhatt (butola_bs@yahoo.co.in)

Celtis australis Linn. (local names – *Kharik*, *Khrik, Roku, Batkar, Brimiji*, and common Nettle) family Ulmaceae is an indigenous species of the Western Himalaya. It has a fairly wide range of distribution that extends eastward to Nepal, and is commonly cultivated in Jammu and Kashmir, Himachal Pradesh, Uttarakhand and parts of the North East Hill region. It grows well at 500-2 500 m asl (Gaur, 1999). In Uttarakhand, *C. australis* is usually grown in traditional agroforestry systems and is a common associate of *Ficus spp. Bauhinia spp.; Albizia sp. Cedrus deodara, Picea smithiana, Abies pindrow, Pinus wallichiana, Quercus* spp*.*, *Betula* spp., *Acer* spp., *Aesculus indica, Rhododendron arboreum,* etc.

Characteristics

Celtis australis is a moderate-sized deciduous tree that can reach 25 m high and 50 cm in diameter, under favorable conditions. It grows well along stream banks, on sloping hillsides, and on clay loam soil with sufficient moisture (Luna 1996).

Celtis has good coppicing ability. The coppiced shoots grow fast. However, the shoots need protection against the grazing and browsing of animals, especially in the first few years (Singh 1982).

Uses

Fodder. The Celtis tree is mainly grown for fodder. It is lopped during lean periods and provides ample supply of highly palatable, nutritious, and tannin-free fodder during peak periods (Singh, 1982; Subba *et al*., 1996).

Timber. The timber quality of *C. australis* is excellent. It is used in making tools and whip handles, cups, spoons, churners, sports goods, oars, canoes, sticks and agricultural implements. It can also be carved, used to construct carriages, and as a general building material (Bhatt and Verma 2002). Its wood is also used as fuelwood. It contains 16.81 KJ/g calorific value, 0.54 g/cc density, 3.4 percent ash, 57.53 percent moisture, 0.40 percent nitrogen, with a Fuelwood Value Index of 464 (Purohit and Nautiyal 1987). The timber of Celtis is also reportedly a good source of paper and pulp (Pearson and Brown 1932; Trotter 1944).

Medicinal uses. The fruits are used as remedies for amenorrhoea and colic. The stems and leaves are crushed, and given to those afflicted with leprosy by the Bhil tribe of Madhya Pradesh (Maheshwari, *et al.* 1986). The tribes of the Western Himalayas boil the roots and use them as remedies for colic and other stomach troubles (Karnick and Pathak 1982). The bark is also made into paste and applied on bones, pimples, contusions, sprains and joint pains (Gaur 1999).

Flowering and fruiting

Sprouting of new shoots, flowering, and fruiting vary considerably with elevation. They may also vary from year to year in some localities because of climatic differences.

The leaves are shed in December-January, while the young shoots appear from March to April. The small greenish flowers appear with the new leaves.

The trees at the foothills start flowering in early March. Those located at higher elevations usually flower late in April (Anon, 1992; Singh, 1982; Luna, 1996).

The fruits are formed rapidly after flowering, and reach full-size by June-July (Troup, 1921). The drupes remain green until September-October, and thereafter turn yellow. The fruits ripen by October–November as their color turns black. The sweet drupes are eaten by birds, squirrels, monkeys and rodents. These animals thus help disperse the seeds, and further propagate Celtis in other areas.

Meanwhile, the fruits that fall to the ground during winter germinate in March-April. However, in dry and low areas, germination is delayed until July,*i.e.* at the onset of the monsoon season. The mortality of seedlings during summer is fairly high, particularly in the lower, dry areas. High mortality of seedlings is also due to the browsing and trampling of cattle and other grazing animals (Singh 1982).

The seeds and vegetative parts of the plant are used to propagate Celtis. In this research, propagation through seeds and branch cuttings was explored.

Propagation through seeds

Seeds were collected in December-January 2000, from 13 different geographically isolated areas. The length, breath and weight of the seeds were measured.

The seeds were germinated in a laboratory at different temperatures prior to being sown in nursery beds. The periodic growths of the seedlings were then measured for a year.

To observe the seasonal variations in the nutritive value of Celtis, the leaves were collected from January to December from four different sites.

Results showed that seed dimensions, including length, breadth and weight, varied according to source. Significant ($p < 0.05$) differences were also observed in seed traits. Significant ($p < 0.01$) positive correlations were found between seed source elevation and both seed morphological characteristics and seed weight (Singh *et al.* 2006).
Moreover, seed germination was

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Celtis australis...

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strongly dependent on temperature. At 25 °C constant temperature, optimum seed germination reached 42.62 percent, irrespective of seed source. These results imply that seed germination of Celtis in nurseries starts only after the temperature rises, which usually happens in February-March (Singh *et al.* 2004).

Propagation through branch cuttings

Significant differences were also observed in the rooting of branch cuttings using different hormonal concentrations. The 500 ppm IBA treatment gave the highest rooting percentage, and the highest number of roots per cutting. Furthermore, sprouting percentage and root length were also higher. IBA not only enhanced root formation but also improved the quality of the root system of Celtis (Butola and Uniyal 2005).

Seed storage

The seeds of Celtis were successfully stored at ambient room temperature as compared to storing them at lower temperatures. Germinating the seeds in nurseries produced poor results compared to germinating them in laboratories.

Seedling growth

In nurseries, Celtis gained maximum shoot and root growth at 61.05 cm and 30.47 cm, respectively, regardless of variations in seed source. However, Gairola *et al.* (1990) reported that Celtis seedlings attained maximum (129 cm) height after a year.

Findings also showed a significant ($p < 0.01$) positive correlation between the growth of seedlings and altitude of the seed source. On average, 55.98 leaves per plant were obtained after one year. The average value of the seedlings' collar diameter was recorded at 5.85 mm after being raised in the nursery for one year.

Seedling weight

Seedling weight exhibited an average value of 10.02 ± 3.28 g after one year of growth. A strong ($p < 0.01$) positive correlation between seed and seedling weight of Celtis was recorded. Saleem *et al.* (1994) obtained variations in the seed weight of Celtis. According to them, heavier seeds grew better than lighter seeds.

Among the various seed and seedling traits, seed weight, and shoot length were found to be strongly influenced by genes. Among the various seed and seedling parameters, seed weight, shoot length, shoot weight, number of branches and seedling weight exhibited high heritability and genetic gain. These characteristics must thus be considered in selecting plants that are most suitable as planting stock (Singh 2004; Singh *et al.* 2006).

Nutritive content of foliage

Significant ($p < 0.05$) seasonal variations were observed for the chemical composition of Celtis foliage. Between seasons, results showed 91.7-169.7 mg/g, crude protein, 0.77-1.63 mg/g, phosphorus, 2.84-7.57 mg/g potassium, 139.3-198.0 mg/g crude fiber, 11.12-18.29 mg/g sugar, and 47.90-65.26 mg/g starch.

Altitude also significantly influenced the nutritive contents of Celtis foliage. Between populations, phosphorus ranged from 1.04 to 1.10 mg/g, potassium from 4.23 to 5.01 mg/g, crude protein from 126.6 to 140.2 mg/g, crude fiber from 160.8 to 171.1 mg/g, sugar from 14.45 to 16.65 mg/g, and starch from 47.08 to 63.11 mg/g.

Altitude had a significant positive correlation with potassium, calcium, crude protein, and starch content. Dry matter content, phosphorus, and soluble sugars showed a significant inverse correlation with altitude. Irrespective of altitudinal variation, dry matter, ash content, crude protein, phenolic contents, and crude fiber exhibited the maximum values during March-April (Spring season).

Season and altitudes significantly influenced the nutritive value of the Celtis foliage. On average, foliage collected from high altitudes exhibited higher nutrient levels as compared to those located at the lower areas.

Conclusions

The results showed that Celtis seeds should be collected from higher altitude areas if they are meant for mass propagation and plantation in rainfed agricultural lands, degraded lands, and wastelands. The seeds collected from these areas would more likely produce nutritious fodder which could be harvested twice in a year (Singh 2004).

Seed weight and shoot growth should be the characteristics considered for raising quality planting stock of *C. australis*.

The results also imply that *C. australis* is a promising tree for integrating in agroforestry systems. This tree not only provides nutritious fodder to the livestock in Central Himalaya, particularly during peak periods, but also fuelwood and small timber for the poor farmers, among other uses.■

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New information sources

The following publications are new releases from the United Nations Food and Agriculture Organization, Asian Development Bank, International Development Research Center, CABI Publishing; and Earth Print:

Bees and their role in forest livelihoods

This publication provides basic information on managing wild bees and the use of their products. It identifies and describes major bee species and their importance for nature conservation and sustaining livelihoods of rural people. Bee products are considered at both subsistence and commercial levels. The book focuses on the potential of managing wild bee species in developing countries. The role of bees in pollinating crops and the impact of managing bees on forestry and farming are also presented. Wild bee-keeping techniques, honey production and marketing, and the international trade in bee products are described with further references and sources of additional information given. For more information, visit http://www.fao.org/.

Biofuels: production, application and development

Written by A. Scragg, this textbook explores the production of biofuels as alternatives to fossil fuels, focusing on the technological issues that need to be addressed for any new fuel source. Each type of biofuel currently in production is considered in detail, covering the benefits and problems with production and use and the potential for biological material to provide sufficient energy for the world's population - the principles on which future fuel development are based. For more information, visit http://wiserearth.org/.

Climate change and impacts on agriculture in Asia and the Pacific

This study recommends cost-effective adaptation responses that could build greater climate resilience into the agriculture sector in Asia and the Pacific. Information was sourced from the ADB-sponsored agriculture sector study, carried out by the International Food Policy Research Institute (IFPRI), which used predictions of global climate models to develop scenarios up to 2050 for Asia and derive implications for food security. For more information, visit http://www.adb.org/.

Conservation for a new era

Written by Jeffrey McNeely and Susan Mainka, this book outlines the critical issues facing us in the 21st century, developed from the results of the World Conservation Congress in Barcelona in October 2008. The landmark publication takes on the pressing issues of today and highlights the solutions to be found through investing in nature. It provides a snapshot of the current situation, split into 21 easy-to-read sections, as well as a roadmap for the future. For more information, visit http://www.wiserearth.org.

Forestry and climate change

Edited by P. H. Freer-Smith and M. S. J. Broadmeadow, this book explores how forests will interact with the physical and natural world, and with human society as the climate changes. Also considered is how the world's forests can be managed to contribute to the mitigation of climate change and to maximize the full range of economic and non-market benefits. For more information, visit http://wiserearth.org/.

Greening growth in Asia and the Pacific: follow-up to the World Summit on Sustainable Development

The book explains three basic principles of Greening growth—quality of economic growth, eco-efficiency of economic growth, and environmental sustainability vis-a-vis environmental performance—and four pillars of Green growth—eco-tax reform, sustainable

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New information sources...

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infrastructure, and the greening of business and sustainable consumption. It explores these principles and pillars as potentials for policy options and approaches for sustainable development and improved welfare, and gives fresh and practical perspectives from regional governments and experts. For more information, visit http://www.fao.org/.

In focus: fighting poverty with facts—community-based monitoring systems

Written by Celia Reyes and Evan Due, this book presents the Community-Based Monitoring System (CBMS), which recognizes the involvement of the poor in planning public programs affecting their well-being. It further recognizes that, to be effective, development programs must be targeted and informed by relevant, current, accurate disaggregated data. To accomplish this, CBMS brings together communities and local authorities to gather and monitor locally obtained, verifiable information about actual living conditions, and to use this information for planning and policy-making.

Drawing from the CBMS experience in Africa and Asia, the authors present recommendations for policy makers, donor agencies, and researchers. They also present guidelines for developing and implementing poverty monitoring systems in other regions of the world. For more information, visit www.idrc.ca/in_focus_poverty and http://www.idrc.ca/en/.

Integrated crop and resource management in the rice-wheat system of South Asia

Edited by J.K. Ladha, Yadvinder-Singh, O. Erenstein, and B. Hardy, this book covers the history of the Rice-Wheat Consortium and explains the importance of resource-conservation technologies developed for this system, such as laser land leveling, zero-till and reduced-till drill-seeded wheat, direct seeding of rice, and a leaf color chart for nitrogen management. This 395-page book presents the outputs of the Asian Development Bank project titled "Enhancing Farmers' Income and Livelihood through Integrated Crop and Resource Management in the Rice-Wheat System in South Asia." The project aimed at producing more food at less cost by improving yield per unit area, and improving water productivity. The book explains how this system can help feed an additional 20 million people per year in South Asia.

IWMI-FAO obtained the findings using a computer model called WATERSIM, which helps examine difficult tradeoffs between food security and the environment, specifically in relation to water supplies. The collaboration between IWMI and FAO was made possible through the Asia-Pacific Water Forum's *Knowledge Hubs* network. IWMI is the knowledge hub on Irrigation Service Reform. This book was developed as the hub's first knowledge product and provides guidelines for revitalizing Asia's irrigation sector. For more information, visit http://www.adb.org/.

Nature and nurture: poverty and environment in Asia and the Pacific

This publication provides an overview of poverty-environment interactions and presents some case studies that show how poor communities in Asia and the Pacific have sought to break out of poverty through local actions that improved their environment or made them less vulnerable to environmental stress. For more information, visit http://www.adb.org/.

Operational plan for sustainable food security in Asia and the Pacific

This report identifies the role and contributions of the Asian Development Bank in addressing the barriers to achieving the goal of food security by focusing on three areas of influence-productivity, connectivity, and resilience. The plan notes that many of ADB's operations in the core and other areas as specified in Strategy 2020 have significant positive impacts in addressing these food security concerns. The plan aims to increase the impacts of ADB's multisector operations on food security, particularly for the poor and disadvantaged, through greater synergy and value addition. For more information, visit http://www.adb.org.

Plant breeding and farmer participation

Edited by S. Ceccarelli, E. P. Guimarães, and E. Weltzien, this book complements the traditional approach to plant breeding by addressing a number of issues specifically related to the participation of farmers in a plant breeding programme, and provides a comprehensive description and assessment of the use of participatory plant breeding in developing countries. It is aimed at plant breeders, social scientists, students and practitioners interested in learning more about its use, with the hope that they all will find a common ground to discuss ways in which plant breeding can be beneficial to all and can contribute to alleviate poverty. For more information, visit http://www.fao.org/.

Planted forests: uses, impacts and sustainability

Edited by J. Evans, this book examines the significance of this rapidly emerging world resource. The chapters consider the strengths and weaknesses of planted forests, management objectives for their use and aspects of ownership and policy. Data from key production countries are used to evaluate the implications and sustainability of planted forests as a source of forest products as well as social and ecological issues. For more information, visit http://www.fao.org/.

Poverty in the Philippines: causes, constraints and opportunities

This report comprehensively analyzes the causes of poverty and recommends ways to accelerate poverty reduction and achieve more inclusive growth. It provides an overview of current government responses, strategies, and achievements in the fight against poverty and identifies and prioritizes

future needs and interventions. The analysis is based on current literature and the latest available data, including the 2006 Family Income and Expenditure Survey. For more information, visit http:///www.adb.org.

Revitalizing Asia's irrigation: to sustainably meet tomorrow's food needs

Based on a comprehensive new study of irrigation in Asia carried out by the International Water Management Institute (IWMI) and United Nations Food and Agriculture Organization (FAO) along with researchers from partner organizations, with funding from the Asian Development Bank, this report presents past and emerging trends in irrigation in Asia, and its drivers; forecasts future food needs and water demands; and outlines strategies and options for revitalizing irrigation to meet the future food needs of Asia's population.

Review of the literature on the links between biodiversity and climate change

This report reviews the literature since the Intergovernmental Panel on Climate Change 4th Assessment Report (AR4). It draws on recent research to summarise advances in our understanding of the impacts of climate change on biodiversity. The evidence for the impacts on biodiversity comes from three principal sources. First, from direct observation of changes in components of biodiversity in nature that can be clearly related to changes in climatic variables. Second, experimental studies using manipulations to eluciadate responses to climate change. Finally, and most widely, from modelling studies where our current understanding of the requirements and constraints on the distribution of species and ecosystems are combined with modelled changes in climatic variables to project the impacts of climate change and predict future distributions and changes in populations. For more information, visit http://www.wiserearth.com/.

Soil ecology and management

Written by J. K. Whalen and L. Sampedro, this book describes the organisms inhabiting the soil, their functions and interactions and the dimensions of human impact on the activity of soil organisms and soil ecological function. The chapters discuss basic soil characteristics and biogeochemical cycling, key soil flora and fauna as well as community-level dynamics (soil food webs). Unlike other soil biology and ecology textbooks, this book also conveys a better understanding of how human activities impact upon soil ecology in a section on ecosystem management and its effects on soil biota. The authors provide a unique perspective on the utility of soil organisms by exploring the biodiversity of soil food webs, how they are impacted by human activities and intervention and their management. For more information, visit http://www.cabi.org.

State of food insecurity in the world 2009

This flagship publication of the United Nations Food and Agriculture Organization presents the latest statistics on global undernourishment and concludes that structural problems of uderinvestment have impeded progress toward the World Food Summit goal and the first Millennium Development Goal hunger reduction target. The situation has been exacerbated by the food crisis and the global economic crisis that have increased the number of undernourished people in the world to more that one billion. This crisis is affecting the entire world simultaneously. In the context of the enormous financial pressures faced by governments, the twin-track approach remains an effective way to address growing levels of hunger in the world. Investments in the agriculture sector, especially for public goods, will be critical if hunger is to be eradicated. For more information, visit http://www.fao.org/.

State of the world's forests 2009

The 2009 edition of this biennial publication looks forward, with the theme "Society, forests and forestry: adapting for the future." Part 1 summarizes the outlook for forests and forestry in each region, based on FAO's periodic regional forest-sector outlook studies. Past trends and projected demographic, economic, institutional and technological changes are examined to outline the scenario for 2030. Part 2 considers how forestry will have to adapt to the future, focusing on the global outlook for wood products demand; mechanisms to meet the demand for environmental services of forests; changes in forest-sector institutions; and developments in science and technology. For more information, visit http://www.fao.org/.

The environmental food crisis: the environment's role in averting future food crises

This report provides the first summary of the United Nations on how climate change, water stress, invasive pests, and land degradation may impact world food prices and life on the planet. It also discusses how increasing population may be fed in a more sustainable manner. For more information, visit http://www.fao.org/.

Towards sustainable production and use of resources: assessing biofuels

This report was produced by the Working Group on biofuels of the International Panel for Sustainable Resource Management. It provides an overview of the key problems and perspectives toward sustainable production and use of biofuels. It is based on an extensive literature study, taking into account recent major reviews. The focus is on so-called first generation biofuels while considering further lines of development. For more information, visit http://www.earthprint.com/. ■

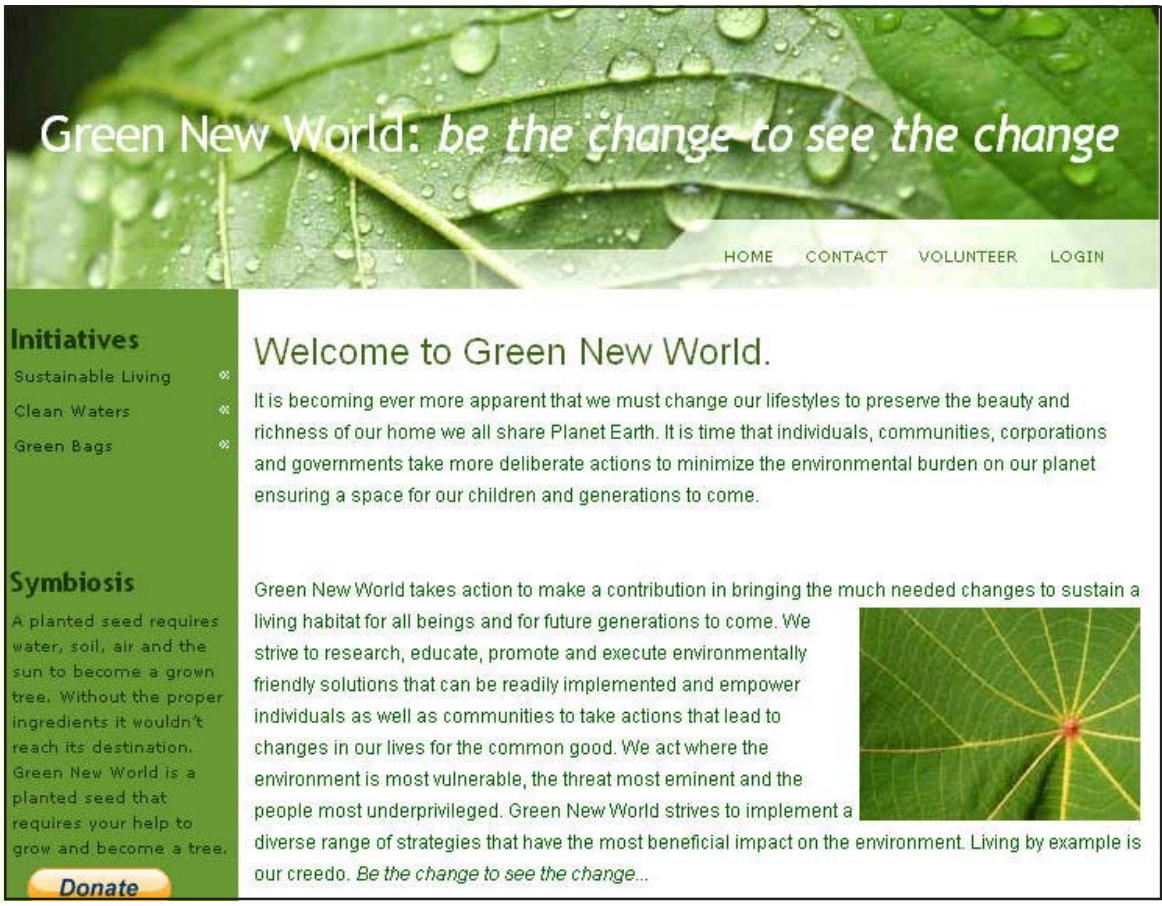
Useful websites

Global Ecovillage Network
http://gen.ecovillage.org/

Ecovillages are urban or rural communities of people, who strive to integrate a supportive social environment with a low-impact way of life. The Global Ecovillage Network is a global confederation of people and communities that meet and share their ideas, exchange technologies, develop cultural and educational exchanges, directories and newsletters, and are dedicated to restoring the land and living sustainably.

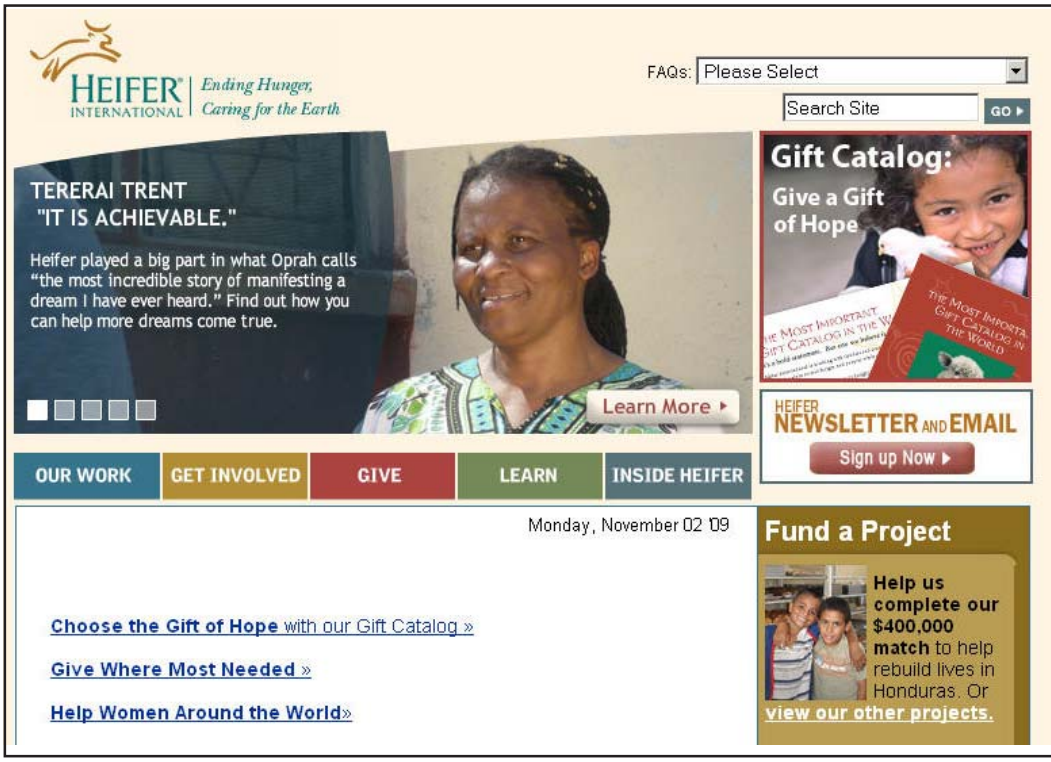
Greenworld
http://
www.greennewworld.org/

Green New World undertakes research, education, and implementation of environmentally friendly solutions that empower individuals and communities to take actions that lead to changes in their lives. Some of their projects include the establishment of a research and education center, and awareness raising and advocacy campaigns on sustainable technologies, biodegradable soaps and detergents, organic fertilizers, and use of biodegradable plastics.



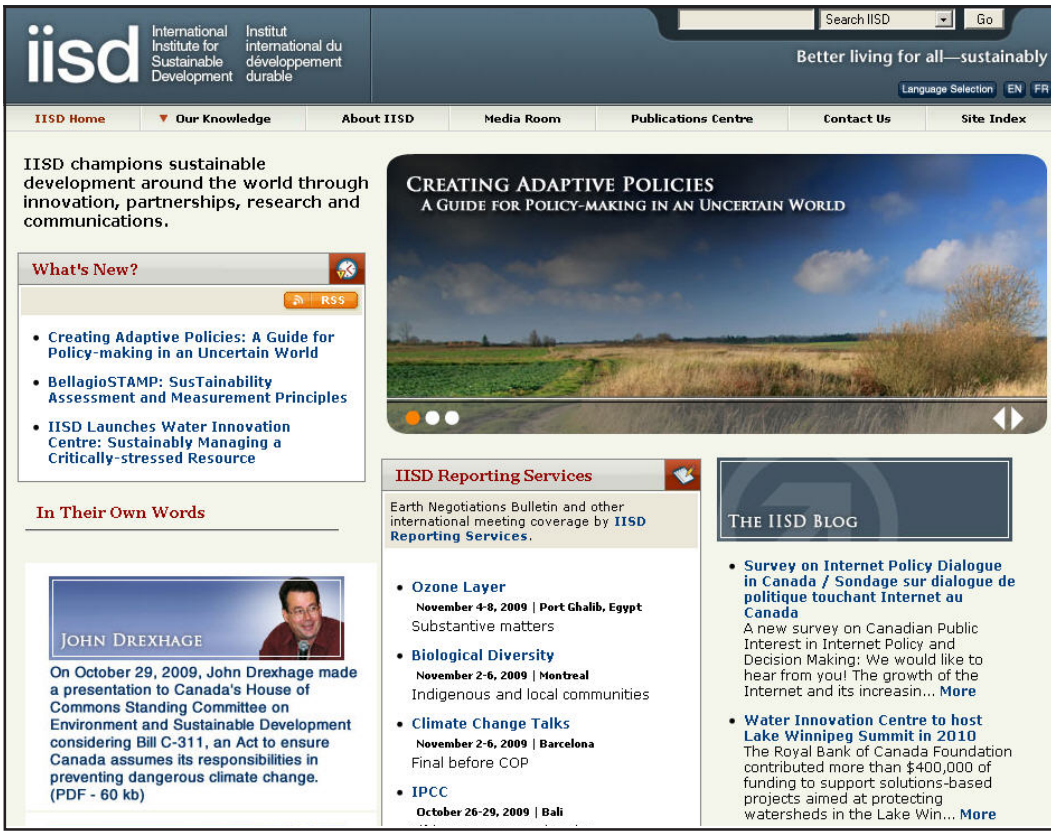
Heifer International
http://www.heifer.org/

Heifer International's mission is to help end world hunger and poverty while caring for the earth. Its projects include agroecology, animal management, disaster rehabilitation, gender equity, HIV-AIDS, and microenterprise.



International Institute for Sustainable Development
http://www.iisd.org/

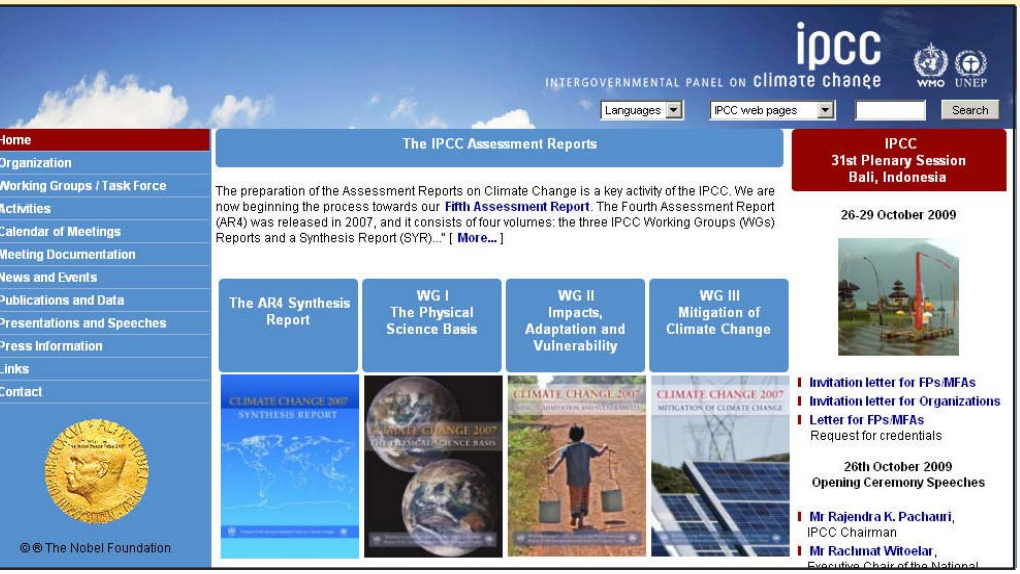
IISD is a policy research institute dedicated to promoting change towards sustainable development by engaging decision-makers in government, business, NGOs and other sectors in developing and implementing policies that are simultaneously beneficial to the global economy, the global environment,
and to social well-being.



Useful websites...

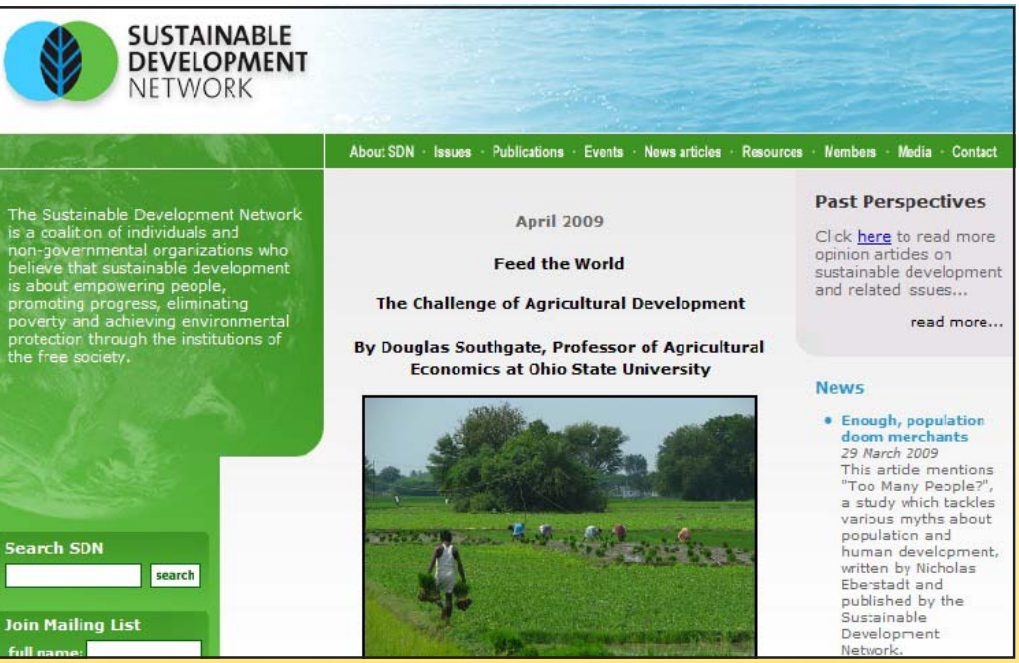
Intergovernmental Panel for Climate Change
http://www.ipcc.ch/

The Intergovernmental Panel on Climate Change (IPCC) assesses scientific, technical and socioeconomic information relevant to the understanding of climate change, its potential impacts and options for adaptation and mitigation.
The reports by the three IPCC Working Groups provide a comprehensive and up-to-date assessment of the current state of knowledge on climate change.
The Synthesis Report integrates the information around six topic areas.



Sustainable Development Network
http://www.kabissa.org/civiorg/285

Sustainable Development Network Limited (SDN) is a UK-based nongovernmental organization that promotes sustainable development at the grassroots level in third world countries. Their programs address sustainable development issues, including ethics, environmental education, waste management, sustainable agricultural development, sustainable use of natural resources, and socially responsible entrepreneurship.



Call for contributions

We are inviting contributions for the 36th and 37th issues of the Asia-Pacific Agroforestry Newsletter (APANews) on or before 31 January and 31 May 2010, 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;
- livelihood;
- farmers' income;
- mining area rehabilitation;
- climate change;
- biodiversity conservation;
- desertification; and
- other key development issues.

Announcements on new information materials, online resources, and useful websites are also welcome.

Interested contributors must adopt the simple, straightforward and popular style in writing the articles instead of that used in journals. This way, your articles can help farmers, development agents, researchers, and practitioners in coping with the challenges of promoting and developing agroforestry in their respective countries.

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, apanews0718@gmail.com, agro_cfnr@yahoo.com. •