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Dear Readers

The 37th issue of APANews features interesting articles on different crop combinations that can be done in agroforestry systems.

One article from India discusses how *Pongamia pinnata* may be integrated in agroforestry farms as an alternative source of bioenergy. Read more about how this tree can be grown and propagated and what other products, aside from oil, can be produced to provide added income to agroforestry farmers.

Another article discusses the production of bamboo shoots in agroforestry farms. Bamboo shoots are considered delicacies in many indigenous communities in India and other Asian countries. They are consumed either as vegetables, curries or pickles. Find out the performance of *Dendrocalamus asper* when intercropped with potato (*Solanum tuberosum*), tomato (*Lycopersicon esculentum*), pea (*Pisum sativum*) and ginger (*Zingiber officinalis*).

Poplar (*Populus deltoides*) is being grown for ply board and also used as fuelwood. One article explores the economic viability of integrating flower seed production in a poplar-based agroforestry system in India. Read more about the results of a study on the performance of 12 flower crops integrated in poplar-based agroforestry systems.

This issue also features initiatives of some state colleges and universities in northern Philippines. The Kalinga-Apayao State College (KASC) presents the results of their Technology Commercialization Program which primarily aims to help farmers implement sustainable farming practices. The authors discuss how the program established a model agroforestry farm showcasing soil and water conservation measures, soil amelioration technologies and intercropping. Find out how farmers were able to learn about agroforestry and other sustainable farming practices through this model farm.

Further, six state colleges and universities collaborated to implement a research, development and extension program in the Cordillera region, northern Philippines. The consortium is implementing more than 700 research and development projects to help resolve forest degradation, soil erosion, flashfloods, siltation of rivers and biodiversity loss in the region. Read more about the consortium's initiatives in developing integrated agroforestry systems; promoting organic vegetable, legume and root crop production; improving the region's weaving and textile industry; enhancing shellfish production; and conserving the famous Banaue Rice Terraces.

We also feature an article that has been written in celebration of 2011 as the United Nations International Year of Forests. Read more about the connection of agroforestry and forests in this feature from the World Agroforestry Centre.

As always, we continue to present useful websites, information resources and relevant events to assist you in your various initiatives in agroforestry. Aside from the official launch of the International Year of Forestsy in February 2011, upcoming events to look out for include an international symposium on short rotation forestry, the launch of the International Day for Biological Diversity, Earth Day and World Environment Day.

Thank you once again to all the contributors. Let us continue sharing information and knowledge to further initiatives in agroforestry research, agroforestry promotion and development, and agroforestry education! —*The Editors*

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COVER. A consoritum of state universities and colleges in northern Philippines implements initiatives to identiy and propagate fiber and dye-yielding species and organize textile weaving stations to help improve the textine industry in the Cordillera Administrative Region (*See story on page 10*).

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Integrating *Pongamia pinnata* in agroforestry as a potential source of biodiesel

K. T. Parthiban (ktparthi2001@yahoo.com), P. Kumar (kumarforestry@gmail.com), V. Subbulakshmi, P. V. and S.Vennila.

Energy is a critical input for the socioeconomic development of India. The country's energy strategy aims at efficiency and security, and to provide access to an environment-friendly and optimum mix of primary energy resources.

In India, energy is a critical factor for poverty alleviation and improvement in the quality of life of the rural people. The demand for diesel energy across the country is increasing, particularly in the transport sector. The transport and industrial sectors consume millions of tonnes of diesel energy every year. This results in depletion of fossil fuel resources and increased pollution.

The situation necessitates the search for alternate and renewable energy resources which are both productive and environment-friendly. The forests in India house more than a hundred different species of potential biofuel sources. Biofuel is an eco-friendly and alternative diesel fuel prepared from domestic renewable resources—i.e., vegetable oils (edible or non-edible oil) and animal fats. India has hundreds of species which could yield oilseeds for biodiesel production. Tree-borne oilseeds in particular could be rich sources of biofuel, especially if cultivated in marginal lands and/or wastelands.

The potential species identified for biofuel production include: *Jatropha curcas, Pongamia pinnata, Madhuca latifolia, Garcinia indica, Azadirachta indica, Calophyllum inophyllum, Simarouba glauca*, etc. Besides Jatropha, *Pongamia pinnata* or Pongamia tree is another potential source of biodiesel.

Behavior and biophysical characteristics

Pongamia pinnata (L.) Pierre., is a medium-sized tree of about 18 m high with a trunk diameter of more than 50 cm and a dense hemispherical crown of dark green leaves. It grows well under a maximum temperature range of 27-38 °C. Mature trees could withstand water logging and slight frost. This species grows well in elevations of 1 200 m, but is not found in the Himalayan foothills or at elevations above 600 m (GOI 1983).

Pongamia can grow on most soil types ranging from stony to sandy to clayey, including verticals. It does not do well on dry sands. It is highly tolerant of salinity and thus is common along waterways or seashores, with its roots in fresh or salt water. It is native to humid and subtropical environments along the coasts and riverbanks of India, especially in Western Ghats and Myanmar. It thrives well in areas with an annual rainfall of 500-2 500 mm. This tree is widely grown in Tamil Nadu and many parts of India as a shade or ornamental tree. It is also grown along rivers, canal banks, roadsides and bunds in Uttarpradesh, Bihar, Orissa and Madhya Pradesh. It occurs wild in the tidal and beach forests of Sunderbans, along stream banks, as well as in the dunes along the seashores in the Andamans.

Flowering and seed generation

Pongamia trees start flowering after three years. It produces 160 kg of seed pods per tree each year. Seeds yield a thick, yellow, orange to brown (Honge) oil. This type of oil is reported to have been used as fuel for lamps in ancient times. Today, the oil obtained from Pongamia is used as a diesel substitute (Anon 2000). However, the trees exhibited greater variations in terms of seed and oil yield. Seed ranges from 9-90 kg on a kernel basis and oil content varies between 30-40 percent.

Collection and treatment of seeds

The ripe pods of Pongamia are collected from April to June and sun-dried. The seeds are extracted by light hammering or using a knife along the sutures. The dry fruits weigh 460-530 kg, and dry seeds weigh 810-1 410 kg. There are 1 500-1 700 seeds per kilogram.

The germinative capacity of fresh seeds varies between 60-89 percent; hence, seeds need to be carefully stored to retain fertility for at least a year.

Although pre-sowing treatment is not required, cold water treatment for 24 hours may be helpful in

Continued on page 4

Pods with seeds of Pongamia pinnata.

Seeds of Pongamia pinnata.

Integrating *Pongamia pinnata*...

Continued from page 3

maintaining viability. When stored in airtight containers, seeds may be viable for about a year.

Propagation

Pongamia can be reproduced by seeds or root suckers. Seeds require no pre-treatment and germinate within 7 days to 1 month of sowing.

Germination is hypogeal and the radicles develop quickly before the plumules emerge. In the nursery, Pongamia seeds could be planted at a spacing of 7.5 cm x 15 cm. Seedlings attain a height of 25-30 cm in their first season. Transplanting the seedlings into the field should be done at the onset of the next rainy season when seedlings are about 60 cm high. Seedlings have large root systems and the soil should be retained around the roots during transplanting. Plantations of Pongamia could be easily established by direct seeding or transplanting nursery-raised seedlings or stump cuttings with a 1-2 cm root-collar diameter.

Clonal propagation

The use of clonal propagation in Pongamia is becoming popular in tree improvement programs (Surendran *et al.* 2000). Propagation by branch cuttings and root suckers is also possible. Vegetative propagation of *Pongamia pinnata* could be done successfully through cleft grafting, which is cheap and economical. The success rate in using cleft grafts ranged from 92-98 percent. Macro propagation through grafting could be used for mass reproduction of this species (Parthiban *et al.* 2007).

Benefits of Pongamia

Pongamia generates a higher yield and better quality oil compared to other bio-energy crops. It is not edible and thus has no direct competition with food crops. Pongamia could also be grown in degraded and marginal lands. As a legume, Pongamia has soil nitrogen-fixing properties, thereby minimizing the need for additional fertilizers.

Table 1. Variation in germination percentage of various seed sources – Mettupalayam.

Sl. No.	Seed source	100 seed weight	Germination percentage	Kernel oil content (%)
1	TNMP 1	58.64	37.33	31.5
2	TNMP 2	62.11	26.67	33.5
3	TNMP 3	69.22	90.67	32.5
4	TNMP 4	52.12	26.67	34.5
5	TNMP 5	55.36	32.00	30.5
6	TNMP 6	48.21	53.33	32.5
7	TNMP 9	57.36	26.00	30.5
8	TNMP 10	60.12	58.33	33.5
9	TNMP 12	58.24	50.00	26.5
10	TNMP 13	64.25	33.67	29.0
11	TNMP 14	67.14	48.00	27.5
12	TNMP 15	55.25	47.33	28.0
13	TNMP 17	51.24	32.00	31.0
14	TNMP 18	34.21	5.00	26.5
15	TNMP 20	35.26	48.00	30.0
16	TNMP 21	37.21	40.67	34.5
17	TNMP 22	40.25	13.67	31.0
18	TNMP 23	45.15	35.67	32.0
19	TNMP 24	42.12	15.33	2635
20	TNMP 25	43.52	25.33	28.0
21	TNMP 26	49.21	55.67	31.0
22	TNMP 27	63.68	90.67	27.5
23	TNMP 28	54.12	18.33	36.0
24	TNMP 29	55.21	10.33	27.5
25	TNMP 30	76.32	6.00	30.0
26	TNMP 32	70.12	40.67	29.0
27	TNMP 33	64.21	21.33	28.0
28	TNMP 41	51.21	51.00	31.5

Wood. With a calorific value of 4 600 kcal per kg, Pongamia is commonly used as fuelwood. It could not be used as quality timber because of its coarse texture, susceptibility to insect attacks, and tendency to break when sawn. Pongamia wood, however, is still used to construct cabinets, cart wheels, posts (NAS 1980), agricultural implements, tool handles and combs (GOI 1983) in India.

Oil. Oil yields of 25 percent could be extracted from Pongamia seeds using a mechanical expeller (ICFRE undated). Aside from being used as fuel for cooking and lamps, Pongamia oil is used as a lubricant, water-paint binder, pesticide, and material for soap making and tanning. The oil is used to treat rheumatism and skin diseases. It is found effective in enhancing skin pigmentation affected by leucoderma or scabies (ICFRE undated).

After extracting the oil, the Pongamia seeds could be effectively used as green manure because of its high protein and nitrogen content. Oil-deficient seeds are also

fed to the livestock as a short-term substitute for protein sources.

Fodder and feed. Troup (GOI 1983) reports that leaves are eaten by cattle and readily consumed by goats. However, the leaves are not used as fodder in many areas of India. According to Singh (1982) the leaves contain 43 percent dry matter, 18 percent crude protein, 62 percent neutral detergent fiber, 40 percent acid detergent fiber, and has an *in vitro* dry matter digestibility of 50 percent.

Other uses. Aside from being an effective green manure, the dried leaves of Pongamia could also be used as an insect repellent in stored grains and combined with the soil to repel nematodes. The bark fiber is used to make strings and ropes.

In addition to being an effective shade or ornamental tree, Pongamia is also a preferred tree species to control soil erosion and bind sand dunes because of its dense network of lateral roots. Its root, bark, leaf, sap, and flowers are used as medicines. •

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The authors can be contacted at the Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam, India-641 301.

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Seedlings of Pongamia pinnata.

Grafted seedlings of Pongamia pinnata.

Exploring the feasibility of bamboo and vegetable intercropping in Jharkhand, India

Animesh Sinha (anim_sinha@yahoo.co.in)

Bamboo shoots as food have not been explored in areas other than the northeastern parts of India. Young, succulent and fermented bamboo shoots are considered delicacies and consumed either as vegetables or curries and pickles. The indigenous communities of Jharkhand harvest bamboo shoots from nearby forests for food.

Fifteen years ago, *Dendrocalamus asper* (Schultes f.) Becker was introduced in India. The Indian Council of Forestry Research and Education, Dehradun, introduced this plant in Jharkhand six years ago through tissue culture (Sinha 2003, Sinha and Nath 2007). As a result, Jharkhand played a leading role in vegetable production in India. Vegetables produced in Jharkhand registered higher productivity than the national average despite poor irrigation facilities and inadequate infrastructure. Cultivating vegetables under this species of bamboo was thus explored.

A plantation of *D. asper* plantlets, raised through tissue culture, was intercropped with potato (*Solanum tuberosum*), tomato (*Lycopersicon esculentum*) and pea (*Pisum sativum*) during the rabi season of 2007 and with ginger (*Zingiber officinalis*) during the kharif season of 2008. The five-year-old plantation of *D. asper* was spaced at 5 m x 5 m. The crops were replicated thrice in a randomized block design. In the rabi season, the vegetables were grown in plot areas of 4 m x 4 m whereas the plots for ginger were 15 m x 3.5 m. The monoculture of bamboo and vegetables was also carried out to compare the yield data.

In general, the yield of all crops, with the exception of pea, decreased when cultivated in a bamboo plantation as compared to the data from the monoculture plantation (Figure 1). The results may be due to increased competition for growth resources like sunlight, moisture and nutrients in bamboo plots compared to those

Continued on page 6

Exploring the feasibility...

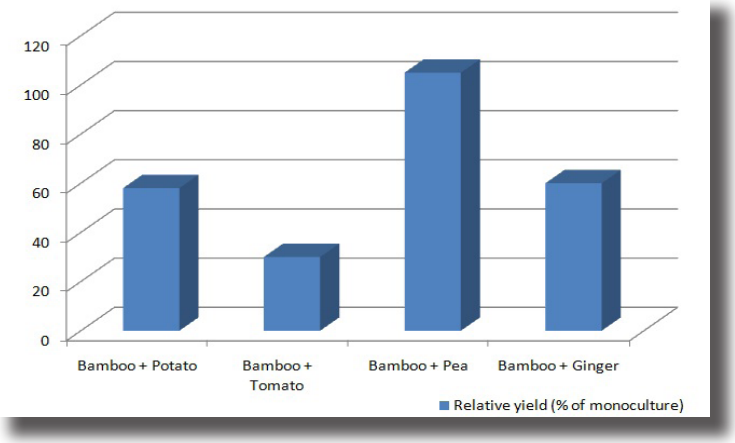
Continued from page 5

without bamboo plots. The yield of pea increased under the bamboo plantation. Further research is needed to explore whether *D. asper* generates an allelopathic effect with the other crops which results in reduced yield.

Among the four vegetables studied, the performances of pea and ginger were found satisfactory. It was also observed that the growth of bamboo intercropped with vegetables was better than the monoculture of bamboo.

On the average, an additional three culms per clump emerged from intercropping of bamboo and vegetables. This would increase productivity of the plantation or farm and provide additional income to farmers. Shanmughavel and Peddappaiah (2000) recommended the intercropping of soybean and turmeric in the initial stages of bamboo plantations. Meanwhile, Vishwanath *et al*. (2007) assessed that bamboo intercropped with ginger was financially more viable than the monoculture of bamboo or ginger. •

Fig. 1 Relative yield (% of monoculture) of vegetables under Dendrocalamus asper plantation



The author is a Scientist at the Institute of Forest Productivity, Lalgutwa, Ranchi- 835303, Jharkhand, India.

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Assessing the economic viability of flower seed production under poplar trees

Sanjeev K Chauhan (chauhanpau@rediffmail.com; chauhansk@dr.com), Sangeeta Rani and Ramesh Kumar

Trees provide various goods and services to meet the needs of people and take care of the environment. Farmers have been integrating the planting of trees in their farming systems for centuries. They adapt the farming systems to local conditions, thereby making them more sustainable.

Today, planting of trees in farms is based on research and science. Although modern ways of integrating trees in farms are successful in the short-term, the sustainability of such systems has yet to be proven in the long-term.

In India, the increasing population has encouraged farmers to combine trees and crops to address the demand for food and other vital resources. Many farmers plant indigenous and exotic fast-growing, multipurpose trees to increase productivity per unit area, improve profitability and maintain sustainability. Growing of crops under trees has been widely promoted to diversify the traditional crop rotation system and increase income. Farmers eventually realize that trees enhance carbon storage. Through spatial experimentation, farmers discovered that increased diversification also means more income. This was particularly demonstrated in poplar-based (*Populus deltoides*) agroforestry systems.

Poplar-based agroforestry systems

A surge of support for poplar-based agroforestry, in terms of infrastructure development and financing, led to an increased demand for poplar plywood or ply board, and fuelwood. *Populus deltoides* is one of the fast-growing

exotic tree species in northwestern India. Poplar is deciduous and can be effectively integrated with shade-loving or winter crops. By the time poplar trees develop foliage, usually from February to March, the understorey crops enter their reproductive phase.

Although the low prices of poplar wood in 2002-2005 forced farmers to look for alternative options, continued demand eventually improved prices. This encouraged farmers to expand their poplar-based agroforestry systems and even venture into commercial intercropping.

Several studies have been done to assess the productivity of different crops grown under poplar trees—wheat, sugarcane, mustard, turmeric, berseem, etc. However, there is lack of information on the growing of flowers under poplar trees for seed production, especially during winter.

Flower production in poplar-based agroforestry systems

Climatic conditions in the state of Punjab are highly suitable for flower production. The climate in this state is similar to most European countries which favors the growth of *Gaillardia pulchella*, *Dianthus barbatus*, *Calendula officinalis*, *Gamolepsis elegans*, *Phlox drumondii*, *Vervena hybrida*, *Coreopsis lanceolata*, *C. tinctoria*, *Chrysanthemum multicaul*, *Petunia hybrida*, *Dimorphotheca aurantica*, *Helichrysum bracteatum*, etc.

Studies on 12 flower crops revealed that seed production could be more profitable than food crops. The benefit-cost ratio of cultivating flower crops for seed production was high—5.32, 4.98, 4.04 and 3.36 for *Petunia hybrida*, *Gaillardia pulchella*, *Coreopsis tinctoria* and *Verbena hybrida*, respectively. This was compared to the benefit-cost ratio of growing wheat under poplar (0.64) and the monoculture of wheat (0.64). However, great care must be taken in choosing the flower species. Aside from the three species mentioned, *Phlox drumondii*, *Coreopsis lanceolata*, *C. tinctoria*, and *Gaillardia pulchella*. were also found profitable.

Farmers in Punjab have already ventured into cultivating flowers for seed production in their poplar-based agroforestry systems. Farmers gain income both from seed production and harvesting 5-6-year-old poplar trees. Poplar-based agroforestry systems in Punjab gain an average productivity of 35-40 t/ha/year of poplar wood—3-4 times higher than the production of poplar wood in many European countries with a rotation period of more than 15 years. •

Authors can be contacted at the Department of Forestry and Natural Resources, and Department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana - 141 004.

Flower cultivation for seed production under poplar.

Integration of poplar-citrus-flower species.

Agroforestry technologies improve land productivity in Kalinga, Philippines

Perfelia R. Buen (fe_buen65@yahoo.com)
and Ernesto C. Miguel (ernestomiguel110@yahoo.com)

In 2006, Kalinga-Apayao State College (KASC) received a grant from the Commission on Higher Education to implement the Technology Commercialization Program. The program aimed to: 1) help farmers implement sustainable farming practices; 2) generate additional information on soil, climate, crops and inputs; 3) characterize the natural resource base; 4) identify biological, physical and socioeconomic constraints to production; 5) enhance integrated and cost-effective soil, water and nutrient management practices; 6) pilot-test available cropping systems; and 7) disseminate agroforestry technologies that focus on the management of soil and water in seasonably dry areas to improve and sustain productivity.

Three barangays were chosen for the study: Barangay Magaogao in Pinukpuk, Barangay Macutay in Rizal and Barangay Baccong in Tanudan. Selection was based on economic profile and existing farming practices. Around 201 farmers were interviewed as key informants and field observations were done through community immersion to determine the historical background of existing cropping systems, production constraints, socioeconomic conditions, and farm issues and concerns.

Profile of the research sites

Barangay Magaogao. Eighty percent of the residents of Barangay Magaogao, Pinukpuk belonged to the Kalinga-Gamonnang tribe, while the remaining population was comprised of migrants – Ilocanos, Itawes and Igorot. The majority of the farmers (70%) practiced patch farming while the rest were into rice and corn production utilizing small and non-irrigated plains of around 42 ha. Farmers did not use hybrid varieties of rice but they used hybrid varieties of corn. Interviews revealed that farmers could not sustain the required inputs for the hybrid varieties.

The mean yield for rice was 45 cavans per hectare. This was quite low as compared to the harvest in Barangay Tabuk which was 120 cavans per hectare.

Barangay Macutay. The majority (70%) of residents in Barangay Macutay, Rizal comprised migrants from Ilocos province while the rest were migrants from the central and southern Luzon provinces (Tagalog, Itawes, Igorot and Kalinga).

The soil characteristics were sandy loam and sandy and stony in some areas. Farmers utilized small valleys for rice production and small patches in the hilly grasslands for production of corn and cash crops. Farmers used hybrid varieties of rice (60%) and corn (90%). With the use of chemical inputs, farmers obtained a mean yield of 70 cavans per hectare.

The majority (60%) of the farmers extracted underground water to irrigate the rice fields.

Barangay Baccong. The Pangol tribe settled in Barangay Baccong, Tabnudan, which is located at a higher elevation than the other two barangays. Farming practices were traditional resulting in an average yield of 80 cavans per hectare. Rice farmers used less chemical fertilizers. Water was sourced from the Amburayan River and tapped through communal irrigation. The soil condition was found to be healthy, which farmers believed contributed to the relatively higher yield of rice. The area for rice production, however, was too small for the population, at only 0.4 ha. Corn production in Barangay Baccong, meanwhile, was found to be higher than in the two barangays. However, the use of chemicals was found to be excessive. Patch farming of rice and vegetables was also being practiced in the area.

Development of an agroforestry model farm

An agroforestry model farm was established by KASC to demonstrate the use of agricultural wastes for soil improvement and different strategies for water conservation. It was also used to support the Technology Commercialization Program and the college's research, training and extension initiatives.

The model farm utilized 5 000 sq m. Soil amelioration was done by integrating rice hull into the soil, which was then fallowed for a month to allow for partial decomposition. Leguminous weeds were then grown. The soil was further enriched with chicken dung, hog manure and mulch using rice straw.

The area was planted with beans (*Vigna sesquipedalis*), okra (*Hibiscus esculentus*), yam, pechay (*Brassica napus*), squash (*Cucurbita maxima*), cucumber (*Cucumis ativus*), (in vitro) banana and corn. The effect of mulch on planting distances and intercropping was studied on beans, okra and yam. Preventive weed management was applied to corn. Pechay was integrated with cucumber and yam. Zero tillage, meanwhile, was applied to squash planted between mango and banana.

The farm also showcased the integration of in vitro banana culture. Banana plantations in Kalinga province suffered from the bunchy top virus. Farmers were thus hesitant to venture into banana farming. Through KASC's agroforestry model farm, the farmers were shown the feasibility of integrating banana tissue culture in a 250 sq. m. experimental area. Around 100 in vitro banana plants, raised in a nursery for a month, were given to farmer cooperators who were interested to venture into banana farming in their agroforestry farms.

Transferring agroforestry technologies to the farmers

Barangay Magaogao. Preventive weed management was shared with the farmers in Barangay Magaogao. Land preparation and planting of corn were done in April prior to the onset of rainfall. Corn growth and the presence/absence of weeds were monitored. Differences in plant growth were evident 20 days after planting.

The farmers harvested their corn after 110 days, the same time as that of the agroforestry model farm. The crops' green leaves were still prominent at the time of the harvest. This demonstrated that proper timing of harvest is necessary to reduce losses due to adverse weather conditions. It also prevents the development of ear fungi and insect and rat damages. Farmers did not use a dryer but instead dried the harvests under the sun on pavements. The farmers were also taught to time their drying to obtain the correct moisture content.

Table 2 compares the corn yield of 20 farmers as a result of conventional farming practices and preventive weed management. Yield was obtained from October to January, for the first, second, third and fifth cropping seasons, and May to August for the second and fourth cropping seasons. Data indicates that the harvest improved during the May-August cropping seasons.

Table 1. Soil analysis before and after soil amelioration.

Laboratory analysis	Before soil amelioration	After soil amelioration
pH	5.5	5.1
Organic matter/Nitrogen (%)	0.51	2
Phosphorus (ppm)	36	300
Potassium (ppm)	42	100

Table 2. Comparison of yields resulting from traditional farming practices and preventive weed management.

Cropping seasons	Harvest using preventive weed management (cavans/ha)	Adjacent farm (cavans/ha)	Harvest using traditional farming practices (cavans/ha)	Harvest in model farm (cavans/ha)
1st (October-February)	43.4		45	
2nd (May-August)	54.6		47	
3rd (October-February)	67.4		62	
4th (May-August)	69.6		58	
5th (October-February)	58.4		56	
Cropping 1		42		129.16
Cropping 2		92		121
Average	58.68		53.6	125.08

However, the price of corn was notably higher during the October-January cropping seasons.

Preventive weed management reduced yield loss by 23.96 percent as compared to the previous 54.57 percent. Around 49 farmers practiced preventive weed management in the third cropping season from the initial 20 farmers.

Barangay Macutay. The process of soil amelioration, meanwhile, was shared with the farmers in Barangay Macutay. Mr. Johnny Carrillo was chosen as the farmer cooperator of the program. His area was identified as a model farm in the barangay to showcase soil amelioration and other agroforestry technologies that were applied in the KASC model farm. He planted mungbean until it reached the flowering stage.

Afterwards, the soil was plowed integrating the mungbean into the soil as green manure. He also added rice straw, gathered from nearby farms, to further enrich soil fertility. Leftovers of legumes were placed at the base of mango trees as mulch.

Formerly an idle and unproductive land, Mr. Carillo's farm is now a productive integrated agroforestry system which served as springboard to achieve the objectives of the Technology Commercialization Program.

Barangay Baccong. In Barangay Baccong, the land area for agricultural activities is limited because of its mountainous landscape. Before the project was implemented, the farmers were into

Continued on page 10

Agroforestry technologies improve...

Continued from page 9

corn farming. To maximize the land area for production, the farmers intercropped corn and beans. The beans served as short-term crop while waiting for the corn to be harvested.

Project impacts

Findings revealed that the biophysical characteristics of the three barangays influenced their socioeconomic conditions and production levels. Patch farming was identified as the main cause of denudation, soil erosion, low production and income, low soil fertility, and decreasing water resource.

Through the program, the farmers were taught agroforestry technologies which were cost-effective and focused on soil, water and nutrient management using available resources in the farms. The project also taught the farmers how to establish integrated farming systems and the use of readily available agricultural wastes.

The use of agricultural wastes as fertilizers improved the conditions of the soil. Because of the resulting increased yield, farmers in the adjoining areas reduced their chemical inputs and adopted the use of agricultural wastes and organic fertilizers in their integrated farming systems. High yields that were obtained from the adoption of organic fertilizers generated the interest of other farmers and convinced them to adopt the same method and develop their idle lands into agroforestry farms.

The successful pilot-testing of integrating in vitro banana into the farms, as showcased in the KASC model farm, encouraged its adoption by 59 farmers.

Technology transfer of these agroforestry technologies were supported by information campaigns (e.g., flyers written in local dialects) which also increased the farmers' awareness of the benefits of these technologies.•

Mr. Johnny Carillo, farmer cooperator of the Technology Commercialization Program, integrates rice, mango and beans in his farm in Barangay Macuta, Kalinga, Philippines.

A farmer cooperator in Barangay Tanudan, Kalinga, Philippines integrates mango in his vegetable farm.

The authors can be contacted at Kalinga Apayao State College, Purok 6, Bulanao, Tabuk, Kalinga 3800 Philippines.

Working together to promote agroforestry in rehabilitating the Cordillera region in northern Philippines

A Jose Lucas Demetrio B. Millare (ajolud@yahoo.com)

ASIST has established an organic fertilizer production facility in Lagangilang, Abra (above) while ASC has developed an organic vegetable production project in Apayao province (below).

Once rich in dipterocarp, pine and mossy forests, the Cordillera Administrative Region (CAR) in northern Philippines now suffers from forest degradation, soil erosion, flashfloods, siltation of rivers and biodiversity loss.

In response to the call by the country's Secretary of Agriculture, the region's state universities and colleges led a collaborative research, development and extension program that focused on integrated agroforestry systems; organic vegetable, legume and root crop production; improvement of the weaving and textile industry; promotion of shellfish production; and conservation of the famous Banaue Rice Terraces.

The CARASUC RDE Consortium is comprised of ASIST, ASC, BSU, ISCAF, KASC and MPSPC. Of the 732 research and development projects approved by the Consortium, 269 have already been implemented and 155 are ongoing.

Promoting integrated agroforestry systems

The Consortium of state universities and colleges believed that agroforestry is the best alternative to rehabilitate degraded areas and increase food production in the region. The Consortium embarked on baseline studies and field trials to demonstrate agroforestry's potentials to achieve food security, maintain economic and environmental sustainability and promote technology development and commercialization. The initiatives aimed to generate and transfer economically viable integrated agroforestry systems and technologies to farmers.

Each member of the Consortium established multistorey systems; promoted the propagation of indigenous tree species for agroforestry farms; established plots to demonstrate pomelo propagation, plantation and processing; and established agrosilvipastoral systems. The Consortium also established eco-parks showcasing soil and water conservation measures.

Introduction of organic vegetable, legume and root crop production

CAR contributes 65-80 percent of the country's total vegetable supply (BAS 2002 cited by Ngohayon *et al*. 2009). However, the introduction and misuse of new technologies eliminated natural enemies and beneficial organisms in the farms which weakened the crops' resistance to pests and pathogens. The situation greatly affected agricultural production in CAR (Ngohayon *et al*. 2009).

The Consortium thus introduced organic farming to produce vegetables, legumes and root crops; and produced bio-organic fertilizers, botanic pesticides and bio-control agents as sources of livelihood.

Part of these initiatives was identifying, collecting and planting different varieties of vegetables suited for organic production. The facilities to produce organic fertilizers were also established in each member of the Consortium. However, challenges like high inputs, marketability of products, support technologies, and limited sources of organic inputs still need to be addressed.

Improving shellfish production

There are 13 major watersheds in the region covering about 1.8 million ha (PCARRD 1984). The watersheds provide hydroelectric power, irrigation, and water supply for household and other domestic use. The geographical landscape also allows for the formation of drainage basins. These basins serve as breeding grounds for indigenous mullet (*ludong*) and eel (*igat*) which fetch high prices in the market.

Over the years, however, water resources are becoming scarce due to logging, quarrying and

Continued on page 12

Working together to promote...

Continued from page 11

mining operations. These activities have resulted in increased water pollution, siltation of river beds and destruction of downstream life-support systems. The Consortium launched research and extension initiatives to increase the production of shellfish and protect other aquatic resources.

These include documentation of different indigenous fish and shell species; construction and improvement of appropriate ponds for fish and shell production; establishment of a museum to showcase the different indigenous fish and shell resources; and the preparation of information materials on fish processing.

Improving the region's textile industry

The region is naturally endowed with fiber-rich and natural dye-yielding plants. Indigenous people in CAR are gifted with skills in weaving traditional textiles and costumes from these plants. They are also gifted in body paintings and producing colorful ethnic costumes. However, the near-extinction of these natural dye-yielding plants due to inappropriate gathering practices and lack of efforts to regenerate them affected the textile industry in the region. The Consortium implemented initiatives to identify and propagate fiber and dye-yielding species, extract fibers and mordants, plant fiber and dye-yielding plants, and promote the sericulture industry. It also initiated manufacturing and marketing of ethnic products, and organized weaving stations.

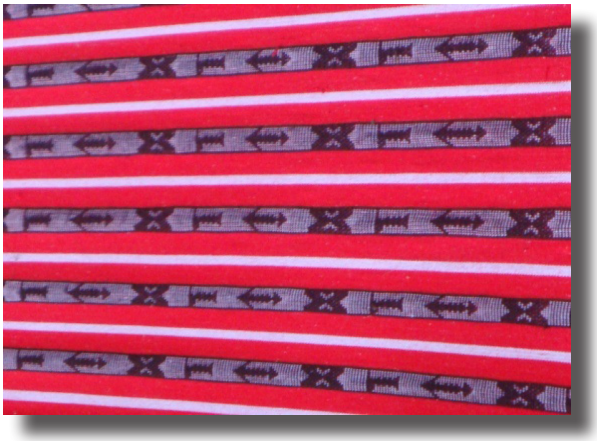
Conservation of the Banaue Rice Terraces

Over the years, the Banaue Rice Terraces in Ifugao have continuously provided food to the province's indigenous communities. However, the dwindling water supply due to deforestation, the

ASIST has established a fish-based eco-park in Lagangilang, Abra (1st) while ASC has its own fish production project in Apayao province (2nd).

An old woman weaves a blanket using colored yarns from dye-yielding plants in Ifugao province.

A sample textile displaying ethnic designs is being produced through the local weaving industry in Ifugao province.



ASIST has developed its Tayum-tayum (Indigofera tinctoria) plantation as a source of natural dye at ASIST, in Lagangilang, Abra.

Different dye-yielding plants produce colored yarns used in textile weaving.

Giant earthworms (Pheritima elongata) threaten to collapse the walls of the famous Banaue Rice Terraces in northern Philippines.

A study reveals that 150 g of chopped and pounded marigold (Tagetes erecta) and 30 g of Melonoides granifera shell lime mixed with 500 ml. of water could kill giant earthworms (Pheritima elongata).

emergence of giant worms that damage the terrace walls and the uncontrolled construction of structures within the rice terraces are posing serious threats to the system's sustainability (Ngohayon *et al*. 2009).

Part of the Consortium's initiatives included watershed rehabilitation and introduction of technologies to address the damage caused by giant worms and other pest infestations. Through the leadership of the ISCAF, control agents against the giant earthworms have been developed. A study by Gonzales and Allig (2007) found that 150 g of chopped and pounded marigold (*Tagetes erecta*) and 30 g of *Melonoides granifera* shell lime mixed with 500 ml of water could kill the giant earthworms. ISCAF is taking the lead in implementing onsite testing of this solution with farmer-collaborators. Native rice varieties suitable for the site were also identified including watershed rehabilitation activities to address the shortage of water supply.

Although a lot has been achieved by the CARASUC RDE Consortium, more work is needed to face the challenges ahead.•

The author is an Associate Professor and Chairman of the Department of Forestry of the Abra State Institute of Sciences and Technology (ASIST), Lagangilang, Abra, Philippines.

References: (1) Gonzales, N. and T. Allig. 2007. Laboratory Evaluation of Melanoides granifera Shell Lime and Marigold (Tagetes erecta) Mixture against Giant Earthworms (Pheretima elongata) Infesting the Ifugao Rice Terraces. Upland Farm Journal. Jan. – Dec. 2007 Issue. ISSN 1655-5287; (2) Ngohayon, S. L. et al., 2009. Restoring the Grandeur of the Cordillera Region: A Challenge to Agroforestry Advocates. Philippine Agroforestry Development Monitor No. 8 Issue, June 2009. ISSN 1908-4757; (3) The Philippines Recommends for Watershed Management. 1984.

IUFRO symposium on short rotation forestry to be held in February 2011

Ever increasing desertification, land degradation, concentration of greenhouse gases (GHG), changing climate, etc. have become subjects of serious global concern. Increasing pressure of swelling human and livestock population, shrinking per capita land, deteriorating natural resources, acute shortage of energy, etc. have altered the livelihood options and sustainability. These problems are being recognized and a number of new forms of forestry have emerged that place greater emphasis on livelihood security, energy, natural resource conservation, environment and sustainable development.

Short rotation forestry (SRF) is the rapid silvicultural practice to reforest areas of barren forest lands/ deforested mountains/salty grounds, etc. It enhances farm income from subsistence farming and also mitigates the adverse influence of global climate change. It maximizes utilization of natural resources using the biological, physical, theoretical and practical knowledge in an ecologically acceptable manner. This practice meets ever-growing wood and energy requirements, generates employment and acts as source of carbon sink. Besides these, SRF also helps in saving the virgin forests' wealth and act as vegetation filter.

Considering the significance and growing interest in short rotation forestry and to celebrate the International Year of Forests, the Department of Forestry and Natural Resources, Punjab Agricultural University, the International Union of Forest Research Organization (IUFRO) and Benwood are organizing an international symposium on "Short rotation forestry: Synergies for wood production and environmental amelioration" on 10-12 February 2011. Presentations will focus on the management and GHG mitigation potential of SRF resources, the ecological implications of invasive species and biodiversity, bio-energy and phyto-remediation, and marketing. The symposium will be held at Punjab Agricultural University in Ludhiana City, India. For more information, visit http://www.iufro.org/events/calendar/. •

2011 – The United Nations International Year of Forests: So what has agroforestry got to do with forests?

Everyone knows what a forest is, but what has agroforestry got to do with forests? In fact, what exactly is agroforestry? Agroforestry means incorporating trees into farms. As forests shrink, trees on farms become all the more important. The International Year of Forests is an opportunity to highlight the global importance of agroforestry and the impact that trees on farms can have on livelihoods and the effects of climate change.

Benefits and potentials of agroforestry

Trees provide farmers with a lot of useful goods, like fruit to eat and sell, feed for their animals and compost for their soils. Over 1 billion ha of agricultural land, almost half of the world's farmland, have more than 10 percent of their area occupied by trees; 160 million ha have more than 50 percent tree cover, which could mean a small forest or an even scattering across the farm. These figures do not include harvesting rubber from trees growing in forests and cultivating cocoa trees in the shade of the forest.

Trees play a crucial role in almost all land-based ecosystems and provide a range of products and services to rural and urban people. As natural vegetation is cleared for agriculture and other types of development, the benefits that trees provide are best sustained by integrating trees into agriculturally productive landscapes — the practice known as agroforestry.

Farmers have practiced agroforestry for generations. Agroforestry focuses on the wide range of working trees grown on farms and in rural landscapes. Among these are fertilizer trees for land regeneration, soil health and food security; fruit trees for nutrition; fodder trees that improve smallholder livestock production; timber and fuelwood trees for shelter and energy; medicinal trees to combat disease; and trees that produce gums, resins or latex products. Many of these trees are multipurpose, providing a range of benefits.

Agroforestry provides many livelihood and environmental benefits, including:

- enriching the asset base of poor households with farm-grown trees;
- enhancing soil fertility and livestock productivity on farms;
- linking poor households to markets for high-value fruits, oils, cash crops and medicines;
- balancing improved productivity with the sustainable management of natural resources; and
- maintaining or enhancing the supply of environmental services in agricultural landscapes, for water, soil health, carbon sequestration and biodiversity.

Over the next two decades, the world's population is expected to grow on average by more than 100 million people a year. More than 95 percent of that increase will occur in developing countries, where pressure on land and water is already intense. A key challenge facing the international community is, therefore, to ensure food security for present and future generations, while protecting the natural resource base on which we all depend. Research on agroforestry, which comprises varied practices integrating crops, livestock and trees, can help communities and households to meet their economic, social, cultural and environmental needs. Trees on farms will be an important part of efforts to meet those challenges, for four reasons.

Trees on farms accumulate carbon

Investments in agroforestry over the next 50 years could remove 50 billion tonnes of additional carbon dioxide from the atmosphere. Most of the deforestation in Africa, and in parts of Asia, is caused by agricultural expansion, largely by smallholder farmers. Agroforestry activities curb emissions of greenhouse gases by slowing the conversion of forest to farm land and holding carbon in the trees on the farms. Developing smallholder agroforestry on land that is not classified as forest could capture 30-40 percent of the emissions related to land-use change. Encouraging farmers to plant trees has the potential to increase farmers' income, sequester more carbon and benefit biodiversity.

Trees on farms are global

Agroforestry is uniquely suited to help grow more food and fuel while conserving the landscape. Agroforestry technologies have traditionally been developed through 'hands-on' experience and transmitted through the generations. Successful agroforestry systems and practices include alley cropping, silvipasture, windbreaks, hedgerow intercropping, parklands, home gardens and relay cropping. Some have been in existence for centuries, evolving in response to needs and constraints both on and off the farm.

Trees on farms feed the hungry

Agroforestry enhances soil fertility and the productivity of animals kept on farms. Planting trees that provide natural fertilizers on farms with poor soils helps farmers restore fertility and increase yields. Gliricidia bushes fix nitrogen in their roots and act as natural green fertilizer factories, tripling yields of maize on farms in Malawi. The prunings are fed to the animals. The bushes also reduce the risk of crop failure during droughts and prevent waterlogging when it rains too much. The nitrogen-fixing tree Faidherbia increased unfertilized maize yield four times in Zambia. The trees are being grown on over 5 million ha of crop land in Niger.

In most countries, trees grown on farms in various agroforestry systems are a source of income and, more importantly, fulfill protective functions as windbreaks and shelterbelts. Establishment of windbreaks is an integral part of farming practices in most countries. Date-palm cultivation in several Western Asian countries has turned deserts into oases. In the United Arab Emirates, extensive date plantations have improved the landscape while generating substantial income. Fruit trees are also a source of wood.

Trees on farms relieve poverty

Farmers can earn considerable sums of money from the trees they cultivate. Domesticating wild fruit trees in Cameroon has allowed smallholder farmers to earn five times as much as they did before. Thousands of farmers in Tanzania are planting Allanblackia trees and earning much-needed income by selling the oil-containing seeds to companies to make margarine. Agroforestry is currently responding to new market opportunities. Planting of trees on farms to supply wood to forest industries has increased significantly in many countries.

Trees grown on homestead farms, in woodlots and on communal lands are an important source of wood and other products. In humid-zone West African countries, such as Burundi, Rwanda and Uganda in particular, trees grown in home gardens meet most household needs for fuelwood and timber. In many cash-crop systems, trees are grown for shade and eventually provide wood – an example is *Grevillea robusta* in tea plantations in Kenya. In the Sudan, *Acacia senegal*, the source of gum arabic, is largely grown in agroforestry systems.

Reprinted from http://www.worldagroforestry.org/campaigns/international_year_of_forests.

International symposium on ecosystem and landscape-level approaches to sustainability slated in March 2011

While the world's ecosystems are under strong and multiple pressures that threaten the critical life-sustaining values that they represent, it is also the case that significant advances have been made around the world in recent years that are positively implicating hundreds of millions of hectares of forests and tens of millions of forest dependent people.

The International Symposium on Ecosystem and Landscape-Level Approaches to Sustainability will be held on 22-24 March 2011 in Burgos, Spain. It aims to: (i) highlight initiatives to advance the understanding and application of ecosystem and landscape-level approaches to sustainable land use and management; (ii) create a forum to better understand the value and prospects of ecosystem and landscape-level approaches to sustainability in terms of potential impacts on policy, practice and decision-making from local to international levels; and (iii) develop a strategic document of recommendations and suggestions to address challenges on sustainable use and management of landscapes and natural resources. For more information, visit http://www.globalforum2011.net/content/seminar. •

Events

February 2011 – Launch of **International Year of Forests** Campaign (For more information, visit http://www.un.org/en/events/iyof2011/)

May 2011 - **The International Day for Biological Diversity: Biodiversity and Forests** (For more information, visit http://www.cbd.int/idb/2011/)

April 2011 – **Earth Day** (For more information, visit http://www.cifor.cgiar.org/events/)

June 2011 - **World Environment Day** (For more information, visit http://www.cifor.cgiar.org/events/)

June 2011 - **Counting on the Environment: The Contribution of Forests to Rural Livelihoods** (For more information, visit http://www.cifor.cgiar.org/events/)

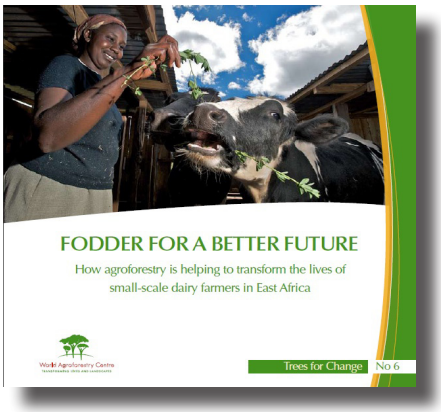
New information resources

Ecosystem Goods and Services from Plantation Forests

The book examines the nontimber goods and services provided by plantation forests, including soil, water and biodiversity conservation, as well as carbon sequestration and the provision of local livelihoods. The authors show that if there is higher provision of ecosystem goods and services from both temperate and tropical plantations, new policies and methods for valuing the services, the practices of small landholders, landscape approaches to optimize delivery of goods and services, and technical issues about how to achieve suitable solutions at the scale of forest stands are required. The book also gives guidance for plantation managers, policy makers, conservation practitioners and community advocates, who seek to promote or strengthen the multiple-use of forest plantations for improved benefits for society. Available: http://www.cifor.cgiar.org/nc/online-library/browse/view-publication/publication/3156.html.

Fodder for a better future: how agroforestry is helping to transform the lives of smallholder dairy farmers in East Africa

Written by C. Pye-Smith, the booklet describes how fodder trees help to improve livestock diets and milk yields and provide a range of other benefits. Their nitrogen-fixing properties increase soil fertility and they also provide firewood for cooking and pollen for honey bees. They can be used to control erosion on steep slopes. It is estimated that a farmer with one cow and 500 fodder trees, which cost less than US$8 to establish, can increase net income by US$60–115 a year. The personal testimonies of smallholder dairy farmers provide insights into the life-changing benefits of using fodder trees. However, large numbers of smallholders have yet to be introduced to this relatively cheap and easy-to-use agroforestry technology. Available: http://www.worldagroforestrycentre.org/our_products/publications.



Relevant publications from FAO

Indigenous Fruit Trees in the Tropics - Domestication, Utilization and Commercialization

This comprehensive review focuses on the biology, ecology and the social impact of indigenous fruit trees on rural plantations. Highlights of the report include new concepts and approaches that have been developed, case studies that have been produced and the potential and feasibility of the domestication and commercialization of indigenous fruit trees. Available: http://www.worldagroforestrycentre.org/our_products/publications.

Towards sustainable production and use of resources: Assessing biofuels

The report 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. In the overall context of enhancing resource productivity, options for more efficient and sustainable production and use of biomass are examined. In particular, "modern biomass use" for energetic purposes, such as biomass used for (co-)generation of heat and power and liquid biofuels for transport, are addressed and related to the use of biomass for food and material purposes. Whereas improving the efficiency of biomass production plays a certain role towards enhancing sustainability, progress will ultimately depend on a more efficient use of biotic (and abiotic) resources (incl. for instance an increased fuel economy of car fleets), although a full consideration of all relevant strategies towards this end (e.g., changing diets high in animal based foods and reducing food losses) is beyond the scope of this report. Available: http://www.unep.fr/scp/rpanel/pdf/assessing_biofuels_full_report.pdf.•

Criteria and indicators for sustainable woodfuels

In many developing countries, woodfuels are still commonly used for household cooking and heating and are also important for local processing industries. In many developed countries, wood-processing industries often use their wood by-products for energy production. In some countries, notably the Nordic countries, forest residues are increasingly used for industrial-scale electricity generation and heating. Several developing countries have enormous potential to produce energy from forests and trees outside forests, for both domestic use and export. However this potential is not properly reflected in national energy-development strategies. This publication sets out principles, criteria and indicators to guide the sustainable use of woodfuel resources and the sustainable production of charcoal. It is designed to help policy- and decision-makers in forestry, energy and environment agencies, non-governmental and other civil-society organizations and the private sector ensure that the woodfuel sector reaches its full potential as an agent of sustainable development.

Impact of the global forest industry on atmospheric greenhouse gases

Written by R. Miner, this publication examines the numerous and complex connections between the global forest products industry and the global carbon cycle to characterize the carbon footprint of the sector. The study considers six types of industry impact: carbon sequestration and storage in forests and forest products; emissions from manufacturing facilities or from electricity producers supplying these facilities; other emissions attributable to product manufacturing; emissions from product transport and use; emissions associated with end-of-life management; and emissions avoided elsewhere in society owing to the forest products industry. Globally, the impact of the industry on carbon in forests cannot be described quantitatively because of the lack of data in many parts of the world and the complexity of the industry's raw material supply chain. Data from some countries, however, suggest that sustainable forest management practices can be effective in keeping forest carbon stocks stable over time. Some of the carbon removed from the forest remains stored in forest products, providing significant benefits.

State of Food Insecurity in the World 2010: Addressing food insecurity in protracted crises

The book follows more than a decade of seemingly inexorable increases in the number of undernourished people. Estimates for 2010 presented in this edition show a slight glimmer of hope, with the first fall since 1995. But that still leaves nearly a billion people hungry, and it is too early to know if this is the beginning of a downward trend or merely a momentary dip in the number of undernourished. This edition focuses on a particular group of countries in protracted crisis where levels of undernourishment are estimated to be at almost 40 percent. The report highlights actions that can be taken to rationalize the way protracted crises are handled. As this edition shows, there are many challenges facing countries in protracted crisis. Through improved understanding of the nature of protracted crisis comes the ability to respond more effectively. Available: http://www.fao.org/publications/sofi/en/. •

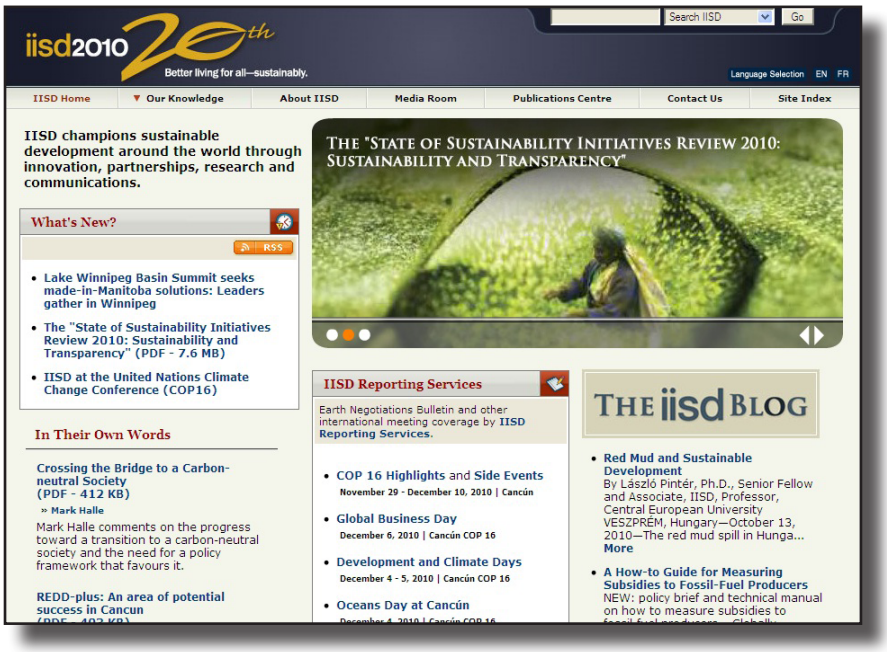
Source: http://www.fao.org/publications/en/

Useful websites

International Institute for Sustainable Development

http://www.iisd.org/

Based in Winnipeg, Manitoba, Canada, IISD specializes in policy research, analysis, information exchange and advocacy. It champions global sustainable development through innovation, research and relationships that span the entire world. It is devoted to the ongoing communication of its findings as it engages decision makers in business, government, nongovernmental organizations and other sectors. It builds long-term strategic alliances, while retaining the institutional agility necessary to confront the challenges of sustainable development.



Winrock International

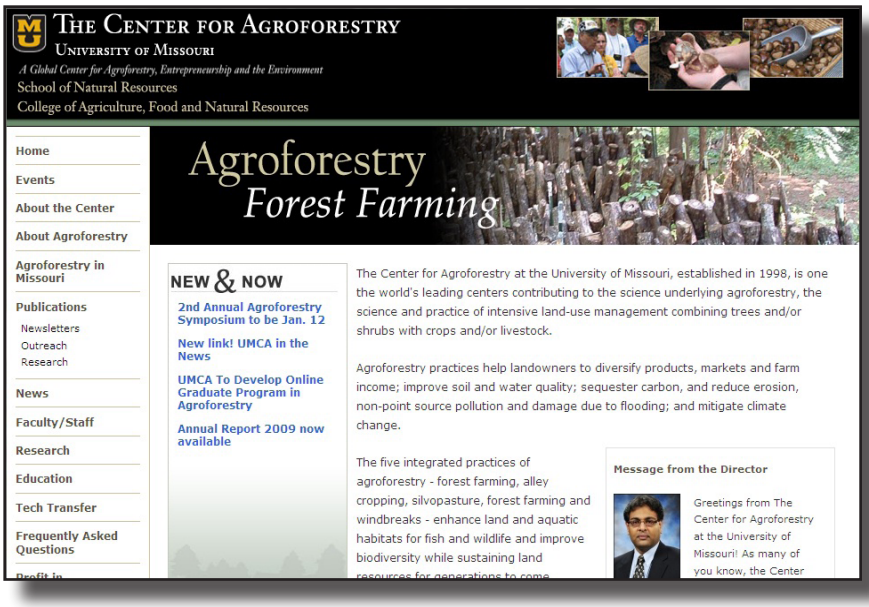
http://www.winrock.org/

Winrock International works with people in the United States and around the world to link local individuals and communities with new ideas and technology. It empowers the disadvantaged, increases economic opportunity, and sustains natural resources. Winrock is increasing long-term productivity, equity, and responsible resource management to benefit the poor and disadvantaged of the world.

Agricultures Network

http://www.leisa.info/

The Agricultures Network produces magazines and other media to build knowledge and exchange information, and stimulates debate and concerted action among key stakeholders. Information resources present success stories from small-scale farmers which can serve as inspiration to others and empower them to improve productivity and generate improved income from their farms.



University of Missouri Center for Agroforestry

http://www.centerforagroforestry.org/

The University of Missouri Center for Agroforestry (UMCA) provides research information on the development of vegetative environmental buffer technologies to reduce nonpoint source pollution and its direct impacts on surface and ground water quality, impacts of commercial agriculture on water and air quality, development of specialty crops for alternative income sources and for bioenergy production. The Center collaborates closely with landowners, natural resource professionals, federal and state agencies and non-profit organizations. •

Call for Contributions

We are inviting contributions for the 38th and 39th issues of the Asia-Pacific Agroforestry Newsletter (APANews) on or before 28 February and 30 June 2011, respectively.

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

Topics of particular interest are on:

- agroforestry and poverty alleviation;
- agroforestry and livelihood;
- agroforestry and farmers' income and livelihood;
- agroforestry enterprises and/or marketing
- agroforestry and mining area rehabilitation;
- agroforestry and climate change;
- agroforestry and biodiversity conservation;
- agroforestry and desertification; and
- other key development issues in agroforestry.

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

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

Send your contributions through E-mail to the UPLB Institute of Agroforestry, 2/F Tamesis Hall, College of Forestry and Natural Resources, UP Los Baños, PO Box 35023, College, 4031 Laguna, Philippines; Fax +63 49 5363809; E-mail fao_apanews@yahoo.com and apanews0718@gmail.com.•

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FAO Regional Office for Asia and the Pacific
39 Phra Atit Road, Bangkok 10200, Thailand
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fao_apanews@yahoo.com and
apanews0718@gmail.com