APANEWS

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Dear Readers

Welcome! The 41st issue of APANews presents interesting articles in agroforestry research and agroforestry promotion and development.

An article from India explores the influence of intercrops on the biomass production of *Albizia lebbeck, Azadirachta indica, Dalbergia sissoo* and *Acacia nilotica* under rainfed and semi-arid conditions. The study compared the growth data of trees (tree height, collar diameter and diameter at breast height or DBH) with and without the intercrops. Biomass production was then measured in terms of bole yield, branches, leaves and root yield. Find out which tree produced the highest total biomass and demonstrated the best growth characteristics with intercrops. Also, find out if cereals or legumes contribute to the high biomass production of trees.

Contributors from Chile explored the effects of base fertilization on the production of female flowers of Stone pine (*Pinus pinea* L.). Stone pine is native to the Mediterranean region and is famous for its pine nuts. The study compared the average number of flowers between fertilized and unfertilized plots, cone production quantity and quality, and extent of fruiting. Read more about the results of the research and other findings on growth characteristics of Stone pine.

An article from Viet Nam introduces the morphology, plant ecology, distribution and propagation techniques of Beach morning glory (*Impomea biloba* Forsk.). Beach morning glory is a vine commonly found along the country's coastal areas. Read more about the medicinal and economic values of Beach morning glory and how it helps protect sand slopes, shorelines and roadsides against soil erosion.

You might also find interesting an article which describes *Bixa orellana* or annatto, a medicinal plant in India that is also tapped for its bixin—a seed-specific pigment used in food coloring and as a natural ingredient of cosmetics. Find out how *Bixa orellana* can be propagated and integrated into an agroforestry farm. The article also provides information on phenology, harvesting, yield and *bixin* content, the importance of pruning, and various uses of annatto seeds.

Meanwhile, agroforestry and climate change are highlighted by a contributor from Kenya. The article presents significant data on the effects of climate change on animal and plant species, mortality and population, and the economy. Read more on the reasons why agroforestry, sustainable forest management and empowerment of local communities are key factors that can help mitigate global climate change.

As always, we have researched interesting events for your networking and agroforestry promotion activities, and websites and information resources that you might find as useful references in the implementation of your agroforestry initiatives.

Let us continue our efforts to establish new and strengthen existing connections, and share knowledge to collectively spearhead innovations in agroforestry. Thank you once again to all the contributors. Let us keep in mind that every knowledge we share contains lessons that we can use to improve our lives.

—The Editors

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PRODUCTION. Patrick B. Durst, Janice Naewboonnien, Roberto G. Visco (Editorial Consultants); Rowena D. Cabahug (Editor); and Perseveranda G. Tubig (Production Assistant)

COVER. A study explored the effects of fertilization on the production of female flowers and cone production and quality of Stone pine (*Pinus pinea* L.) (*see story on page 5*).

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Increasing biomass production of relevant trees under rainfed agroforestry system

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A study was undertaken to determine whether intercrops influence the biomass production of selected tree species under rainfed, semiarid conditions. In 1998, tree saplings of *Albizia lebbeck*, *Azadirachta indica, Dalbergia sissoo* and *Acacia nilotica* were planted in the central research farm of the Indian Grassland and Fodder Research Institute, Jhansi, India, using 6m x 12m spacing. The soil in the experimental site was sandy loam with pH6.54. It was found to be low in organic carbon and available nitrogen and P_2O_5 with medium amounts of K_20.

The treatments comprised four trees planted solely and trees planted with winter crops (i.e., barley and gram (*Cicer arietinum*)). The winter crops were sown under rainfed conditions during 1990 and onwards. There were two additional treatments of sole barley and sole gram. All 14 treatments were laid out in a replicated randomized block design.

Tree growth data

In 2004-2005, during the *kharif* season succeeding the cultivation of winter crops, rainfed leguminous fodder crop was sown as a common treatment in all the plots. The growth of the trees was recorded prior to measuring their biomass production (Table).

On the average, *Dalbergia sissoo* gave the best performance, followed by *Acacia nilotica* and *Albizia lebbeck* in terms of plant height, collar diameter, and diameter at breast height (DBH) with and without crops. *A.indica* exhibited the poorest performance in the first three criteria but was slightly superior to *Albizia* in terms of DBH. There were no variations observed in the growth data of trees with and without cereal and legumes as intercrops. The results were probably due to the deep roots of trees which pose less competition for nutrients for the agricultural crops planted in between them. The growth of trees was observed to be higher when integrated with agricultural crops.

Biomass production

In June 2005, the seven-year-old trees under various treatments were cut to measure their biomass production. In each tree, the bole, branches, leaves, and root biomass were recorded separately. Samples were drawn and oven-dried. Dry biomass yields were then recorded.

Bole. *Dalbergia sissoo* recorded the highest dry bole yield (13.23 t/ha), while the lowest was from *A.indica* (7.93 t/ha) (Figure 1). *Dalbergia sissoo*, which demonstrated better growth characteristics, was definitely superior to the other trees.

On the average, the performance of trees, sown with and without crops, showed different trends with few variations in biomass production. The highest dry bole yield (9.92 t/ha) was exhibited by trees intercropped with legumes (Figure 2). This may probably be due to better management practices when trees are intercropped with legumes as compared to the sole planting of trees.

Branches. On the average, *Acacia nilotica* yielded the maximum dry yield of branches (13.95t/ha) with and without crops (Figure 1). The minimum dry yield was recorded with Albizia (7.04t/ha) sown with and without crops in their inter spaces.

As with the case of bole production, high biomass production from branches was observed in trees intercropped with legumes. The highest dry branch yield (10.01 t/ha) was registered with trees

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Table. Growth data of trees prior to measuring biomass production.

Trees	Tree height (m)	Collar diameter (cm)	DBH (cm)
Albizia lebbeck	8.1	23.3	13
A.indica	7.44	20.8	17.5
Dalbergia sissoo	10.54	26.6	21.8
Acacia nilotica	8.65	24.3	20.7
Trees with and without crops			
Sole trees	8.89	20	
Tree + cereal crop	8.53	22.7	
Tree + legume crop	8.63	22.1	

Increasing biomass production...

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intercropped with cereal (Figure 2). The lowest production of branch yield was recorded with the sole planting of trees.

Leaves. Among the four trees, *Dalbergia* produced the highest yield in dry leaves, followed by *Albizia* and *A.indica*. *Acacia* produced the lowest dry leaf yield (Figure 1). *Dalbergia* recorded 4.91 t/ha of dry leaves. The high performance of *Dalbergia* was primarily due to its superior growth characteristics. On the average, the study results did not show variations in the yield of dry leaves in all treatments (Figure 2).

Roots. Again, *Dalbergia* produced the highest yield (9.76 t/ha) followed by *Acacia* and then *Albizia* with *A. indica* having the lowest yield (Figure 1). Again, the performance of *Dalbergia* may be due to its better growth characteristics compared to the rest of the trees planted with and without crops (Table).

The performance of trees in the production of root biomass was superior when intercropped with legumes (683 t/ha) as compared to the sole planting of trees (6.39 t/ha) or in treatments with cereal as an intercrop (6.68 t/ha) (Figure 2). This may be due to the capability of leguminous crops to enrich soil quality as compared to cereals.

Total biomass production. Interestingly, the highest total biomass yield (Figure 3) was registered with the intercropping of trees and legumes under rainfed conditions. On the average, planting legumes as an intercrop helped the trees yield 29.19 t/ha of total biomass.

Dalbergia planted with and without intercrops produced the highest total biomass, while the lowest was *A.indica*. The results coincided with the growth characteristics of the trees. *Dalbergia* demonstrated the best growth characteristics

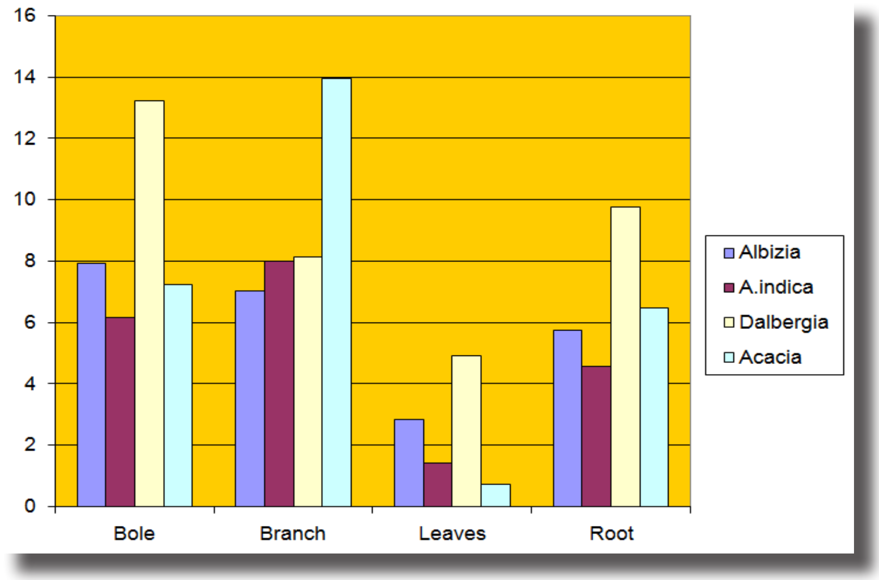

Fig. 1. Dry biomass yield (t/ha) under various tree species.

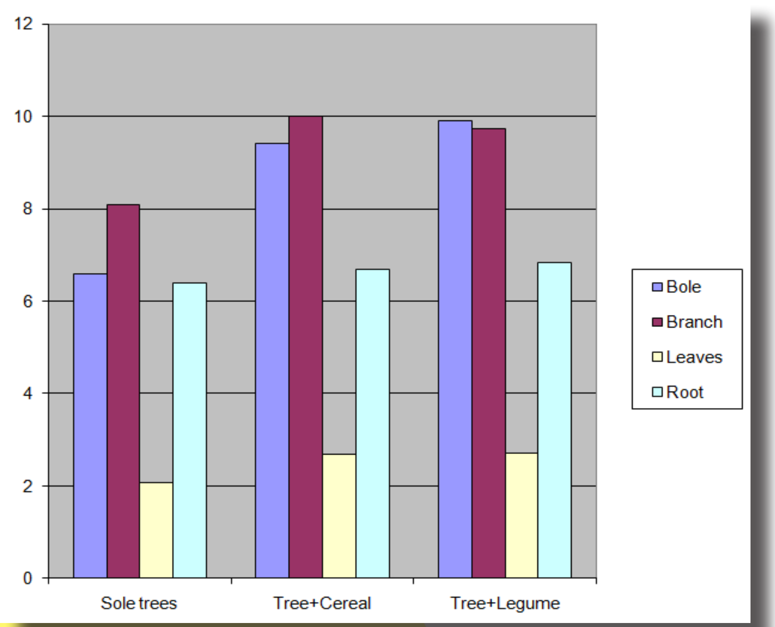

Fig. 2. Dry biomass yield (t/ha) from trees with and without root crops.

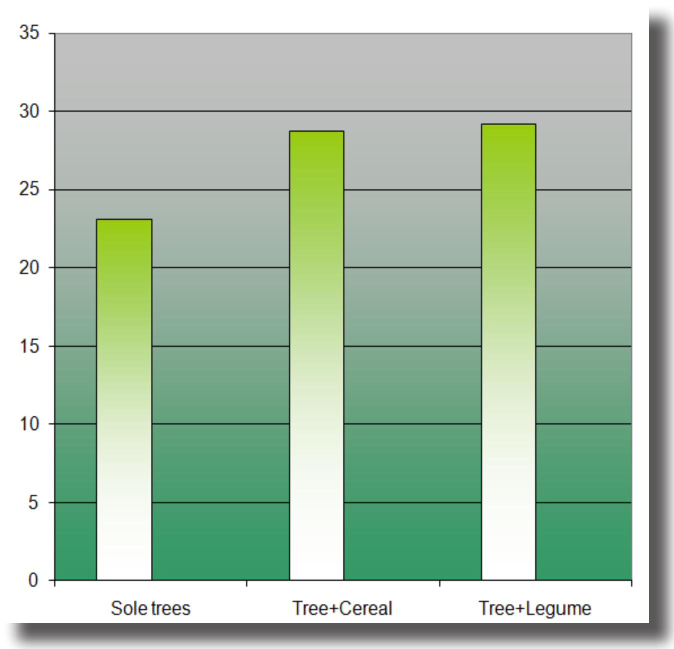

Fig. 3. Total dry biomass yield (t/ha) under trees with and without crops.

followed by *Acacia* and *Albizia*, while the lowest yield was obtained from *A.indica*. Using legumes as intercrops also improved the trees' biomass production as compared to using cereals as intercrops or sole cultivation of trees.•

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Effects of fertilization on the production of female flowers in Stone pine (*Pinus pinea* L.)

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Pinus pinea L., commonly known as Stone pine, is famous for its edible seeds, called pine nuts. It is native to the Mediterranean area, and requires between 400-800 mm annual rainfall and 4-6 dry months for fruiting (Mutke *et al*. 2007).

Worldwide, the seeds of Stone pine are known as Mediterranean pine nuts. Nuts in specific amounts are scientifically proven to reduce the risk of vascular accidents (López 2007). They contain high amounts of vegetable protein, unsaturated fatty acids, fiber (Salas-Salvadó *et al*. 2005), vitamins (folic acid, niacin, tocopherols, Vitamins B6 and B2) and minerals. The nuts are low in sodium and contain various healthy bioactive compounds such as phytosterols and polyphenols (Blomhoff *et al*. 2006). Nuts are thus considered high in nutritional value (Segura *et al*. 2006).

Fertilizers, meanwhile, have demonstrated the capability to increase crop yields and improve product quality. Moreover, fertilization promotes root development and aerial plant growth, thereby contributing to the efficient use of soil and water (Sotomayor *et al*. 2001). Research on the effects of fertilization is readily available on walnut, chestnut and other species that produce edible seeds or nuts (Calama *et al*. 2007).

*Pinus pine*a nuts are one of the most important edible fruits produced in the Mediterranean forests. Research results over the years have recognized that fertilization and irrigation increase cone production and biomass of roots, leaves and trunks. However, there is limited scientific knowledge about the effects of fertilizer application on Stone pine plantations and orchards. Two studies have been conducted to monitor the effects of fertilization on Stone pine.

The first one monitored cone production and quality in a 40-50-year-old forest located on poorly drained, slightly acidic soils. Different doses of lime superphosphate, dolomite and potassium chloride were compared. Results showed a positive response to fertilization in the quantity and quality of cones produced, especially in the treatments that incorporated a greater quantity of dolomite (Calama *et al*. 2007). Nevertheless, the effect of mineral fertilization on the quantity and quality of cones was less than expected. The authors suggested that future studies should explore the incorporation of nitrogen fertilizers and organic matter to improve the structure of sandy soils.

The second research was conducted in Turkey to evaluate the effects of nutrients in the loss of cones. Results showed a negative correlation between nitrogen, phosphorus, calcium and manganese present in the needles and the loss of cones—i.e., when nutrients declined, cone loss increased (Kilci 2011). The authors recommended that phosphorus and calcium should not be applied in drought-stricken areas as it could contribute to cone loss.

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A special issue on agroforestry in *Sustainability*: call for papers

Interested researchers and writers are invited to submit manuscripts to a special issue of *Sustainability* to focus on agroforestry. Contributors can log online at www.mdpi.com until 31 May 2013.

Papers will be published continuously (as soon as accepted) and will be listed in the special issue website. Research articles, review articles, as well as communications are invited. For planned papers, a title and short abstract (about 100 words) can be sent to the Editorial Office for announcement on the website.

Submitted manuscripts should be original and have not been published previously or submitted for publication. All manuscripts are refereed through a peer-review process. A guide for authors and other relevant information for submission of manuscripts is available on the Instructions for Authors page. *Sustainability* is an international peer-reviewed monthly journal published by the Multidisciplinary Digital Publishing Institute.•

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A further study was conducted in Chile that evaluated the effects of fertilization in a young plantation by counting the number of female flowers of Stone pine trees after 1-2 years of application.

Methodology

A plantation of 1.8 ha was established in 1993 in Toconey (latitude 35° 24 '42.99'' S, longitude 72° 3' 32.76'' W), Pencahue in the Maule River Valley, Maule Region. The area has a slope of 20-25 percent. Stone pine trees were planted using 5 m x 5 m spacing. In the winter of 2009, 16-year-old Stone pine trees, were thinned by cutting diagonals (geometric thinning), thereby achieving a final average spacing of 7 m x 7 m. Formation and lift pruning were also applied.

Soil analysis recorded very low values for available phosphorus, boron, nitrogen, potassium, and exchangeable calcium. Medium values were obtained for organic matter, manganese, copper and iron. High values were obtained for magnesium.

The study considered the application of base fertilization according to soil analysis values. Base fertilization was applied in two plots at different exposures plus the control—P1: fertilization northwest exposure (n=27), P2: fertilization north exposure (n=27), PT: unfertilized north exposure (n=9) or control plot.

Fertilization was applied in September 2009. It used a mixture of phosphoric acid and calcium phosphate (60 g per plant), zinc sulfate (10 g per plant); sodium borate (20 g per plant), potassium sulfate (60 g per plant) and carbamide (50 g per plant).

Two evaluations were made in 2010 and 2011, counting female flowers by visual observation from the ground, with the help of a ladder located against the slope and by using prismatic lenses. Cone production was also evaluated, differentiating them by size: large (> 350g), medium (350 - 200 g) and small (<200 g).

Statistical analyses were done using InfoStat 2011. When there were significant differences, a multiple comparison of Fisher's LSD tests was made.

Results

Female flowers. The average number of flowers showed statistically significant differences between the two plots one and two years after fertilizer application. The results highlighted that fertilized plots have significant differences in the presence of cones (Table 1).

In 2010, fertilized trees increased cone production by 41 percent as compared to unfertilized trees. The northwest exposure plot (P1) achieved the highest increase, (46%). In 2011, female flower production decreased in both fertilized and control plots, although statistical significance was maintained between trees with and without fertilization. P1 maintained a greater increase in relation to the control (59.4%), while P2 reached a 47.8 percent increase in relation to control.

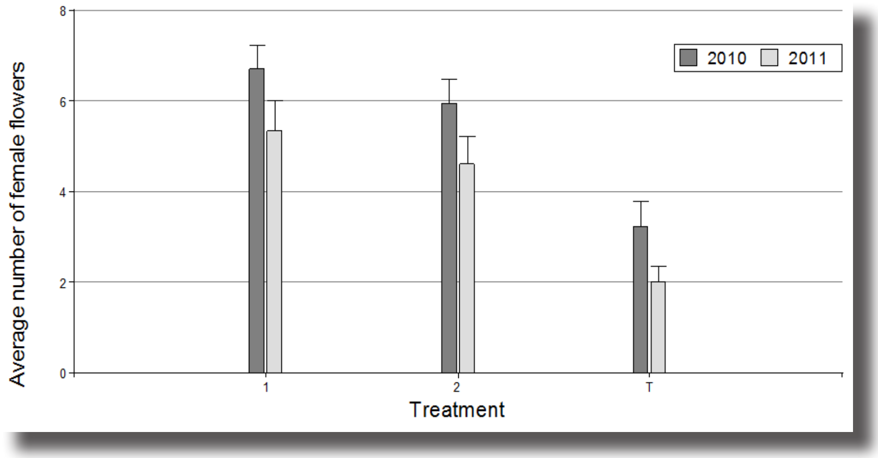
Figure 1 illustrates the number of female flowers per year. Figure 2 shows the appearance of Stone pine's female flowers.

Table 1. Number of *P. pinea* female flowers (± standard error) by treatment. production.

Year	Plot	N° female flowers	Percentage increase vs. control
2010	1 (NW Exposure)	6.70 ± 0.50 a	46
	2 (N Exposure)	5.96 ± 0.51 a	36.8
	T (N Exposure)	3.22 ± 0.86 b	---
2011	1 (NW Exposure)	5.33 ± 1.02 a	59.4
	2 (N Exposure)	4.62 ± 0.60 a	47.8
	T (N Exposure)	2.00 ± 0.14 b	---

*Small letters indicate significant differences between treatments using the LSD Fisher test ($p \leq 0.05$).

Fig. 1. Average of female flowers (± standard error) by treatment.



Considering both years, an average of 5.6 flowers per tree (average range of 1.75-13 flowers/tree) was obtained in fertilized plots, while 2.6 flowers per tree (average of 1-5 flowers/tree) were obtained in the control plot (Table 2) A previous study by Venegas (2010) recorded female flowers on the same plantation, establishing a range of 4-8 female flowers per

The production of female flowers in 2010 would allow 2.5 cones per tree without fertilization and 5.4 cones per tree with fertilization (Table 3) three years later, since the fruits take 3.5 years to mature. Considering the current density of 204 trees/ha, cone production would reach between 170 kg/ha (510 cones/ha) and 367 kg/ha (1.102 cones/ha). These values are significantly lower than the 500 kg/ha of cones harvested in 2009.

According to Crawford (1995), the normal minimum yields are 500 kg of cones/ha/year, with a planting density of 100 trees/ha. This corresponds to 15 cones per tree (3 cones = 1 kg). This level of productivity is usually achieved in dense plantations in Chile without management interventions. The level of flower and cone production depends on alternate bearing, characteristic of the species and diminished spring water availability(rainfall), as stated by Mutke *et al*. (2007).

Fruiting. Stone pine is characterized by a rounded crown to maximize the interception of light and increase fruiting (Mutke 2005). Loewe *et al*. (2011) conducted a study in 2009 to observe the effect of thinning on the development of tree crowns. Two years later, there was a significant increase in crown area which would increase flowering. These results did not match with the results of this study as P2 had a higher increase in crown surface than P1, at 76.3 percent and 56.4 percent, respectively (Figure 3). Table 3 shows P1 with more flowers than P2. It should be noted that at these densities increased light availability quickly allows crown expansion.

Cones. There were no statistical differences in the first and second year after fertilization. These results did not agree with Salazar y Lazcano-Ferrat (2003) when they studied fruit trees and found that the application of fertilizers caused an increase in fruit size. There were differences in the total cone number between treatments two years after fertilization (Table 4).

The analysis of production in relation to tree diameter done by Ximénez de Embún (1958) and cited by Calama and Montero (2007), indicated that normal cone production in a tree of 27 cm DBH is 5.75 kg/year, while in 28 cm DBH trees, cone production is 6.8 kg/year. These values were

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Fig. 2. Pinus pinea female flowers.

Table 2. Minimum and maximum quantity of female flowers.

Year	Plot	Nº female flowers		
		Minimum	Maximum	Average
	1 (NW Exposure)	3	14	6.7
	2 (N Exposure)	2	11	5.9
2010	T (N Exposure)	1	6	3.2
	1 (NW Exposure)	1	14	5.3
	2 (N Exposure)	1	13	4.6
2011	T (N Exposure)	1	4	2

Table 3. Projection on the average number of cones in the third year of treatment.

Plot	No. of female flowers (2010)	Projected no. of cones (2013)	Projected yield of cones (kg/ha) -2013	No. of female flowers (2011)	Projected no. of cones (2014)	Projected yield of cones (kg/ha) (2014)
1	6.7	5.4	1.102 / (367)	5.3	4.2	857 / (285)
2	5.9	4.7	959 / (319)	4.6	3.7	755 / (251)
T	3.2	2.5	510 / (170)	2	1.6	326 / (109)

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significantly higher than those obtained in Toconey, where trees with 28 cm DBH produced a maximum of 3.1 kg of cones in P1, and trees with 27 cm DBH produced 3.2 kg of cones. These results confirmed the alternate bearing characteristic of Stone pine and highlighted the remarkable growth of the species in Chile as compared to Spain, where the same diameters were obtained 23-27 years earlier (Table 5).

Dasometric parameters. Dasometric parameters one and two years after fertilization are shown in Table 6. Results showed that there were no significant differences from fertilization and plot exposure.

There was no significant difference found among fertilized and non-fertilized plots for dasometric (DBH and height) parameters (Table 7). The observed growth rates were higher than those reported by Montoya (1990) who indicated that a maximum of 0.39 m/year height growth was observed in 23-year-old trees, and 0.3 m/year was observed in 17-year-old trees. Martinez *et al*. (1993) indicated that the average diameter growth is 0.29 cm/year with a maximum of 1.47 cm. These values were also largely exceeded in this study.

Conclusions

Results showed that fertilization had a significant effect on female flower production. This study demonstrated an increase in Stone pine flowers by 41 percent and 54 percent after one and two years of fertilizer application, respectively. There were no significant differences found regarding the effect of fertilization on the size of trees.

The application of base fertilization, meanwhile, addressed the nutritional deficiencies of the soil. Results showed that base fertilization increased cone

Table 4. Average of *P. pinea* cones (± standard error) by treatment.

Year	Treatment	Number of Cones by size			
		Big	Medium	Small	Total
2009	Fertilized	0.19 ± 0.05a	3.29 ± 0.38a	0..81 ± 0..17a	4.29 ± 0.48a
	Control	0.84 ± 0.13b	2.38 ± 0.9a	0..87 ± 0..39a	2.21 ± 1.14a
2010	Fertilized	0.80 ± 0.24a	3.03 ± 0.57a	1.38 ± 0.27a	3.62 ± 0.63a
	Control	2.25 ± 0.57b	4.13 ± 1.75a	1.75 ± 1.08a	2.58 ± 1.48a
2011	Fertilized	2.03 ± 0.46a	0.89 ± 0.18a	0.24 ± 0.06a	3.15 ± 0.53b
	Control	1.21 ± 1.08a	0.63 ± 0.43a	0 ± 0.13a	1.84 ± 1.26a

Table 5. Cone production (kg) by age, diameter and country.

Age	Diameter (cm)	Cone production (kg/tree)	Country
17*	28.5	2.2 ± 0.48	Chile
17**	28.7	3.1 ± 0.35	Chile
17***	27	3.2 ± 0.41	Chile
36	25	5	Spain
38	26	5.6	Spain
40	27	5.8	Spain
42	28	6.8	Spain
44	29	7.4	Spain

*Non Fertilized Northern exposure

*** Fertilized Northern exposure

Fig. 3. Increase in crown area (m2) by exposure.

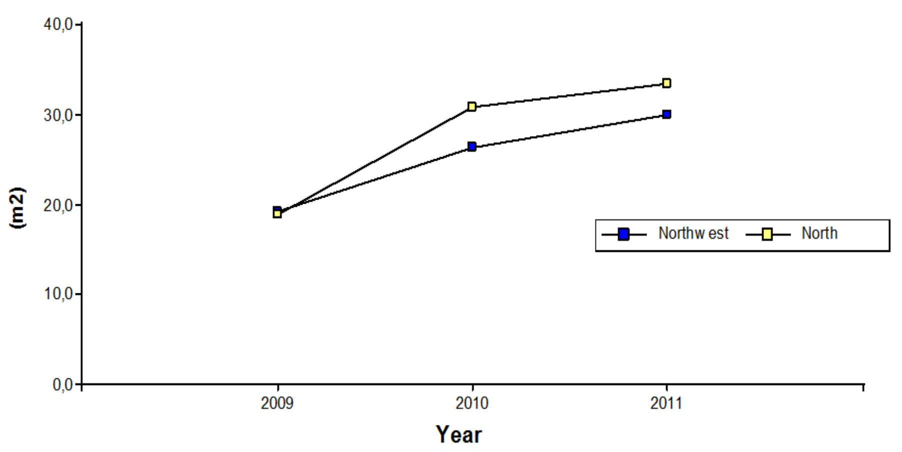

Fig. 4. Fertilizer application on Pinus pinea.

productivity by 2.3 times based on projections of the number of female flowers produced. This effect would be even greater if fertilization is used to specifically address cone production and applied every year or regularly after Stone pine trees reach sexual maturity. This study showed that fertilization did not affect cone size, an aspect that should be explored in further studies.●

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Fig. 5. A general view of the research plot in winter.

Table 6. DBH and height (± standard error) one and two years after fertilization.

Plot (Exposure)	2009		2010		2011	
	DBH (cm)	Height (m)	DBH (cm)	Height (m)	DBH (cm)	Height (m)
1 (NW)	26.54 ± 3.70 a	9.57 ± 1.15 a	28.75 ± 4.18 a	10.13 ± 1.08 a	29.70 ± 3.97 a	10.63 ± 1.34 a
2 (N)	26.37 ± 3.90 a	9.79 ± 1.03 a	27.01 ± 4.50 a	10.53 ± 1.19 a	28.62 ± 5.06 a	11.06 ± 1.47 a
T (N)	26.45 ± 3.79 a	9.68 ± 1.09 a	28.54 ± 4.84 a	10.15 ± 0.86 a	30.49 ± 5.59 a	10.94 ± 1.10 a

Means with the same the letter have no significant differences (p< = 0.05)

Table 7. Annual increment in DBH and height after fertilization.

Plot	DBH Increment (2009-2010) (cm)	Height Increment (2009-2010) (m)	DBH Increment (2010-2011) (cm)	Height Increment (2010-2011) (m)
1	2.20 ± 0.28 a	0.56 ± 0.06 a	0.95 ± 0.27 a	0.50 ± 0.10 a
2	0.64 ± 0.28 b	0.75 ± 0.06 a	1.61 ± 0.27 a	0.52 ± 0.10 a
T	1.41 ± 0.46 ab	0.65 ± 0.10 a	1.95 ± 0.44 a	0.79 ± 0.17 a

*Means with the same small letter have no significant differences (p< = 0.05).

Beach morning glory (*Impomea biloba* Forsk.) helps prevent coastal erosion and desertification in Viet Nam

Martin Kropff, Vo Tong Xuan and Hoang Quang Ha (ha_hoang2000@yahoo.com)

Beach morning glory (*Impomea biloba* Forsk.) or *Rau muong bien* is considered one of the economically and ecologically valued creepers in the coastal areas of Viet Nam. From the family Convolvulacaeae, Beach morning glory is widely distributed by cuttings or seeds. The plant grows well in hot temperatures and well-drained sand soils.

Fig. 1. The leaves and flowers of Beach morning glory (Impomea biloba) in summer-fall.

Morphology

Impomea biloba is a perennial creeper reaching 7-10 m long with smooth trailing, rooting at the nodes, two-lobed leaves, and flowers measuring 4-6 cm x 3-4 cm. Flowers bloom in late summer and continue up to mid-fall (Figure 1). The flowers of the *Impomea* genus all contain funnel-shaped blossoms that are blue, purple, pink, scarlet, or white. They can also be multicolored to create a pattern. The flowers of *Impomea biloba* Forsk, meanwhile, are mainly purple. Some *Impomea* flowers can grow to 6-10 cm across, but on average are usually about 5-7 cm in length.

In general, the leaves of *Impomea* genus are heart-shaped and 4-6 cm or 8-10 cm (other *Impomea*) long. The seed pods hang from the vines. As the seeds mature, the pods start to turn a light brown color. When the seeds are fully mature, they turn dark brown and are 0.3-0.5 cm in size.

Beach morning glory grows up to 2-4 m long within two months, and the main stem can reach up to 7-10 m long. This plant needs support to grow. Hence, they are often found planted along fences or in hanging pots and baskets.

Distribution and plant ecology

This plant can be found along the beaches of Viet Nam and about 5 km in the inland areas at altitudes of about 1.0-10 m asl. They grow best when daylight hours are longer (Figure 2).

Some of the flowers survive in different environments; however, they do not grow well in moist or fertilized soils because such conditions promote production of leaves instead of flowers.

Beach morning glory is considered a weed in most areas because it reseeds every year, and grows fast.

Fig. 2. Beach morning glory (Impomea biloba) grows well in unfertile white sands and well-drained sandy soils one year after planting.

Fig. 3. The leaves of Beach morning glory (Impomea biloba) is used as fodder for pigs and rabbits in the coastal regions of Viet Nam.

The flowers attract hummingbirds and butterflies. The seeds are planted after the winter season ends.

Propagation

Beach morning glory can be propagated by seeds and cuttings. The seeds ripen in October-December. They then germinate for 1-3 months after winter. The seeds are sown about 1-2 cm below ground and 15-20 cm apart. They can also be grown in indoor pots 4-6 weeks before the end of winter. Before sowing, the seeds should either be slightly nicked with a knife or soaked overnight in room temperature water.

Between spring and summer, the seeds are naturally germinated for seedlings. The seedlings are then distributed widely for cultivation.

Cuttings, meanwhile, are also used to propagate beach morning glory. Cuttings of about 15-20 cm long are prepared and planted in sands and sand dunes.

Medicinal values

Roots are scraped and eaten raw to cure stomach aches. The tuber (the stem) is an herb which is used to treat intestinal parasites. Beach morning glory is also a popular cure for several ailments including inflammatory and algesic diseases.

Economic values

The flowers of Beach morning glory are often used to treat ailments. The leaves and young cuttings, meanwhile, are eaten raw or as fodder for pigs and rabbits (Figure 3).

The roots are also edible and consumed when the plants are 2-3 years old. They are harvested in the fall and then dried.

The seeds, however, are poisonous. When eaten, the seeds cause hallucinations, nausea, vomiting, drowsiness, and muscle tightness.

Environmental values

This plant grows well on sand dunes and well-drained sand soils. It even grows well in unfertile white sands or along the banks of shrimp lakes as a form of protection for the sand slopes (Figure 4). Moreover, the plant can cover about 60-80 percent of the sand soil surface and protect rural roadsides in many coastal areas of Viet Nam against soil erosion.•

Fig. 4. Beach morning glory (Impomea biloba) grows well along the banks of shrimp-lakes and protects these sandy areas against erosion and desertification.

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Forest and forest products technology and the environment 2013

The international scientific conference on forest and forest products technology and the environment will be held 27-31 May 2013 in Brno, Czechoslovakia. The conference aims to present progressive scientific and research results and operational findings on environment-friendly applications of technology in forestry and the wood-processing industry.

Discussions will focus on the current technical, technological, economic, social and ergonomic problems in silvicultural, logging and other forest operations.

Issues to be highlighted include methods to assess and study the technology impact on the environment; possibilities to mitigate the impact of forest technologies and operations on the environment; site and watershed impacts of forest operations; factors contributing to the enhancement of environment-friendly timber haulage, especially in sloping terrains, and as related to the economy of forest operations; prospects for the application of small-scale production technologies, bionics and biotechnologies; management of integrated prevention; issues of the machine-tool-workpiece relation in timber processing; the effect of lifelong university education in the fields of forest engineering and wood technology on transferring current scientific knowledge and research findings into practice.

For more information, visit http://www.fortechenvi.com/.•

Bixa orellana L.: a potential source of edible dye and means to improve rural livelihood

K. Kumaran (drkkmail@yahoo.com), M. Kiruba, S.Kala, and P. Durairasu

Indians have been considered forerunners in the art of natural dyeing. Natural dyes are used as raw materials in coloring textiles, drugs, cosmetics, etc. Owing to their non-toxic effects, natural dyes are also used to color various food products.

In India, there are more than 450 plants that can be tapped for natural dyes. Some of these plants also possess medicinal values. One particular plant is *Bixa orellana* L. which produces *bixin*—a seed-specific pigment widely used in the food and cosmetics industries. The various products and uses of *Bixa orellana* are increasingly becoming recognized, especially in the last 20 years where consumers require natural ingredients in their foods (Plotkin1993).

Distribution

Bixa orellana L. is commonly known as annatto or roucanor lipstick tree. It is native to tropical central and south America but it has become naturalized in many countries of Africa and Asia. In India, it is naturalized and cultivated to a small extent in Mysore, Kerala, along the Coromandel Coast, and in certain districts of Andhra Pradesh, Maharashtra, West Bengal and Assam.

Description

The stems of *Bixa orellana L.* are light brown. The bark is more or less smooth with many warty lenticels which become fissures as the plant matures. If given ample space, *annatto* generally branches several times near the ground and develops a dense, spreading crown. The plant roots firmly with a thick taproot and finer laterals. The alternate leaves have long petioles and thin ovate blades with long

Bixa orellana tree with pods.

pointed tips. Panicles at the branch tips have few to many pink or white flowers.

Bixa orellana L. bears flowers from August to December. It has three types of flowers with shades varying from white to pink—white flowers bear green pods, pink flowers bear red pods, and pinkish white flowers bear brown pods.The flowers and fruits of annatto appear in clusters. The leaf resembles that of a betel vine leaf and has veins red in color.

The fruits of the trees are soft and thorny like that of *Datura* spp which have four petals. The fruits bear nearly 50 seeds which become red when they ripen.The fruits are spiny capsules that dry and split open in two parts to expose the red seeds and the inner surfaces (Howard 1989;Liogier 1995).The red color compound is extracted from the seeds which are coated with thin pulpy, bright orange resin commonly known as annato dye or bixin. The quantity of bixin in the seed varies from 0.70 to 3.50 percent by weight and contains various types of carotenoid, out of which cisbixin alone accounts for 82 percent. *Bixin* is the principal coloring material, which is a highly unsaturated compound.

Silviculture of *Bixa orellana*

Bixa orellana can adapt to a wide range of conditions in the tropics and in the frost-free sub-tropics. It thrives best in areas with a temperature range of 20-36^{0}C and an annual rainfall of 1 250-2 000 mm, preferably well-distributed but with a dry season for seed ripening. A tropical climate with a humid atmosphere is suitable for the cultivation of annatto.

Nutritional requirements are not high and the tree can grow on a variety of soil types, provided there is good drainage. Annatto fits well into an agroforestry system as long as the plants are not shaded by other large trees and are cultivated in open and sunny areas. These factors contribute to good performance.

Nursery techniques

The plant can be propagated by seeds or through other vegetative methods. If propagation is done by seeds, it is best to raise them in a nursery. Nurseries can be established in April-May. Seedlings are raised in polythene bags that contain a mixture of soil, sand and manure. Seeds germinate in about 8-10 days. Seedlings are then transplanted when they are 20 cm tall. Pits that are 30 cm^3 in size are dug in early June at spacings of 3 m x 3 m. They are filled with a mixture of soil and compost. Transplanting the six-month-old seedlings is done before the onset of the monsoon season.

Propagation can also be done through stem cuttings and cleft grafting, usually in November-December.The semi hardwood stem cuttings measuring 15 cm long and 2 mm in diameter are treated with 4 000 ppm of IBA, resulting in a high rooting percentage (85%). The rootstock measures 10.10-11.50 mm in diameter if scions are collected from superior mother trees (Kala 2009).

Plantation management

Bixa orellana is planted during the monsoon season (June to September). It can be planted until October provided there is sufficient irrigation. Pits measuring 30 cm^3 are dug at 3 m x 3 m or 3 m x 2.5 m spacing to accommodate1 100 -1 200 plants per hectare. If cultivation is done during the dry season, it is recommended that plants are watered 2-3 times a month considering the soil type, soil texture, water holding capacity and atmospheric temperature.

Better results are obtained when moisture stress is absent from the flowering to capsule maturity stages.Weeding, mulching and loosening of soil around the pits are likewise recommended to achieve improved yield.

Although there have been no reported case of pests, *Bixa orellana* sometimes exhibit symptoms of the die back disease if exposed to prolonged water-logged conditions. Hence, it is advisable to spray the plants with a mixture of Bavistin and copper oxychloride as soon as symptoms of the die back disease manifest.

Phenology

Flowering generally starts in the second year of planting. If *Bixa orellana* has been propagated using vegetative propagules, flowering starts after 12 months.The blooms start appearing in July-August up to the end of October. Capsule (fruit) formation starts 30 days after flowering. Fruiting is seen in September-October.

Yield and *bixin* content

Harvesting of fruits may be initiated from October onwards. The right time to harvest the fruits is determined by the time the capsules are dry and cracks in the fruits can be seen. Capsules are harvested in bunches and spread on polythene sheets or cloths under semi-shaded conditions for 6-7 days.The dried pods are beaten to remove the seeds.The separated seeds are then winnowed and stored in gunny bags in cool and dry places.

The yield of B*ixa orellana* increases with age from 528.6 kg/ha for two-year-old plants to 2 483.3 kg/ha for three-year-old plants. For individual trees, the yield of dry seeds varies between 0.5 to 4 kg per year. Seeds contain 0.07 percent essential oil and 1.008 percent *bixin* (Kanjilal and Singh 1995). However, the bixin content of seeds present in the assembled 34 genotypes ranged between 1.13 percent (KABi 5) and 3.13 percent (TNBi 1)(Kala2009).

Pruning

Pruning is important to achieve better yields. It is recommended to prune the branches/twigs every other year after harvest. Pruning should be done early in the morning. A light spray of fungicide after pruning is also required to avoid fungal attack. The pruned twigs sprout into 3-5 new shoots.

Uses

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Pods and seeds of Bixa orellana.

Bixa orellana L.: a potential...

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Annatto seeds are the world's second most important natural colorant after caramel, yielding yellow to red color (Mercandante and Ptander1998). The seed coloring materials bixin and orellin are isolated from *Bixa orellana*. The color may reach up to 7 percent of the seeds' dry mass (Kutzer1999). The dye, obtained from the seeds,is used to color food, dye cloths and paint skin. The pulp surrounding the seeds is widely used in herbal medicines against burns, dysentery, constipation and fever (Parrotta 2001).

Variations in the flowers of Bixa orellana.

The crop is now increasingly becoming recognized in the food industry as the seeds are directly powdered and mixed with food products as coloring. In the tropics, *Bixa orellana* is being cultivated as food coloring and natural dyes for cheese, soap, cloth, paint, lipstick, margarine, etc. A few seeds are added to rice, soups or as flavoring to chocolates and meats. Seeds are cooked in butter and eaten.

Annatto is grown as an ornamental or hedge crop. The roots are used in the flavoring of meats. Bixin is also used in hair dyes, coloring in floors and shoe polishes, hair oils, as an ingredient in pharmaceutical ointments, etc. The bark provides fiber and is used to produce ropes and twines.

The branches with dry pods, meanwhile, are used in floral arrangements.

Restrictions on the use of many synthetic colorants and the relative instability of most other carotenoids are leading to the increased use of bixin, especially in the dairy industry. World production in 1983, estimated at about 3 000 tonnes of *annatto* seeds, is now perceived to have risen rapidly to over 10 000 tonnes, half of which comes from Brazil (Anand 1983).•

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Second IUFRO conference on complex forest ecosystems: from tree to landscape

A forest is the most complex of the terrestrial ecosystems, and significant efforts have been made to understand and model the mechanisms underlying its behavior. The technological advancements of the last two decades have allowed development of sophisticated approaches to assessing complexity as well as integrating scale, measurements and accuracy into the understanding of response of the forest to different stimuli. The purpose of this conference is to introduce the latest advances in representation, quantification, measurement, analysis and modeling of forest cover "from tree to landscape."

The conference will discuss measurement and assessment of forest resources, growth and yield models for forest ecosystems, and integration of data and models of varying scales.

The conference will be held on 7-9 October 2013 In New Orleans, USA. For more information, visit http://gis.latech.edu/cfe/. •

Agroforestry and climate change in developing countries

Dickson Wamuku (dicksonwamuku@yahoo.com)

Environmental stress forced more than 25 million people to migrate in 1998 alone, according to The Red Cross. However, studies predict that 200 million people will be forced from their homes by 2050 due to environmental factors arising from climate change. It is also projected that 40 percent of animal and plant species will become extinct due to climate change. In addition, it is estimated that global climate change will leave more than 300 000 people dead, 325 million affected, and will result to economic losses amounting to about $120 billion every year.

It is generally recognized that poor communities in developing countries will be significantly affected by climate change and global policies on climate mitgation. Temperature increases and altered patterns of rainfall, as well as extreme events, will have an influence on livelihoods and the sustainable use of natural resources and management strategies. At the same time, increasing access to energy in both cost-effective and climate-friendly ways is a major challenge for many developing countries.

Agroforestry

Agroforestry as a land-use approach that integrates multipurpose trees with crop production. Aside from addressing the worsening wood fuel supply and shortage in building materials, agroforestry also addresses environmental degradation. Moreover, agroforestry practices are seen as an opportunity to take pressure off the remaining natural resources and increase the diversity of vegetation on existing farms.

Grevillea robusta adapts to a wide range of climatic and soil conditions. It is considered one of the most suitable tree species in agroforestry farms in many rural areas in developing countries. It is a fast-growing tree that does not compete for crop nutrients, produces substantial wood biomass and offers nutrient-rich leaves. Studies have indicated that most forestry farmers were found to prefer *Grevillea robusta* in their agroforestry farms.

Sustainable forest management

Climate change is emerging as perhaps the greatest environmental and development challenge of the 21st century as it exerts multiple stress on the biophysical, social and institutional environment. It is now directly linked to recurrent droughts, intense rainfall and floods, spread of pests and vector-borne diseases, increased competition for resources, collapse of financial institutions, and human and animal migration and biodiversity losses. Food security is at risk in arid, semiarid, and other fragile ecosystems.

Carbon dioxide, methane, nitrous oxide, sulpher hexafluoride, perflourocarbon and hydroflourocarbon are the six greenhouse gases (GHGs) responsible for anthropogenic global warming. Major sources of these gasses include increased fossil fuel combustion, industrial activities, inappropriate agricultural activities, and deforestation and forest degradation. Carbon dioxide is the principal GHG gas accounting for about 70 percent of all emissions. Deforestation alone contributes about 20 percent of all GHG emissions and is reported to be accumulating in the atmosphere at a rate of about 6 billion tons per year.

Sustainable forest management and conservation has been recognized as one of the most promising pathways for mitigating climate change. Forest plants and soil drive the global carbon cycle and in the process trap and store enormous amounts of carbon. Trees and forest remove carbon dioxide from the atmosphere and convert it to carbon during photosynthesis, which is then stored in the form of wood and vegetation, a process referred to as carbon sequestration.

Trees generally contain 25 percent carbon by weight and the overall biomass of forest also acts as a carbon sink. For instance, the organic matter in forest soils, such as the humus produced from the decomposition of dead plant materials, act as a carbon storage. Measures to protect restore and sustainably manage forests offer significant potential for climate change mitigation. Furthermore, forest-based measures can be an effective complement to minimize fossil fuel emissions.

Empowerment of local communities

Many local communities in developing countries have unique and fascinating wetlands and

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Grevillea robusta is considered one of the most suitable tree species in agroforestry farms in most developing countries. It is a fast-growing tree that does not compete for crop nutrients, produces substantial wood biomass and offers nutrient-rich leaves.

Agroforestry and climate change...

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forests. These ecosystems host different plant and animal species and offer potential for tourism. Local communities residing in these ecosystems have yet to realize th importance of forest and wetland conservation. As a result, such ecosystems are destroyed because of the need for livelihoods, fuelwood, timber, building materials, farming lands and construction of homes.

To enhance environmental conservation, local groups should be empowered and trained in the importance of agroforestry, forest and wetland conservation, establishment and management of agroforestry tree nurseries, design of planting programs in degraded habitats, management of planted tree seedlings, planting of tree seedlings in degraded habitats, community plots, school compounds and hilltops, promotion of agroforestry tree seedlings among local communities and the importance of establishing environmental task forces. Training can help develop people who are skilled in environmental protection and conservation and agroforestry tools, techniques and practices. Trained members are expected to share their knowledge with community members so that the destruction of forests and wetlands is reduced and totally discouraged.

Opinion leaders should also be identified. They are often drawn from religious groups, conservation and environmental bodies, and other respected personalities. They can be sensitized as champions to take the lead in promoting agroforestry farming and wetland and forest conservation. Farmers who own agroforestry tree nurseries and have vast experience in the management of tree nurseries should likewise be mobilized and stimulated to facilitate delivery of tree seedlings to implement agroforestry initiatives.

Conservation task forces can be formed from trained community members. Task forces can partner with opinion leaders and other stakeholders in environmental conservation and agroforestry. Some of the activities of task forces can include community planting and agroforestry tree nursery establishment in the different villages. Establishing nurseries will ensure the steady supply of tree and crop species for agroforestry farms.

In support of training initiatives there are educational materials that are shared with the community. The materials should not only be used during training but even after, and shared with as many community members as possible.

Sustainable forest management through agroforestry could help mitigate climate change, but not without the empowerement of local communities who are also in a key position to protect and conserve their source of living.•

The author can be contacted at Star Awake CBO in Bungoma County, Kenya.

New publications

Ecosystem services from agriculture and agroforestry: measurement and payment

Agricultural systems are no longer evaluated solely on the basis of the food they provide, but also on their capacity to limit impacts on the environment, such as soil conservation, water quality and biodiversity conservation, as well as their contribution to mitigating and adapting to climate change.

To cope with these multiple service functions, they must internalize the costs and benefits of their environmental impact. Payments for ecosystem services are hoped to encourage and promote sustainable practices via financial incentives.

This book was written by John Beer, Fabrice DeClerk, Jean Francois Francois Le Le Coq, Bruno Rapidel and edited by Fabrice DeClerck and Jean Francois Le Coq. The authors show that while the principle is straightforward, the practice is much more complicated. Whereas scenic beauty and protection of water sources provide benefits to the local population, carbon sequestration and biodiversity conservation can be considered international public goods, rendering potential payment schemes more complex. Few examples exist where national or international bodies have been able to set up viable mechanisms that compensate agricultural systems for the environmental services they provide.

This book provides several examples of successful programs, and aims to transfer them to other regions of the world. The authors show that a product can be sold if it is clearly quantified, there exists a means to determine the service's values and there is a willing buyer. The first two sections of the book present methodological issues related to the quantification and marketing of ecosystem services from agriculture, including agroforestry. The third and final section presents case studies of practical payments for ecosystem services and experiences in Central and South America, and draws on some lessons learnt for effective and sustainable development of ecosystem services compensation mechanisms. For more information, visit www.amazon.com.

Guidelines for climate proofing investment in agriculture, rural development and food security

This publication aims to present a step-by-step methodological approach to assist project teams to assess and incorporate climate change adaptation measures into agriculture, rural development, and food security investment projects. While the guidelines focus on the project level, an improved understanding of climate change impacts should also be used to incorporate climate change considerations into agriculture planning and policy at the country level. Though rural development projects include irrigation, rural infrastructure, agriculture production, and natural resource management, this report focuses mainly on irrigation infrastructure projects and agriculture production projects. For more information, visit http://www.adb.org/documents/guidelines-climate-proofing-investment-agriculture-rural-development-and-food-security.

Living with the trees of life: towards the transformation of tropical agriculture

This book is based on the career of Roger Leakey, the former Director of Research at the International Centre for Research in Agroforestry. The book presents the experiences of real life situations in rural villages of remote and distant places. It demonstrates how the multidisciplinary science of agroforestry, which embraces biology, genetics, ecology, agronomy, horticulture, forestry, soil science, food science, and the social sciences, can offer hope from the doom and gloom often emanating from the tropics.

Written in an accessible and engaging style that will appeal to both a professional and general readership, this book takes a more positive approach to the issues facing agriculture and highlights an innovative approach to resolving the big issues of poverty, malnutrition, hunger and environmental degradation including climate change. For more information, visit www.amazon.com.

Profitable farms and woodlands: a practical guide in agroforestry for landowners, farmers and ranchers

Written by Joshua Idassi and edited by the US Forest service and the USDA National Agroforestry Center, this practical guide was developed by a team of agroforestry specialists from the Land Grant Universities and the USDA National Agroforestry Center (NAC), led by the Agroforestry Consortium. The guide aims to assist underserved and limited resources farmers and woodland owners to adopt best management technologies in agroforestry. The guide depicts step-by-step methods and principles for developing agroforestry practices for farmers and woodland owners for the purpose of enhancing the economic and environmental benefits of their farms and woodlands." For more information, visit www.amazon.com.

Protecting biodiversity in production landscapes: a guide to working with agribusiness supply chains towards conserving biodiversity

Biodiversity is being lost at a rate that will have significant economic and social implications around the world if this unabated deterioration is allowed to continue. This loss is attributable to the need to produce more food supplies for an ever-increasing world population. This publication examines the impacts of agricultural supply chain activities on biodiversity and ecosystems and provides recommendations for conservation policies that are needed to preserve this vital resource. It provides government policy-makers with guidelines to develop strategies for involving agricultural supply chains in the drive for biodiversity protection and the implementation of sustainable development. For more information, visit https://unp.un.org/Details.aspx?pid=22959.

Seasonality, rural livelihoods and development

Written and edited by Stephen Devereux, Rachel Sabates-Wheeler, Richard Longhurst and Robert Chambers, the book focuses on seasonality as a severe constraint to sustainable rural livelihoods and a driver of poverty and hunger, particularly in the tropics. Many poor people in developing countries are ill equipped to cope with seasonal variations which can lead to droughts or floods and the consequences for agriculture, employment, food supply and the spread of disease. The subject has assumed increasing importance as climate change and other forms of development disrupt established seasonal patterns and variations.

This book is the first systematic study of seasonality in over twenty years, and it aims to revive academic interest and policy awareness of this crucial but neglected issue. Thematic chapters explore recent shifts with profound implications for seasonality, including climate change, HIV/AIDS, and social protection. Case study chapters explore seasonal dimensions of livelihoods in Africa (Ethiopia, Kenya, Malawi), Asia (Bangladesh, China, India), and Latin America (Peru). Others assess policy responses to adverse seasonality, for example through irrigation, migration and seasonally-sensitive education.

The book also includes innovative tools for monitoring seasonality, which should enable more appropriate responses. For more information, visit http://www.amazon.com/Seasonality-Rural-Livelihoods-Development-ebook/dp/B007H9H1ZE. •

Useful websites

USDA – Know Your Farmer, Know Your Food

http://www.usda.gov/wps/portal/usda/knowyourfarmer?navid=KNOWYOURFARMER

Know Your Farmer, Know Your Food (KYF2) is a US Department of Agriculture-wide effort to stimulate food- and agriculturally-based community economic development; foster new opportunities for farmers and ranchers; promote locally and regionally produced and processed foods; cultivate healthy eating habits and educated, empowered consumers; expand access to affordable fresh and local food; and demonstrate the connection between food, agriculture, community and the environment.

The International Analog Forestry Network

http://www.analogforestrynetwork.org/en/home.html

The International Analog Forestry Network aims to sustain the exchange of knowledge, experiences and updated information between groups to help restore ecosystems environmental stability and biodiversity through research, design and application of the Analog Forestry system.

Agriculture and Agri-Food Canada

http://www.agr.gc.ca/index_e.php

Agriculture and Agri-Food Canada provides information, research and technology, and policies and programs to achieve an environmentally sustainable but competitive agriculture, agri-food and agri-based products sector that proactively manages risk, and an innovative agriculture, agri-food and agri-based products sector.

Cornell International Institute of Food, Agriculture and Development

http://ciifad.cornell.edu/

CIIFAD partners with key institutions in Africa, Asia and Latin America to initiate and support innovative programs that contribute to improved prospects for global food security, sustainable rural development and environmental conservation around the world.

Call for Contributions

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

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

Topics of particular interest are on:

- agroforestry and poverty alleviation;
- agroforestry and rainfed agriculture;
- agroforestry, organic farmning, soil and water conservation practices/measures;
- agroforestry and livelihoods;
- agroforestry and farmers' incomes and livelihoods;
- 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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