APANEWS

Asia-Pacific Agroforestry Newsletter

No. 42
August 2013

Dear Readers

Welcome to the 42nd issue of APANews! As always, we feature interesting articles on agroforestry research and agroforestry promotion and development.

An article from India presents current efforts in developing different varieties of spice crops to help conserve biodiversity and mitigate climate change. India is known to be the largest producer, consumer and exporter of spices in the world. The article discusses how climate change is reducing the spice crop varieties and that different research and gene centers in India are actively developing new spice crop varieties to address this issue. The article also cited the critical role of communities—their involvement and insights from the field help promote participatory action research to help conserve spice crop varieties in their natural habitats and in agroforestry systems. Read about the details on page 3.

An article from Viet Nam presents results of a research to determine the salt tolerance of mangrove forests and how these results could be used to develop mangrove tree-based livelihood models. Like the article from India, the article also cited the important role of communities in the establishment and rehabilitation of mangrove forests. Research results indicate two effective models that can provide livelihood to the local communities. Find out what these models are on page 5.

A project initiated by the Philippine Agroforestry Education and Research Network focused on the institutionalization of agroforestry as a climate change adaptation strategy by building local capacities and developing policies in southeast Asia. The project built the technical capabilities of junior lecturers from local academic institutions and technicians from local government agencies. It also recognized the value of farmers' knowledge on climate change adaptation and the need for policy advocacy in helping to institutionalize agroforestry at the local and national levels. The project comprised four components: implementation of national training programs on climate change adaptation strategies, documentation of climate change adaptation strategies of selected upland farmers, hosting of policy dialogues on agroforestry and monitoring of project progress. Read more about the project on page 10.

Another article from India discusses ways to manage the Witch's Broom disease in *Salvadora* trees. *Salvadora oleoides* and *S. Persica* are often integrated in agroforestry systems in India because of their ability to produce almost 50 percent seed oil. These trees often suffer from Witch's Broom disease which causes leaf distortion and leaf curling. This disease is transmitted through psyllid (*Euphyllura obsoleta*). Infection results to slow branch growth and the formation of multiple buds. Continuous feeding of psyllid will eventually result to death of the trees. Find out the details on how to manage this disease on page 12.

We also feature interesting events in 2014 that you might want to participate. New publications from FAO, CABI, Springer, Elsevier, Bioversity International and Center for International Forestry Research might also be useful in undertaking your various initiatives in agroforestry.

Thank you to all contributors and readers for your continuous support to APANews! Let us continue to work together to further promote agroforestry for sustainable development.—*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 Assistants)

COVER. The integrated farm of Mrs. Helena Uy in Kalinga province, northern Philippines showcases the successful integration of forest and fruit trees with agriculural crops. The fam has become a stable source of food and income for her family and farm workers (*see story on page 10*).

PRINTER. Thammada Press Co. Ltd., 86 Soi 50 /1 Charansanitwong Road, Bangplad, Bangkok 10700, Thailand.

Spice crops in agroforestry systems: conserving biodiversity and mitigating climate change

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Expanding farms to produce food grains is limited because of increasing population. Undertaking agroforestry/land-use systems (tree-agriculture-livestock) gives maximum returns and sequesters significant amounts of carbon to minimize the effects of climate change. Including spice crops in agroforestry systems offers opportunities to gain additional profit. Aside from being food supplements, spices are also used for medicinal purposes. This is the reason why spice production is a popular source of income in rural areas in India.

Spices supply calcium, iron, Vitamins B and C, carotene and other antioxidants (Rathore and Shekhawat 2008). There are over 120 spices grown in different parts of the world and around 63 of these are grown in India. India is the largest producer, consumer and exporter of spices in the world. In 2008-2009, India exported $11.68 billion worth of spices. India's tropical, subtropical and temperate climate is conducive to growing spices.

Unfortunately, drought, flooding, rising temperatures and new pests and diseases are continuously threatening agricultural systems around the world. To survive, rural communities diversify their farming to cope with changing conditions. This would require crops that could withstand extreme temperatures, drought and salinity. Genetic management of these crops is considered a vital source of livelihood for rural communities and spices are not an exception.

In India, wild species of spice crops are at risk of extinction, threatening a valuable source of genes that are necessary to boost resistance to biotic and abiotic stresses. Efforts are underway to develop improved varieties of spice crops for commercial cultivation and to combat the negative effects of climate change.

Climate change will cause an increase in average air temperature between 1.4^{0}C and 5.8^{0}C, atmospheric CO_2 concentration and significant changes in rainfall pattern (Houghton et al. 2001). In India, climate change will greatly impact the Himalayan region, Western Ghats, coastal areas and the northeastern region. The maximum increase will be in the Himalayan region. Sea level along the Indian coast is likely to rise with global sea level rise. Water yield is projected to increase in the Himalayan region in 2030 by 5-20 percent. However, water yields are likely to vary across the northeastern region, Western Ghats and coastal areas. Moderate to extreme drought severity is projected in 2030 for the Himalayan region as compared to the other regions.

The impacts of shifting climate patterns on natural resources, such as water, fisheries and forests are consequently threatening the gene pool of spice crops. Current situation requires the development of new varieties of spice crops and its integration into diverse farming systems such as agroforestry.

Studies at the Indian Gene Centre have found that many areas currently suitable for spice crops would become unsuitable in the next 25 years and vice versa. The new varieties of spice crops should be able to cope with these changes while continuously providing livelihood to rural communities (Datta 2010).

Biodiversity in spices

Agrobiodiversity is the foundation of sustainable agriculture development in India. The reliance on the gene pool of wild species to improve that of domesticated species is expected to intensify. Climate change will make it too hot, too cold, too wet or too dry for many existing crop varieties to continue producing at their current levels. Large-scale adoption of a few improved varieties has resulted in displacing diverse genetic variability. Also, the traditional knowledge associated with the use of old varieties of spice crops has largely been ignored and is slowly disappearing. There is an urgent need to collect and store the seeds/planting materials of traditional cultivars, obsolete cultivars and wildlings to enrich the germplasm of spice crops.

The Indian Institute of Spices Research (IISR) in Calicut continuously collects and conserves the genetic resources of spice crops, which include cultivated, wild, hybrids and several endangered species. The national repository of spice germplasm maintained in ex situ and in situ conservatories are enriched regularly through collection surveys in primary and secondary centers of origin. The succeeding sections discuss the germplasm collected to date and the varieties developed to combat the impact of climate change.

Black pepper. *Piper nigrum* L. is one of the most important spices in India, particularly in the Western Ghats and northeastern region, which many believed to be the origin and center of diversity for *Piper nigrum*. *P. nigrum* belongs to the family *Piperaceae*. The major

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center of diversity of the genus *Piper* is central and northern South America where 60 percent of the species are distributed. More than 1 000 species are included in the genus of which 110 are of Indian origin.

IISR in Kozhikode is the national repository for black pepper germplasm with a collection of 1 286 wild accessions, 1 300 cultivar accessions and nine exotic collections in the gene bank. Among them are the germplasms of endangered species like *Piper barberi* and P. *arboretum*. *Piper colubrinum*, a species resistant to Phytophthora, Pollu beetle and Radopholus similes. Some high-yielding varieties can grow under changed climatic conditions. Panniyur-4 and Panniyur-5 varieties could tolerate adverse climatic conditions while Srekara and Subhakara varieties can survive droughts. Pournami has been found to tolerate nematode infestation while IISR Shakti (P-24) has been found to tolerate *Phytophthora capsaici*.

Cardamom. *Elettaria cardamomum* Maton belongs to the family *Zingiberaceae*, indigenous to south India and Sri Lanka where it grows wild in the tropical rainforests. This spice crop has three varieties which are distinguished by adaptability and types of panicle—Malabar, Mysore and Vazhuka. The germplasm collections are maintained at IISR in Karnataka (416 germplasm), Indian Cardamom Research Institute in Kerala (612 germplasm), Cardamom Research Station in Kerala (152 germplasm) and in the Regional Research Station in Karnataka (161 germplasm). The germplasm of particular species has suffered from deforestation, forest fires, pest and diseases and large-scale cultivation of high-yielding varieties (Parthasarathi et al. 2010). The conservation of cardamom germplasm is critical in developing varieties resistant not only to extreme environmental changes but also to pests and diseases.

Ginger. *Zingiber officinale*. Rosc is believed to originate from southeast Asia and is used as spice and medicines. India is currently the major producer and exporter of ginger. Eight species of ginger have been observed in Western Ghats and adjoining areas. At present, about 50 ginger cultivars, with various quality attributes and yield potentials, are prevalent in India, including the economically important species of the genus which are *Z. zerumbet* and *Z. casumunnar*. The ex situ gene bank of ginger at IISR holds 659 accessions including indigenous and exotic collections and related taxa. Certain varieties like Himgiri are less susceptible to the rhizome rot disease while IISR Mahima varieties were found resistant to nematode (*Meloidogyne incognita* and *M. javonica*).

Turmeric. The genus *Curcuma* belongs to the family *Zingiberaceae*. The genus *Curcuma* consists of about 117 species where around 40 species are reported to originate from India (Velayudhan et al. 1999).

Curcuma species differ in floral characteristics, chemical traits, aerial morphology and underground rhizome features (Valton 1918; Velayudhan et al. 1999). *C. aromatica* (*Kasturi manjal*), *C. caesia* (black turmeric) *C. amada, C. zedoaria, C. purpurescens, C. mangga, C. heyneana, C. xanthorrhiza, C. aeruginosa, C. phaeocaulis* and *C. petiolata* are cultivated in different places and regions. The ex situ gene bank of ginger at IISR conserved 1 040 accessions including indigenous and exotic collections and related taxa while other research centers hold 650 accessions. Turmeric varieties like Co-1 is suitable for drought-prone areas, hilly, saline and alkaline soils; BSR-1 is suitable for drought-prone areas; BSR-2 is resistant to scale insects; Roma is suitable for late planting and hilly areas; Ranga is appropriate for late planting and low lying areas and moderately resistant to blotch and scale insect; Sugana is tolerant to rhizome rot; while IISR Alleppy, IISR Kedaram, Sona and Varna are tolerant to leaf blotch.

Chili. Chili belongs to the genus *Capsicum*. It is usually grown in hot and humid areas. Due to the long history of cultivation, outcrossing nature and popularity of the crop, large genetic diversity, including local landraces have evolved. The important *Capsicum* species grown in India includes *Capsicum. annum L., C. annum L. var. avicular, C. annum var. grossum Sendt., C. annum var. longum Sendt, C. chinense Jacq, C. frutescens, C. eximium, C. pubescens*, and C. *minimum* Roxb. Syn. *C. fastigiatum* Bhumme. A large number of varieties are resistant/tolerant to different biotic factors. These include Pusa Sadabahar, Pant C-1, Pant C-2, Punjab Lal, Pusa Jwala, and Jawahar -218 which were also found resistant/tolerant to leaf curl virus. CA-219 and CA -33 are resistant/tolerant to bacterial wilt while Jawahar -218 and PBC-36 are resistant/tolerant to fruit rot. Andhra Joyti and Bahskar are resistant/ tolerant to thrips and mites while K-2 is resistant to the root knot nematode.

Nutmeg. Nutmeg and mace are the two distinctively different spices produced from the fruits of *Myristica fragrans* Houtt. It was introduced to India during the 18th century. At present, the crop is very popular in Kerala, Tamil Nadu and Karnataka states. About 12 species of Myristica occurs in the Indo-Malayan region (Krishnamoorthy and Rema 1994). The nutmeg germplasm conservatory at IISR, Kozhikode consists of 484 accessions including 406 accessions of *M. fragrans* and 18 accessions of related taxa. IISR Viswasree is an improved variety released from the Institute recently.

Clove. *Syzygium aromaticum*. L Merr. & Parry belongs to the family *Myrtaceae* and is believed to be indigenous to the Moluccas Islands. In India, the cultivation of clove is largely restricted to south India. The germplasm conservatory at IISR, Kozhikode holds 233 accessions including two exotic collections, one each from Zanzibar and Sri Lanka.

Cinnamon. Cinnamon represents the dried inner bark of *Cinnamomum veerum* Presl of the family *Lauraceae*. In addition to the true cinnamon (*Cinnamomum veerum*) the other economically important species are Chinese cassia (*C. cassia* Bercht & Presel), Indonesian cassia (*C. burmannii* C.G. and Th. Nees), Bl. Saigon cassia (*C. loureirii* Nees), Camphor (*C. .camphora*) and Indian cassia (*C. tamala* Nees). The tree spices germplasm conservatory at IISR, Kozhikode has 408 accessions of *C. veerum* and 72 accessions of related taxa.

Vanilla. *V. planifolia* Andr. Syn. *V. fragrans* Salisb. is a climbing orchid native to tropical America and was introduced to India during the 19th century. Apart from *V. planifolia*, other cultivated species are *V. pompona* sch. and *V. tahitensis*. *V. walkeriae* Wt. and *V. wightiana* Lndl. are two wild species of vanilla occurring in Western Ghats besides *V. vatsalae*. *V. pilifera* is reported to come from northeast India. At IISR in Kozhikode, 82 accessions of vanilla are conserved in addition to seedling progenies and somaclones.

Conclusions

Considerable diversity exists among the different species of spices including variations in plant type, morphological and physiological characteristics, reactions to pests and diseases, and adaptability and distribution in India. The establishment of the National Bureau of Plant Genetic Resources, Indian Council of Agricultural Research and various agriculture universities has made tremendous impacts in collection, evaluation, conservation and utilization of regional germplasm to develop spice varieties in the region.

The involvement of communities in the respective areas was seen to be critical in maintaining the plots, undertaking participatory action research, and carrying out observations and sharing perceptions. Promotion of in situ and ex situ cultivation of spice crops to conserve important species in their natural habitat and implementation of climate change adaptation measures are critical to sustain food security in the country. The diverse nature of certain spices resulted in the release of improved varieties of spices for commercial cultivation and to combat the negative effects of climate change. Spice crops can be utilized to identify and exploit novel genes for improved survival under the impacts of climate change.

Cultivation of spice crops in agroforestry systems not only augments per capita income but also offers efficient land management. This practice helps in poverty alleviation, women empowerment and livelihood support. Further, spice crops help in biodiversity conservation, watershed management, carbon sequestration and climate change mitigation. •

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Developing mangrove tree-based livelihood models in northcentral Viet Nam

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Of over 500 000 ha of mangrove forest areas in Viet Nam, about 3 000 ha are naturally distributed in the river mouths and (mud) lagoons of Thanh Hoa to Thua Thien Hue provinces in northcentral Viet Nam. Table 1 indicates the main components of the flora of these mangrove forests.

A research was conducted to find out the salt tolerance of mangrove forests and predictable changes in the tidal river flows because of rising sea water (Table 2). The research also aimed to find out how the salt tolerances of mangrove trees could be used to establish mangrove forest models that would go beyond the basic functions of protection and shade for fish and salt-tolerant animals to become sources of livelihood for local communities. The research aimed to find out effective models that will

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enable local communities to raise e.g., Dia fish or Siganus gustatus, brown crap, earth shrimp or oysters.

Rehabilitating the mangrove livelihood forests

In 2013, the local people and government staff in Quang Tri and Thua Thien Hue provinces have organized to rehabilitate the mangrove forests in their respective areas. These initiatives resulted in the growth of 2 000 seedlings of *Rhizophora stylosa* (cay Duoc voi–cay Dang) and *Avicennia marina* (cay Mam quam) in Lang Co, and 3 000 seedlings of Rhizophora stylosa (cay Dang–cay Duoc voi), Avicennia marina (cay Mam quam, Mam oi), and Sonneratia caseolaris (cay Ban chua) in the Gio Viet area. In the nurseries, most of these seedlings were prepared for 18-24 months before planting. They were planted in salty munds near the river mouth using rice-husk

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Fig.1. Mangrove forests of Nypa fruticans (Arecaceae), Bruguiera gymnorrhiza (Rhizophoraceae) and Thespesia populnea (Malvalcaeae) at salinities between 8-33 ppm.

Fig. 2. Apple mangrove and Beach Hibiscus forests at salinities of > 8-12 ppm.

Table 1: Components of the mangrove plant species in northcentral Viet Nam.

Order	Scientific name	Vietnamese name	Locations*
1	*Rhizophora stylosa*	Cay Đang-Đuoc voi	QN (1), TH, TTH (2), KG (3)
2	*Bruguiera gymnorrhiza*	Cay Vet du	QN (1), QB, QT, TTH (2), KG (3)
3	*Avicennia marina*	Cay Mam đen, Mam oi	QN (1), TH, TTH, KG (3)
4	*Hibiscus tiliaceus*	Cay Tra	QT, TTH (2)
5	*Thespesia populnea*	Tra bo đe	QN (1), QT, TTH (2)
6	*Nypa fruticans*	Cay Dua nuoc	QT, TTH, KG (3)
7	*Bruguiera parviflora*	Cay Vet tach	QT, TTH (2)
8	*Bruguiera cylindrica*	Cay Vet khang	TH, QT, TTH (2), KG (3)
9	*Sonneratia caseolaris*	Cay Ban chua	QN (1), TH, QB,QT, TTH (2), KG (3)
10	*Sonneratia alba*	Cay Ban trang	QT, TTH, KG (3)
11	*Kandelia candel*	Trang	QN (1), QB, TH, TTH (2)
12	*Phoenix paludosa*	Cha la bien	QN (1), TH, TTH (2)
13	*Cyperus stoloniferus*	Coi gau bien	TH, TTH (2)
14	*Lumnitzea racemosa*	Coc trang	QN (1), TH, TTH (2)
15	*Aegyceras corniculatum*	Cay Su	QN (1), TH, QT, TTH, KG (3)
16	*Excoecaria agallocha*	Cay Gia-Cay Cha	QN (1), TH, QB, QT, TTH (2), KG (3)
17	*Impomea biloba*	Rau Muong bien	QN (1), QT, KG (3)
18	*Avicennia alba*	Cay Mam trang	KG (3)
19	*Bruguiera cylindrica*	Cay Duoc	KG (3)
20	*Rhizophora apiculata*		
21	Others		

**QN: Quang Ninh Province – (1) north Vietnam; TH: Thanh Hoa province, QB: Quang Binh province, QT: Quang Tri province, TTH: Thua Thien Hue province – (2) northcentral; KG: Kien Giang province –(3) south Viet Nam*

Table 2: Salt tolerance in mangrove tree species in northcentral Viet Nam.

Order	Scientific Name	Vietnamese Name	Photos	Salinity (ppm, 0/00)
1	*Rhizophora stylosa Griff. (Rhizophoraceae)*	Cay Dang-Duoc voi		8-30
2	*Bruguiera gymnorrhiza (L.) Lamk. (Rhizophoracese)*	Cay Vet du		8-33 (2 km from seashore, 50% of high sites)
3	*Bruguiera parviflora (Roxb.) W. (Rhizophoracese)*	Cay Vet tach		8-33 (1/2 of its root system)
4	*Sonneratia caseolaris (L.) Engl. (Sonneratiaceae)*	Cay Ban chua		1-8-12, 12 km from seashore (33 ppm = 1/2 of root system)
5	*Sonneratia alba J.E.Smith. (Sonneratiaceae)*	Cay Ban trang		1-8-12
6	*Hibiscus tiliaceus L. (Malvaceae)*	Cay tra		1-8-12 (33 PPM = 1/2 of root system)
7	*Nypa fruticans Wurmb. (Arecaceae)*	Cay Dua nuoc		<8-12-20 (2 km from seashore)

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Table 2: (Continued)

Order	Scientific Name	Vietnamese Name	Photos	Salinity (ppm, 0/00)
8	*Excoecaria agallocha L. (Euphorbiaceae)*	Cay Gia-Cay Cha		8-33 (2 km from seashore, 50% of high sites)
9	*Avicennia marina (Forsk.) Vierh.* (Verbenaceae)	Cay Mam quam- Mam oi		8-33 (2 km from seashore)

Source: Hoang Quang Ha, Bui Thi Thuy Nhi, Le Sy Thinh (2010-2012.

Fig. 3. Beach hibiscus tree at salinities of > 8-12 ppm.

Fig. 4. Growing cay Dang- cay Duoc voi (Rhizophora stylosa) in saline areas of 8-33 ppm has become a source of livelihood for local communities.

as a part of containers for apple mangrove (*Sonneratia caseolaris*). This would promote the growth of pneumatophores or breathing roots.

Planning for community and household livelihoods

Most of the salt-tolerant aquaculture species raised in the northcentral provinces suffer from salinities between 5-35 ppm—Dia fish (*Siganus gustatus*), Brown crap and Earth shrimp. Two main mangrove livelihood models were found effective as sources of livelihood: raising salt-tolerant fish and crap in Lang Co and Huong Phong communities in Thua Thien Hue Province, and raising salt-tolerant crap and fish in Gio Viet, Trieu Phuoc communities in Quang Tri Province.

Fig. 5. Raising fish – Dia fish (Siganus gustatus) surrounding mangrove forests in northcentral Viet Nam.

Table 3 presents the aquaculture species and their corresponding requirements for integration in mangrove forests. •

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Table 3: Aquaculture species and corresponding requirements for integration in mangrove forests.

Order	Species groups	Primary growth requirements	Secondary growth requirements	Distribution areas of mangrove trees
1	**Crap**	**Salinity: 5-35 ppm**		*Rhizophora apiculata* *Rhizophora stylosa* *Avicennia marima* *Sonneratia caseolaris* *Bruguiera gymnozzhiza* *Nypa fruticans* (1*) *Sonneratia caseolaris* (2*) *Hibiscus tiliaceus* (3*)
1.1	*Scylla serrata* (Mud crap- brown crap)	Fencing nets	Temperature Agricultural wastes	
1.2	*Scylla paramamosain* (Mud crap-Green crap)	Shade trees	Trash fish Agricultural wastes	
2	**Fish**		**Algae (4*)**	*Rhizophora stylosa* *Avicennia marima* (4*-good for fish's algae) *Bruguiera gymnozzhiza* *Sonneratia caseolaris* (2*) *Hibiscus tiliaceus* (3*) *Nypa fruticans* (1*)
2.1	*Siganus gustatus* (Dia fish)		Algae	
2.2	*Mugil cephalus* (Doi fish)	Well-cleaned water	Water	
2.3	*Scatophagus argus* (Brown fish)	Well-cleaned water	AlgaeAlgae Agricultural wastes	
3	**Shrimp**	**Salinity:5-35-50 ppm**	**Algae (4*)**	*Rhizophora apiculata* *Rhizophora stylosa* *Avicennia marina* (4*- good for shrimp's algae) *Bruguiera gymnozzhiza* *Sonneratia caseolaris* (2*)
3.1	*Metapenaeus ensis* (Brackish pink shrimp)	5-8-12 (1*, 2*, 3*)	Algae	
3.2	*Penaeus semisulcatus* (Green tiger prawn)	>8-10-35	Algae	
3.3	*Penaeus monodon* (Giant tiger-prawn)	Well-cleaned water pH7-9	Air-supply Low level of NH_3, H_2S Algae	
3.4	*Litopeneus vannamei* (White-leg shrimp)	Well-cleaned water pH7-9	Air-supply Low level of NH_3, H_2S	

**1-uncleaned water; 2-mostly-brackish water; 3-both 1 and 2; 4 - tree species is good for fish and shrimp's algae.*

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Fig. 7. Growing cay Ban chua or Apple mangrove (Sonneratia caseolaris) in saline areas with less than 8 ppm as source of livelihood for local communities.

Building capacities and improving policy development to promote agroforestry as a climate change adaptation strategy in southeast Asia

Leila Landicho (leila_landicho@yahoo.com)

Through the funding support of the Asia-Pacific Network for Global Change Research, the Philippine Agroforestry Education and Research Network (PAFERN) implemented a project on the "Institutionalization of agroforestry as a climate change adaptation strategy via local capacity and policy development in Southeast Asia" in June 2011-June 2012. The project was envisioned to help sustain the initiatives of earlier projects aimed at promoting agroforestry as a climate change adaptation strategy.

The project built on the capabilities of local development actors which include junior lecturers from academic institutions and technicians from local government agencies. The junior lecturers were primarily responsible for transferring new knowledge and skills to students; while the technicians provided technical assistance to the local farmers. It recognized the importance of farmers' local knowledge on climate change adaptation. It documented farm-level evidences of climate change, observed effects of climate change on agricultural production, and farmers' climate change adaptation strategies.

The agroforestry farm of Professor Fernando Marzo in Trento, Agusan del Sur province in southern Philippines integrates fruit trees, forest trees and annual crops.

The role of policy advocacy was likewise recognized as a critical factor in helping to institutionalize agroforestry. The project thus addressed current issues and concerns that confront agroforestry promotion, and the corresponding measures that could help address these concerns so that agroforestry can be advanced as a development strategy in southeast Asia.

Project objectives

The project aimed to strengthen the capacities of junior lecturers engaged in agroforestry education programs, and community development workers/agricultural technicians involved in the research and extension programs at the local/community levels. It aimed to mainstream agroforestry in the development programs of local government units/agencies in each of the six collaborating countries in Southeast Asia.

Specifically, it intended to (i) implement six national training programs on promoting different climate change mitigation and adaptation strategies; (ii) organize dialogues with different policy-making bodies at the national and local levels to promote the integration of agroforestry in their development programs; and (iii) document climate change adaptation strategies of the upland farmers in selected areas in Southeast Asia.

Project components

The project comprised four components: (i) implementation of a national training program on climate change adaptation strategies; (ii) documentation of farmers' climate change adaptation strategies; (iii) hosting of policy dialogues on agroforestry; and (iv) monitoring of progress.

National training on climate change adaptation strategies. National training programs were conducted each in Indonesia, Malaysia, Thailand, Philippines, Lao PDR and Viet Nam. The program aimed to enhance the knowledge and skills of the junior agroforestry lecturers and agricultural technicians/extension workers on climate change and appropriate climate change adaptation strategies. The programs focused on practical ways in which they could apply the climate adaptation strategies in their home institutions, or share with upland farming communities in their respective areas.

Documentation of climate change adaptation strategies of selected upland farmers. This project component assessed the understanding and awareness of selected agroforestry practitioners and upland farmers on climate change and its impacts to their agricultural production systems; identified evidences of climate change based on the experiences and observations of the agroforestry practitioners and upland farmers; and determined the impacts or effects of climate change on agricultural production based on the experiences of selected farmers. It also analyzed the different mechanisms and strategies that are being employed by agroforestry practitioners/upland farmers in coping with the impacts of climate change; and formulated recommendations to concerned national and local development organizations as regards the adoption of appropriate and sound climate change mitigation and adaptation strategies. Among the project collaborators that carried out this project component were Thailand, Malaysia, Indonesia and the Philippines.

Policy dialogues on agroforestry. Dialogues were organized each in Lao PDR, Viet Nam and the Philippines to deliberate on key issues and policy options toward institutionalizing agroforestry in the countries of the project collaborators. The policy dialogue convened the different agroforestry stakeholders, including the implementers of the agroforestry-related policies and programs. The policy brief drafted in 2010 was used as guide and reference during the deliberations

Project monitoring. PAFERN conducted periodic project monitoring activities to ensure that country activities were on track. Actual site visits and discussions were done to learn more about the details and progress of the different project components. Project monitoring visits were carried out in Indonesia, Thailand and Malaysia.

The project was implemented through the collaboration of the six country networks under the Southeast Asian Network for Agroforestry Education (SEANAFE)— Indonesia Network for Agroforestry Education (INAFE), Lao Network for Agroforestry Education (LaoNAFE), Malaysia Network for Agroforestry Education (MANAFE), Philippine Agroforestry Education and Research Network (PAFERN), Thailand Network for Agroforestry Education (ThaiNAFE), and Viet Nam Network for Agroforestry Education (VNAFE). PAFE RN served as the lead institution of the project. •

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Soil conditions in rainfed rice areas in Isabela province in Northern Philippines during drought or long dry season.

An agroforestry farm in Mallig, Isabela province in northern Philippines integrates fruit trees and annual crops as a way af adapting to the impacts of climate change. The farm boasts of multiple harvests thereby ensuring continuous sources of food and income.

The agroforestry farm of Mrs. Helen Uy in Tabuk, Kalinga province in northern Philippines has become a source of food and income for her family and farm workers throughout the year.

Mitigating challenges of Witch's broom disease of *Salvadora* trees in agroforestry systems

R. Raj Bhansali (rikhab51@gamil.com)

Salvadora oleoides (*Mitha Jal*) and *S. persica* (*Khara Jal*) are natural predominant agroforestry tree species in the saline tracts of India's arid zone (Figure 1). *S. oleoides* with *Prosopis* and *Capparis* shrubs are integrated in traditional agroforestry systems of western arid Rajasthan (Saxena1997). The integration of woody perennials in mixed farming systems is common in this area to help address drought and famine.

Farmers encourage the natural regeneration and establishment of multipurpose trees and shrubs which are grown with pearl millet, mungbean, clusterbean and sesame crops. The *Salvadora* trees are economically important because of their ability to produce almost 50 percent seed oil.

Witch's Broom disease

Salvadora trees often suffer from Witch's Broom disease. Incited by phytoplasmic organisms, this disease is the major cause of loss in fruits and seeds (Raj Bhansali 1994; Raj Bhansali and Jindal 1999; Kumar et al. 2012).

The disease is transmitted through psyllid (*Euphyllura obsoleta*). The *S. oleoides* Witch's Broom disease psyllids were first found in India in 1975 (Mathur 1975). This insect species also feeds on *S. persica* (Faragalla 1991; Raj Bhansali 1994). *E. obsoleta* vectors are very small (2 mm), light green to cream yellow in color, and covered with fine, powdery waxy material during the development of nymphs from the eggs (Figure 2). The psyllids mostly infect the vegetative and reproductive buds of *S. eloides*.

The insect lives in the form of eggs during winter, and develops into nymphs and adults in leaves during February and March. The psyllids feed on the juvenile buds of *S. oleoides* and later on feed on young developing leaves. In winter, psyllids give birth to live young wingless creatures which in late winter produce adults (Figure 3).

Psyllids carrying the Witch's Broom disease cause leaf distortion and leaf folding which covers and protects the psyllids. The disease also cause stunted and abnormal branch growths similar to the witch's brooms (Figures 3 and 4).

The abnormal growth appears due to the proliferation of axillary buds into multiple buds. This condition results to slow branch growth and the formation of multiple buds which gives the impression of a witch's broom.

At first, only the appearance of the shrub is affected. However, continued feeding of the psyllids stunts the *S. oleoides's* foliar growth, eventually causing weakness and death (Figure 3). The affected trees produce less number of flowers, fruits and seeds. The developed seeds, meanwhile, have abnormal sizes and shapes.

Pest management

The management of pests and diseases in agroforestry trees are difficult due to the unorganized natural growth of plants in farmers' fields as well as in wastelands. In crops, such diseases are generally managed through the application of insecticides or growth of resistant germplasm. Application

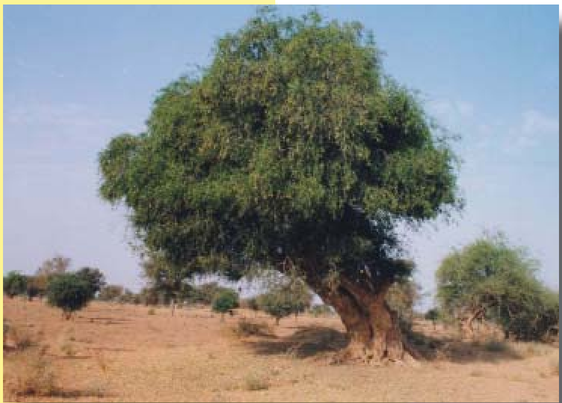

Fig. 1. Salvadora trees are integrated in agroforestry systems in the arid zones of India to help address drought and famine.

Fig. 2. Salvadora trees are infected by the Witch's Broom disease carried by psyllids (Euphyllura obsoleta).

of insecticides is effective yet expensive and labor-intensive due to the trees' height and large canopies.

Another method being used is to spray antibiotics. However, the psyllids and the phytoplasma causing the disease develop resistance to the antibiotics and thus prove ineffective in the long run.

Pruning the affected branches is also used to address the Witch's broom disease. This is undoubtedly inexpensive but laborious. However, in the case of *Salvadora* trees, pruning the affected branches have helped reduced the population of the psyllids and the spread of the disease, thus minimizing damage in the short term. Further, pruning will remove the eggs, nymphs and adults of the psyllids thereby reducing the secondary transmission of the disease. Take note, however, that pruning is only effective if the plants are grown in isolation.

Pruning must be at least 6 in below the affected section of the branches, preferably before bud break, to remove the eggs. This method, however, is not that effective if the trees and shrubs are grown with minimal spacing or if there are many untreated and unpruned plants nearby. In such situation, the likelihood of re-infestation by winged females from nearby plants is high.

Nevertheless, pruning is still considered the best method to address this disease. Pruning *S. oleoides* branches during summer also prompts the production of more vegetative buds and reduces the population of psyllids. The population of psyllids is high in winter as compared to summer.

In western Rajasthan, the management of the disease is difficult because *S. oleoides* are naturally grown in the farmers' fields and wastelands. The only possible way to manage the spread of this disease is to use resistant germplasm of *Salvadora* trees. Resistant accessions of *S. oleoides* have been identified from 9-16-year-old plantation at the Central Arid Zone Research Institute in Jodhpur, India. These accessions were collected from the plants grown in Gujarat and Rajasthan regions. The integration of disease-resistant *Salvadora* trees in agroforestry systems will greatly help farmers' agro-based industries and further diversity agroforestry systems in saline arid areas. •

The author can be contacted at the Division of Plant Improvement, Propagation and Pest Management, Central Arid Zone Research Institute, Jodhpur 342003, India.

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Fig. 3 and 4. The Witch's Broom disease causes leaf distortion and folding, and stunted and abnormal growth of branches.

SEAVEG 2014: families, farms, food

The World Farmers Organization and partners invite scientists, students, farmers, policymakers and other stakeholders to participate in *SEAVEG 2014: Families, Farms, Food – Regional symposium on sustaining small-scale vegetable production and marketing systems for food and nutrition security* to be held on 25-27 February 2014 in Bangkok, Thailand.

The significant contributions of small-scale farming systems in attaining the Millennium Development Goals and other internationally agreed benchmarks to eradicate poverty, enhance food and nutrition security, and strengthen local economies will be the focus of SEAVEG 2014. The regional symposium will examine how policies and practices to sustain small-scale agriculture—and vegetable production and marketing in particular—can improve availability of and accessibility to safe and nutritious food, and contribute to better nutrition and balanced diets, thus enhancing the socio-economic development of ASEAN member states. For more information, visit http://www.seaveg2014.com/. •

Global forum for innovations in agriculture

In response to the threats posed by global water shortages, pollution and climate change, thousands of innovators around the world are employing cutting-edge technology to create sustainable agriculture solutions. On 3-5 February 2014, these innovators are being brought together for the first time at the *Global forum for innovations in agriculture* (GFIA) 2014. Hosted by the City of Abu Dhabi and in strategic partnership with the Abu Dhabi Food Control Authority, GFIA 2014 will present the world's largest collection of sustainable agriculture inventions and pool together the highest level of expertise, investors and suppliers to show the world how big ideas can be developed to solve the world's ever increasing food needs. For more information, visit www.InnovationsInAgriculture.com. •

International Conference on forests, soil and rural livelihoods in a changing climate

The Aquatic Ecology Centre, Kathmandu University, and the Department of International Environment and Development Studies (Noragric), University of Life Sciences, Norway, in collaboration with the Nepal Agroforestry Foundation, Forest Action Nepal and Department of Forest Research and Survey invite papers and posters to be presented at the International conference on *Forests, soils and rural livelihoods in a changing global context* to be held in Dhulikhel, Kave, Nepal on 28-30 September 2014. The conference is an outcome of the Norwegian Research Council supported project "Forest and soil restoration and land use change impacts on carbon pools and fluxes in the Himalaya: research and capacity building in Nepal (FORESC)," which investigated different land use and forest management effects on soil and biomass carbon stocks as well as implications for local livelihoods.

Papers and posters are called for presentation in forest/land degradation and restoration, governance and management of natural resources, remote sensing and geospatial approach to carbon quantification, ecosystem services and biodiversity, community/agroforestry and livelihood security, and watershed resources monitoring and conservation.

Deadline for submission of abstracts is on 31 May 2014 while full papers is on 15 September 2015. For more information, visit http://www.forestrynepal.org/event/6117. •

IUFRO 2014 World congress

The 24th IUFRO World Congress will be held on 5-11 October 2014 with the theme "Sustaining forests, sustaining people–the role of research." It will provide opportunities for participants to share knowledge and build relationships with colleagues from around the world on the ecological, economic and social aspects of forests and trees. For more information, visit http://iufro2014.com. •

World forests summit 2014

In 2014, The Economist's *2nd World Forests Summit* will discuss the major themes impacting the world's forests. The summit will highlight debates on sustainable land use, the compatibility of forests with expanding commercial agriculture, the future of forests and bioenergy as well as developments within the timber and fibre markets.

Topics to be discussed include:

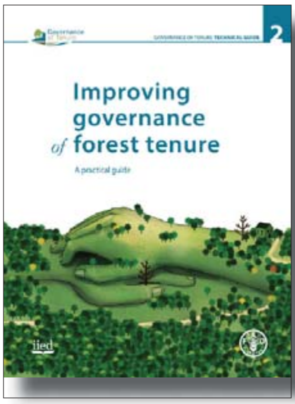
- The true economics of forests - how can we price all the benefits that forests provide adequately? What new trade opportunities will arise, apart from timber and trade of forest products? How to make forest initiatives interesting for private financial institutions?
- Rethinking land use: how to achieve sustainable forest and land management?
- Agroforestry: dealing with the expansion of commercial agriculture?
- Local forest management - collaborating with indigenous communities
- Innovation in forests - new products and business models
- Public-private partnerships in forestry: finding the right balance between conservation and the use of natural resources

For more information, visit http://www.economistinsights.com/sustainability-resources/event/world-forests-summit-2014. •

FAO publications

Improving governance of forest tenure: a practical guide

This technical guide helps take action in four critical areas of forest good and services decision making: understanding, organizing, engaging, and ensuring. It starts by highlighting some key opportunities and challenges in governance today and presents a toolkit containing some 86 tools described in summary form and 9 key tools. A glossary and extensive web-linked bibliography are also provided.



Realizing the Potential of Agricultural Innovation in Family Farming

This brochure aims to share with institutions, organizations and possible donors the activities that FAO's Research and Extension Branch (OEKR) is developing in the field of agricultural innovation systems in family farming. It is designed as a folder with a general description of OEKR work and definitions of agricultural innovation systems and family farming.

Save and grow: cassava – a guide to sustainable production intensification

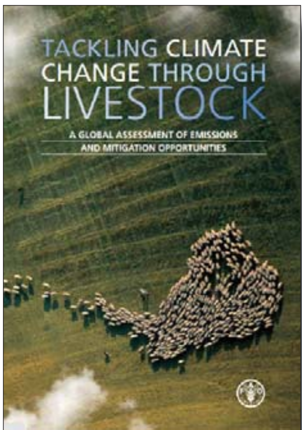
This guide is the first on the practical application of FAO's "Save and grow" model of agriculture to specific smallholder crops and farming systems. The guide shows how ecosystem-based "Save and grow" approaches and practices can help tropical developing countries to avoid the risks of unsustainable intensification, while realizing cassava's potential for producing higher yields, alleviating hunger and rural poverty, and contributing to national economic development.

Promoting investment in agriculture for increased production and productivity

Investing in agriculture is one of the most effective ways of reducing hunger and poverty, promoting agricultural productivity and enhancing environmental sustainability. Covering the development of sustainable agriculture, food production and food security, this paper explains the relationship between all levels of investment and their interdependence to be successful. Written by S. Syed, and M. Miyazako, this paper describes how to drive increased investment, at what stage and where, providing a useful overview of investment in agriculture for policymakers and researchers.

Tackling climate change through livestock

An important emitter of greenhouse gases (GHG), the livestock sector also has a large potential to reduce its emissions. This newly released report provides the most comprehensive global assessment

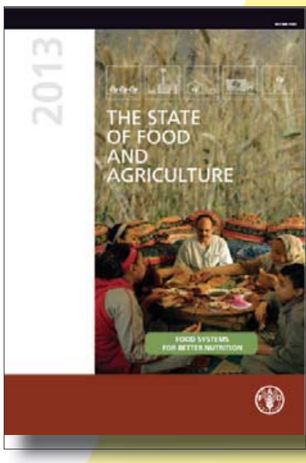


made to-date of the livestock sector's GHG emissions and its mitigation potential. The report also presents a detailed assessment of the magnitude, the sources and pathways of emissions from different production systems and supply chains. Relying on life cycle assessment, statistical analysis and scenario building, the report identifies concrete options to reduce emissions.

It comes at a time when the world needs to urgently reduce GHG emissions to avert catastrophic climate change. The livestock sector can make an important contribution to such international efforts by offsetting some of the sector's emission increases, which are expected as demand for livestock products is projected to grow by 70 percent by 2050.

The state of food and agriculture 2013 – food systems for better nutrition

Malnutrition – in the form of undernutrition, micronutrient deficiencies, and overweight and obesity – imposes unacceptably high economic and social costs on countries at all income levels. The causes of malnutrition are complex, yet all forms of malnutrition share one common feature: nutritionally inappropriate diets. The *State of food and agriculture 2013* makes the case that healthy diets and good nutrition begin with food and agriculture.



All publications are available at http://www.fao.org. •

New publications

Agroforestry abstracts

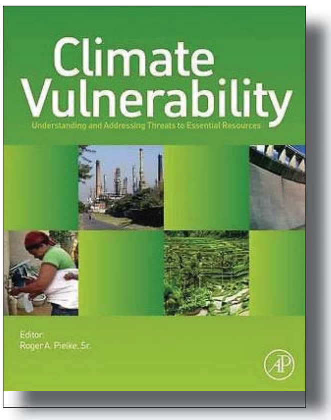
Agroforestry abstracts is a fully searchable abstracts database of internationally published research on agroforestry, from selection of trees and shrubs suitable for agroforestry to socioeconomic issues that impact on agroforestry throughout the world. Developed from the original applied life sciences database, *CAB abstracts, Agroforestry abstracts* delivers all the new highly-targeted, searchable summaries covering key English and non-English language journal articles, bulletins, conferences, theses and books about agroforestry every week. The database includes a fully searchable backfile to 1980. With over 104 000 research summaries and 8 000 records added to the database each year, Agroforestry abstracts brings a wealth of current and seminal research in agroforestry to your fingertips. It now only available online with back copies of some older issues available upon order from CABI. (Available: http://www.cabi.org/)

Agroforestry systems journal

Agroforestry systems is an international scientific journal that publishes results of novel, high impact original research, critical reviews and short communications on any aspect of agroforestry. The journal particularly encourages contributions that demonstrate the role of agroforestry in providing commodity as well non-commodity benefits such as ecosystem services. Papers dealing with both biophysical and socioeconomic aspects are welcome. These include results of investigations of a fundamental or applied nature dealing with integrated systems involving trees and crops and/or livestock. Manuscripts that are purely descriptive in nature or confirmatory in nature of well-established findings, and with limited international scope are discouraged. To be acceptable for publication, the information presented must be relevant to a context wider than the specific location where the study was undertaken, and provide new insight or make a significant contribution to the agroforestry knowledge base. (Available: http://link.springer.com/journal/10457)

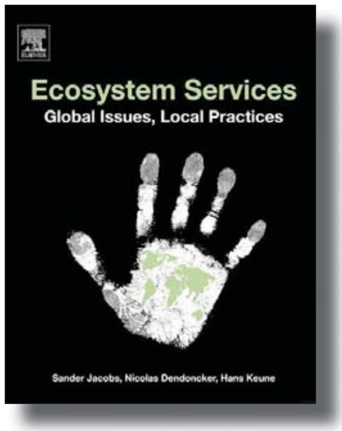
Climate vulnerability: understanding and addressing threats to essential resources

Climate change has been the subject of thousands of books and magazines, scientific journals, and newspaper articles daily. It is a subject that can be very political and emotional, often blurring the lines between fact and fiction. The vast majority of research, studies, projections and recommendations tend to focus on the human influence on climate change and global warming as the result of CO_2 emissions, often to the exclusion of other threats that include population growth and the stress placed on energy sources due to emerging global affluence. Edited by Roger A. Pielke, Sr. of the Cooperative Institute for Research in Environmental Sciences, University of Colorado, USA, *Climate vulnerability* seeks to remove the politics and emotion that surround climate change and assesses the broad range of threats using the bottom up approach—including CO_2 emissions, population growth, emerging affluence, and many others—to our five most critical resources: water, food, ecosystems, energy, and human health. Inclusively determining what these threats are while seeking preventive measures and adaptations is at the heart of this unique reference work. (Available: http://store.elsevier.com/Climate-Vulnerability/isbn-9780123847034/)



Ecosystem services: global issues, local practices

Edited by Hans Keune, *Ecosystem services: global issues, local practices* covers scientific input, socioeconomic considerations, and governance issues on ecosystem services. This book provides hands-on transdisciplinary reflections by administrators

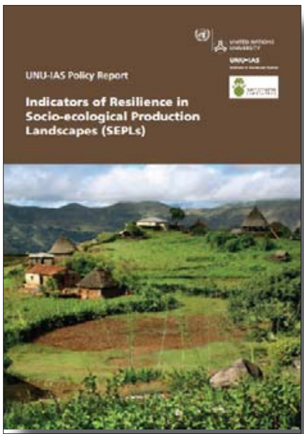


and sector representatives involved in the ecosystem service community. Ecosystem services develops shared approaches and scientific methods to achieve knowledge-based sustainable planning and management of ecosystem services. Professionals engaged in ecosystem service implementation have two options: de-emphasize the ecological and socioeconomic complexity and advance in the theoretical, abstract field, or try to develop research that is policy relevant and inclusive in an uncertain environment. This book provides a wide overview of issues at stake, of interest for any professional wishing to develop a broader view on ecosystem service science and practice. (Available:

http://store.elsevier.com/Ecosystem-Services/isbn-9780124199644/)

Indicators of resilience in socioecological production landscapes

Written by N. Bergamini, R. Blasiak, P. Eyzaguirre, K. Ichikawa, D. Mijatovic, F. Nakao and S. M. Subramanian, the policy report constitutes an important supplement to a set of 20 indicators for resilience in socioecological production landscapes that was developed over the course of joint collaboration between Bioversity International and the United Nations University Institute of Advanced Studies. The indicators were disseminated widely in March 2012. Subsequently, a need was identified for sharing a more in-depth overview of the considerations that went into creating this list of indicators as well as the outcomes of initial field-testing. (Available: http://www.bioversityinternational.org/)



Managing water and agroecosystems for food security: comprehensive assessment of water management in agriculture series

Water protection, food production and ecosystem health are worldwide issues. Changes in the global water cycle are affecting the wellbeing of humans in many places, while widespread land and ecosystem degradation, driven by poor agricultural practices, is seriously limiting food production. Understanding the links between ecosystems, water, and food production is important to the health of all three, and sustainably managing these connections is becoming increasingly necessary. Edited by E. Boelee, this book shows how sustainable ecosystems, especially agroecosystems, are essential for water management and food production. (Available: http://bookshop.cabi.org/)

The contribution of forests and trees to sustainable diets

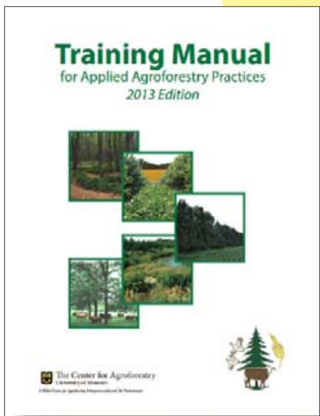
With the growing demands from a population expected to reach 9 billion people by 2050, it is unclear how current global food system will meet future food needs. Ensuring that all people have access to adequate and nutritious food produced in an environmentally and socioculturally sustainable manner is one of the greatest challenges of our time. Sustainable diets have been proposed as a multidimensional framework to address the need for nutritious and adequate food in the context of the many challenges facing the world today: reducing poverty and hunger, improving environmental health, enhancing human well-being and health, and strengthening local food networks, sustainable livelihoods and cultural heritage. This paper examines the contribution of forests and trees to sustainable diets, covering among others, nutritional, cultural, environmental and provisioning aspects.

Written by B. Vinceti, C. Termote, A. Ickowitz, B. Powell, K. Kehlenbeck, and D. Hunter, the paper contains literature reviewed that highlight major opportunities to strengthen the contribution of forest and tree foods to sustainable diets. However, several constraints need to be removed: cultural aspects, sustainable use of non-wood forest products, organization of forest food provisioning, limited knowledge of forest food composition, challenges in adapting management of forests and trees to account for forest foods and in integrating forest biodiversity into complex landscapes managed for multiple benefits.

The paper identifies research gaps and makes recommendations to enhance the contribution of forest foods to sustainable diets through increased awareness and better integration of information and knowledge on nutritious forest foods into national nutrition strategies and programs. (Available: http://www.cifor.org/)

Training manual for applied agroforestry practices (2013 edition)

This newest version of the *Agroforestry training manual* is designed for natural resources professionals and landowners and includes worksheets and exercises for use as an educational tool. The manual features descriptions of establishing and managing the five agroforestry practices, plus success stories of Midwestern landowners utilizing agroforestry on agricultural and forested lands. Additional chapters include: planning for agroforestry; wildlife habitat and agroforestry; marketing principles and economic considerations. Appendix sections include tree, shrub, grass and forage information for agroforestry planting and timber sales suggestions. The Additional resources section at the end of each Chapter has been updated and expanded. (Available: http://www.centerforagroforestry.org/) •



Useful websites

Agrilinks

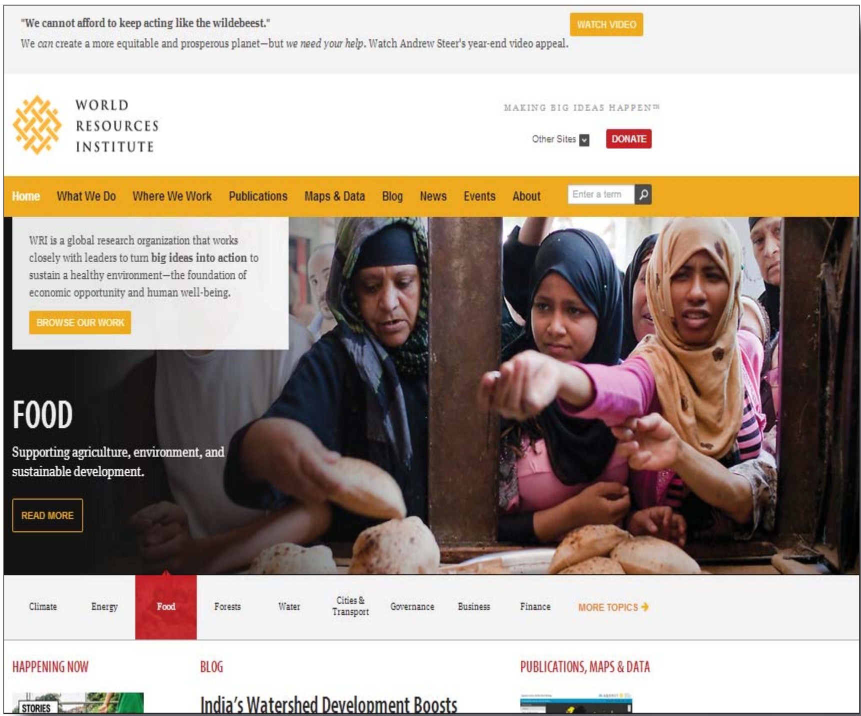
http://agrilinks.org/

Agrilinks is a space for agriculture specialists and practitioners to access current information and resources on important agriculture and food security related topics and issues. The site leverages an array of experiences, resources, and expertise to encourage and promote knowledge flow among practitioners, USAID, partners, and other organizations specializing and working on current agricultural development issues. It captures new learning in food security and agricultural development, disseminates it among practitioners, USAID mission staff, and other donors, and connects those actors to each other in order to improve development outcomes around the world.

Landcapes for People, Food and Nature Initiative

http://blog.ecoagriculture.org/

The *Landscapes for People, Food and Nature Initiative* is an international collaborative initiative of cross-sectoral knowledge sharing, dialogue, and action to support the integrated management of rural landscapes for food production, ecosystem conservation, and sustainable livelihoods. As part of this Initiative, the *Landscapes blog* serves to further these goals, and hosts insight and commentary from a cross‐sectoral group of leaders in the field with interests in agriculture, food security, natural resources management, and poverty reduction.



World Resources Institute

www.wri.org/tags/agroforestry

WRI's mission is to move human society to live in ways that protect Earth's environment and its capacity to provide for the needs and aspirations of current and future generations. Its work centers on climate, energy, food, forests, water and cities and transport.

Australian Centre for International Agricultural Research (ACIAR)

aciar.gov.au/

The Centre encourages Australia's agricultural scientists to use their skills for the benefit of developing countries and Australia. It funds research projects that are developed within a framework reflecting the priorities of Australia's aid program and national research strengths, together with the agricultural research and development priorities of partner countries. It also commissions research into improving sustainable agricultural production in developing countries, fund project related training, communicate the results of funded research, conduct and fund development activities related to research programs, and administer the Australian Government's contribution to the International Agricultural Research Centres.

Call for Contributions

We are inviting contributions for the 44th and 45th issues of the Asia-Pacific Agroforestry Newsletter (APANews) on or before 28 February and 30 June 2014, 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 livelihood;
- agroforestry and farmers' income and livelihood;
- agroforestry enterprises and/or marketing
- agroforestry and mining area rehabilitation;
- agroforestry and climate change;
- agroforestry and biodiversity conservation;
- agroforestry and desertification; and
- other key development issues in agroforestry.

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

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

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

Asia-Pacific Agroforestry Newsletter
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