Germplasm exchange among farmer groups: a way to improve the genetic quality and market chain

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It has been said that the wood supply for domestic consumption or export in the future will come from farms. Thus, farmers in Indonesia, especially those in Java and Nusa Tenggara, grow trees on their farms through agroforestry.

On-farm tree planting has been increasing for the last five years. Trees growing on farms provide fuelwood, building materials, food and fodder. They also provide shade, shelter, erosion control, watershed protection and soil enrichment. Hence, access to quality tree planting material is important.

Unfortunately, smallholder and individual farmers do not have access to improved seed sources or germplasm. Those who do have access simply cannot afford the high cost. Good-quality planting materials are only distributed among research agencies, big private companies and donor agencies. This is where germplasm exchange comes in as an easy and effective way for smallholder farmers to gain access to tree germplasm.

Germplasm exchange among farmers or farmer groups

Germplasm exchange helps improve the quality of genetic materials for smallholder farmers. This has been done since the time of the barter trade of agricultural crops and other goods. The exchange can take place within the farmer groups in a village, between villages in a sub-district or between sub-districts within an island or across the islands. It is important, however, that germplasm exchange be done in areas that have similar geographic and ecological conditions (elevation, soil type, rainfall, etc.), i.e. farmers in the highlands should not exchange germplasm with farmers in the lowlands.

What are the benefits of tree germplasm exchange?

- Tree seed needs are fulfilled.
- Tree seeds collected from different land races will broaden the genetic base, thereby ensuring prodution of good-quality seeds.
- Points of exchanges can also serve as market channels.
- Points of exchanges can also serve as channels for information exchange.

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Punjab farmers have recently realized the benefits of growing indigenous, fast-growing dek and kadam under agroforestry systems. Both species can yield high economic returns within a 10–12-year rotation and can partly provide the raw material requirements of the industry. Dek is mainly used in making furniture and panels while kadam is used in making plywood. However, under Punjab conditions, the economic returns from kadam systems are lower than poplar because of its slow growth, evergreen nature and lower price in the market.

Leucaena, a fast-growing, thornless, evergreen, leguminous woody perennial, has been found very useful on sloping lands. It is specifically raised in silvipastoral systems on the lower shiwalik hills of the state. A number of new leucaena varieties have been introduced for their fodder value.

Teak/sagwan and Australian acacia (Acacia spp.), though encouraged by private nurseries for use in agroforestry systems (agri-silvicultural and horti-silvicultural models) in Punjab, has a long rotation period.

Punjab farmers are experimenting with various agroforestry models. Their agroforestry systems aim to conserve and optimize the utilization of land and water for production of food, fodder, fuelwood, and timber. Scientists at the Punjab Agricultural University are working to provide farmers with the latest technologies for different agroforestry systems. They have been concentrating more on wood technology, and the biophysical and socioeconomic processes of the system.

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Fig. 3. Teak-based agroforestry system.

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In Indonesia, successful models of tree germplasm exchange exist in some farmer groups in West Java and Nusa Tenggara:

Farmer groups in Cibugel, Sumedang, West Java. These farmers grow suren (*Toona sureni*), a popular tree species whose timber is in high demand for building houses, making furniture and other products. However, existing plantations are not performing well due to poor tree management and low-quality genetic material. The farmers normally collect seeds locally from a single tree or collect wildlings surrounding the trees.

To improve the growth and performance of suren trees in this village, the BPTH (Regional Tree Seed Centre) in Bandung, in collaboration with the Indonesia Forest Seed Project (IFSP), financed by DANIDA (the Danish International Development Agency), provided technical assistance through trainings on seed technology, nursery techniques and seed source establishment and management.

The project helped address the lack of improved seed sources of suren and manglid (*Magnolia* spp.) in the greater Sumedang area. The farmers were provided with seeds and seedlings of suren, manglid, sawo (*Manilkara zapota*) and sengon (*Paraserianthes falcataria*).

As a result of this project, the *Arisan Benih*, or seed exchange, was established between two farmer groups from Tasikmalaya, two farmer groups from Cianjur and four farmer groups from Sumedang.

Based on the mother tree selection and seed collection plan prepared by IFSP and supervised by the BPTH staff, each farmer group collected seeds from 10 or more trees growing on their land, with each group collecting an average of 2 kg of seeds. The BPTH staff assembled the seed lots from each farmer group and mixed them to form a bulk seed lot. Three-fourths of the bulk seed lot was equally divided and redistributed to each farmer group. The remaining one-fourth was used to establish a one-hectare seed orchard.

The bulk seed lot, containing seeds from six provenances (land races) has a broader genetic base than seed collected by farmers through traditional methods. The use of seed collection guidelines and visual comparison by the farmer groups indicated that the bulk seed lot was genetically and physiologically superior to previous collections. The seed orchard is expected to produce good-quality seeds to supply local seed needs and increase tree productivity and land productivity.

Seed exchange in Nusa Tenggara. Since the early 1990s, Winrock International, a US-based development organization, has been providing small grants, information materials and training to help non-governmental organizations (NGOs) and farmer groups in developing agroforestry innovations in Nusa Tenggara and Java. In 2000, the World Agroforestry Centre (ICRAF) joined Winrock and its partner government agencies to raise tree seed awareness and technical capacity of NGOs and farmer groups in Southern Sumatra, West Java and Nusa Tenggara.

ICRAF and its partners provided trainings, distributed high-quality seeds of selected species and supported the establishment of farmer seed orchards and NGO/farmer-operated tree seed supply enterprises. More than 100 NGO staff are now well-trained in seed technology and seed source management, and more than 1 000 farmers are now knowledgeable in seed technology and are receiving small amounts of high-quality seeds.

Moreover, the number of farmers (individual or group) collecting tree seeds for their own use or for sale is increasing. Most farmer groups annually collect about 100 kg of tree seeds of various species. Some of the groups sell seeds locally while most entrust the seeds to NGOs, which in turn find markets for them. A network, called KMPNT (Consortium of Farmer Community in Nusa Tenggara), enables NGOs to exchange information, products, tree seeds and seedlings between the farmer groups.

The NGO-based tree seed exchange has been very effective in East Nusa Tenggara. For example, the Yayasan Mitra Tani Mandiri (YMTM) in Kefa has six farmer groups in five villages who are actively collecting and supplying species such as gamal (*Gliricidia sepium*), lamtoro (*Leucaena leucocephala*), sandalwood (*Santalum album*), jambu mete (*Anacardium occidentale*), kayu merah (*Pterocarpus* spp.) and teak (*Tectona grandis*).

Two farmer groups serve as seedling suppliers for species such as mahogany (*Swietenia macrophylla*), teak, kayu merah, *Gmelina arborea*, jambu mete and orange. Small quantities of seedlings are planted on their own lands, while the remaining seedlings are sold to various buyers from local government agencies, projects, NGOs and government institutions from Timor Leste.

Farmer groups exchange seeds or seedlings with other villages or sub-districts. The NGO usually distributes information on the seeds and seedling stocks to other NGOs or government agencies by distributing brochures and letters and serving as the facilitator between buyers and the sellers (farmers).

There is a big potential to market

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tree seeds to Indonesia's neighbor, Timor Leste (East Timor). Another big market for tree seedlings is the local government agencies who use tree seeds in their national land rehabilitation and reforestation programs.

Meanwhile, the YMTM in Bajawa, Flores, is operating a similar system for its farmer groups. It links closely with YMTM Kefa, especially when there is a need for seed stocks. YMTM Bajawa, for instance, exchanges its surplus gamal seeds with the surplus mahogani seeds of YMTM Kefa. A similar system is used by Yayasan Tananua operating in Timor, Sumba and Flores. ■*The author is a tree germplasm specialist at the World Agroforestry Centre-Southeast Asia.*

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The state will witness the real "green revolution" when it is covered with greenery consisting of trees. Punjab's new socioeconomic policies have brought forestry and agriculture closer than ever.

Moreover, support from different donor agencies to strengthen the research and extension base is encouraging farmers to try agroforestry. The Punjab State Forest Department has been giving financial support to agroforestry adopters (an incentive of US$225 per hectare for the first three years) to diversify the present land use system and to conserve the state's natural resources. ■*The authors can be contacted at the Department of Forestry and Natural Resources, Punjab Agricultural University, Ludhiana-141 004, India.*

Photosynthetically active radiation affects tree-crop growth and productivity in semi arid, rainfed agroforestry

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Tree-crop intercropping has the potential to increase biomass production per unit area, but tree shade can inhibit crop growth. The Indian Grassland and Fodder Research Institute (IGFRI) conducted a study to help improve farming techniques by studying the effects of availability of photosynthetically active radiation (PAR) diffused through different tree canopies in tree-crop intercropping.

The study was carried out in Jhansi (25°272' N, 78°352' E and 271 m asl), central India. The area is semi-arid with an mean annual rainfall of 900 mm, most of which falls from July-September. It has adverse agroclimatic conditions and undulating soil with poor fertility.

In the study, chickpea (*Cicer arietinum*) and barley (*Hordeum vulgare*) were grown under the tree canopy of siris (*Albizzia lebbek*), neem (*Azaderachta indica*), sisam (*Dalbergia sissoo*) and babul (*Acacia nilotica*) during the winter seasons of 2004 and 2005. A succeeding crop of cowpea (*Vigna ungiculata* L.) was raised during the monsoon season.

Height, collar diameter, diameter at breast height (DBH) and crown diameter were recorded for the canopy trees prior to the sowing of cowpea (Table 1). Observations were recorded on green and dry biomass production and crude protein yield of the understorey cowpea (Table 2). Under-canopy PAR and specific leaf weight (SLW) of cowpea were recorded.

The trees' growth parameters such as tree height, collar diameter, DBH and crown area were influenced by the preceding winter crop (barley and chickpea). *Albizzia* showed a significant increase in height when chickpea was grown under the tree canopy. The collar diameter was

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Table 1. Growth data of trees prior to the sowing of cowpea (June 2004).

Treatments	Tree height (m)	Collar diameter (cm)	DBH (cm)	Crown area (m^2)
Siris (solo)	6.33	22.85	18.5	41.93
Siris + barley	7.35	18.4	14.25	43.74
Siris + chickpea	8.6	22.95	17.5	51.24
Neem (solo)	7.05	17.45	13.6	19.14
Neem + barley	7.1	17.95	15.3	20.99
Neem+ chickpea	6.1	17.65	15.35	25.91
Sisam (solo)	9.35	25.3	18.95	37.02
Sisam+ barley	8.2	20.1	15.95	26.14
Sisam + chickpea	8.85	21.15	18	28.94
Babul (solo)	7.9	22.35	18.45	41.16
Babul + barley	8.05	21.6	18.4	41.9
Babul+ chickpea	7.95	21.8	17.7	41.59
CD (5%)	2.33	4.66	3	9.09