AGROFORESTRY PRINCIPLES

BY DR. FRANKLIN W. MARTIN & SCOTT SHERMAN

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INTRODUCTION

WHAT IS AGROFORESTRY?

In simplest language, agroforestry is the production of trees and of non-tree crops or animals on the same piece of land. The crops can be grown together at the same time, can be grown in rotation, or can even be grown in separate plots when materials from one are used to benefit another. However, this simple definition fails to take into account the integrated concepts associated with agroforestry which makes this system of land management possibly the most self-sustaining and ecologically sound of any agricultural system. Thus a second definition of agroforestry would be the integration of trees, plants, and animals in conservative, long-term, productive systems. Agroforestry can be considered more as an approach than as a single finished technology. Although several finished systems have been devised and tested, such technology may require adjustment for particular situations. The flexibility of the agroforestry approach is one of its advantages.

WHY AGROFORESTRY?

Agroforestry systems make maximum use of the land. Every part of the land is considered suitable for plants that are useful. Emphasis is placed on perennial, multiple purpose crops that are planted once but yield benefits over a long period of time. Furthermore, systems of agroforestry are designed for beneficial interactions of the crop plants, and to reduce unfavorable interactions. They are designed to reduce the risks associated with agriculture, small scale or large, and to increase the sustainability of agriculture. Agroforestry practices normally help conserve, and even improve, the soil.

Agroforestry includes a recognition of the interactions of crops, both favorable and unfavorable. The most common interaction is competition, which may be for light, water, or soil nutrients. Competition invariably reduces the growth and yield of any crop. Yet competition occurs in monoculture as well and this need not be more deleterious in agroforestry systems. Interactions may be complementary, as in the case of trees, pasture, and foraging animals, where trees provide shade and/or forage, and animals provide manure.

Agroforestry systems are designed to produce a range of benefits including food, feed, fuels, often fibers, and usually renewed soil fertility.
Agroforestry systems take advantage of trees for many uses, to hold the soil, to increase fertility through nitrogen fixation, or through bringing minerals from deep in the soil and depositing them by leaf-fall, to provide shade, construction materials, foods and fuel.

Agroforestry systems may be thought of as principle parts of the farm system itself, which contains many other sub-systems that together define a way of life.

**DEFINITIONS**

**Alley Cropping:** Growing annual crops between rows of trees.

** Beautification:** Planting trees for ornamental purposes.

**Boundary Plantings:** Trees planted along boundaries or property lines to mark them well.

**Dispersed Trees:** Trees planted alone or in small numbers on pastures or otherwise treeless areas.

**Earthworks:** Constructions made of earth, usually to conserve or control water.

**Improved Fallows:** Areas left to grow up in selected trees as part of a trees-crop rotation system.

**Individual Trees:** Trees occurring alone, whether spontaneously or planted.

**Living Fences:** Fences in which the poles are living trees, or in which all of the fence consists of closely-spaced trees.

**Nectar Crop:** Trees valuable as a source of nectar for honey bees.

**Terraces:** Level areas constructed along the contours of hills, often but not necessarily planted with trees.

**Vegetative Strips:** Long, narrow areas of any type of vegetation, usually planted along contours for erosion control; may include trees.

**Woodlot:** An area planted to trees for fuel, or timber.

**SUMMARY OF BENEFITS OF AGROFORESTRY**

- Improved year-round production of food and of useful and salable products.
- Improved year-round use of labor and resources.
- Protection and improvement of soils (especially when legumes are included) and of water sources.
- Increased efficiency in use of land.
- Short term food production offsetting cost of establishment of trees.
- Furnishing of shade for vegetable or other crops that require it or tolerate it.
- Medium and long-term production of fruits.
- Long term production of fuel and timber.
- Increase of total production to eat or to sell.

**COMPONENTS OF AN AGROFORESTRY SYSTEM**

**LAND**

Agroforestry is not a system of pots on the balcony nor for the greenhouse. It is a system to manage the agricultural resource, land, for the benefits of the owner, and the long-term welfare of society. While this is appropriate for all land, it is especially important in the case of hillside farming where agriculture may lead to rapid loss of soil. Normally land will be what the farmer owns (farmers that rent land may have little interest in the long term benefits of agroforestry), and thus farmers must think conservatively, how the land can be maintained over long periods of time.
Trees

In agroforestry, particular attention is placed on multiple purpose trees or perennial shrubs. The most important of these trees are the legumes because of their ability to fix nitrogen and thus make it available to other plants. The roles of trees on the small farm may include the following:

- Sources of fruits, nuts, edible leaves, and other foods.
- Sources of construction material, posts, lumber, branches for use as wattle (a fabrication of poles interwoven with slender branches etc.), thatching.
- Sources of non-edible materials, including sap, resins, tannins, insecticides, and medicinal compounds.
- Sources of fuel.
- Beautification.
- Shade.
- Soil conservation, especially on hillsides.
- Improvement of soil fertility.

In order to plan for the use of these trees in agroforestry systems considerable knowledge of their properties is necessary. Desirable information includes the uses described above, the climatic adaptations of the species, including adaptations to various soils and stresses, the size and form of the canopy as well as the root system, and the suitability for various agroforestry practices.

Some of the most common uses of trees in agroforestry systems are:

- Individual trees in home gardens, around houses, paths, and public places.
- Dispersed trees in cropland and pastures.
- Lines of trees with crops between (alley cropping).
- Strips of vegetation along contours or waterways.
- Living fences and borderlines, boundaries.
- Windbreaks.
- Improved fallows.
- Terraces on hills.
- Small earthworks.
- Erosion control on hillsides, gullies, channels.
- Woodlots for the production of fuel and timber.

Some very good food-bearing trees for agroforestry are given in Table 1. Table 2 lists some of the best of the non-food producing trees used in agroforestry. Some successful uses of trees in isolation are given in table 3.

Non-Tree Crops

Any crop plant can be used in agroforestry systems. The choice of crop plants in designing such systems should be based on those crops already produced in a particular region either for marketing, feeding animals, or for home consumption, or that have great promise for production in the region. In keeping with the philosophy of agroforestry, however, certain other values should be pursued in the choice of crops, including:

- Crops for making money.
- Crops for feeding the farmer.
- Crops for good nutrition.
- Crops for self sufficiency.
- Crops for feeding the animals.
- Crops for protecting the soil.
Thus, selection of crops requires a judgement based on knowledge of the crops, adaptations, production uses, as well as family needs, opportunities for barter, and markets.

Any farm animal can be used in agroforestry systems. The choice of animal will be based on such values as:

- Animals for making money.
- Animals for feeding the farmer.
- Animals for supplying labor.
- Animals for non-food products.
- Animals for using crop residues.
- Animals for furnishing manure.

Some examples of the use of trees, crops, and animals together are given in table 4.

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>Edibility</th>
<th>Principle Uses In Agroforestry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anacardium occidentale</td>
<td>Cashew</td>
<td>flowers, seeds</td>
<td>garden, fence, pasture</td>
</tr>
<tr>
<td>Annona muricata</td>
<td>Soursop</td>
<td>flowers</td>
<td>garden, fence, pasture</td>
</tr>
<tr>
<td>Borassus aethiopicum</td>
<td>Borassus palm</td>
<td>multiple food</td>
<td>garden, pasture</td>
</tr>
<tr>
<td>Cajanus cajan</td>
<td>Pigeon Pea</td>
<td>seed, leaves</td>
<td>hills, nitrogen fixation, fuel, hedgerows</td>
</tr>
<tr>
<td>Cajanis cajan</td>
<td>Pigeon Pea</td>
<td>seed, leaves</td>
<td>hills, nitrogen fixation, fuel, hedgerows</td>
</tr>
<tr>
<td>Cajania cajan</td>
<td>Pigeon Pea</td>
<td>seed, leaves</td>
<td>hills, nitrogen fixation, fuel, hedgerows</td>
</tr>
<tr>
<td>Carica papaya</td>
<td>Papaya</td>
<td>flowers</td>
<td>garden, quick shade</td>
</tr>
<tr>
<td>Cnidoscolus chayamansa</td>
<td>Chaya</td>
<td>leaves</td>
<td>rapid hedge</td>
</tr>
<tr>
<td>Cocos nucifera</td>
<td>Coconut</td>
<td>multiple uses</td>
<td>pasture, roadside, construction</td>
</tr>
<tr>
<td>Coffea arabica</td>
<td>Coffee</td>
<td>seeds (bean)</td>
<td>hedges, hills, fuel</td>
</tr>
<tr>
<td>Gliricidia sepium</td>
<td>Mother of Cacao</td>
<td>flowers</td>
<td>living fence, feed, fuel</td>
</tr>
<tr>
<td>Leucaena leucocephala</td>
<td>Leucaena</td>
<td>leaves</td>
<td>hills, alley cropping, nitrogen fixation</td>
</tr>
<tr>
<td>Manihot esculenta</td>
<td>Cassava</td>
<td>roots, leaves</td>
<td>rapid hedge</td>
</tr>
<tr>
<td>Moringa pterygosperma</td>
<td>Drumstick</td>
<td>leaves, flowers</td>
<td>fence, garden</td>
</tr>
<tr>
<td>Theobroma cacao</td>
<td>Cocoa</td>
<td>pulp, seeds</td>
<td>understory tree, pasture</td>
</tr>
<tr>
<td>Psidium guajava</td>
<td>Guava</td>
<td>flowers</td>
<td>pasture, fuel</td>
</tr>
<tr>
<td>Sauropus androgynus</td>
<td>Katuk</td>
<td>leaves</td>
<td>hedge, alley cropping</td>
</tr>
<tr>
<td>Yucca elephantipes</td>
<td>Izota</td>
<td>flowers</td>
<td>hedge</td>
</tr>
<tr>
<td>Zizyphus mauritiana</td>
<td>Jujube</td>
<td>flowers</td>
<td>erosion control, fuel</td>
</tr>
</tbody>
</table>

*Any tree can be used in agroforestry systems, including all trees with edible products. In actual practice, very large trees are usually not used in agroforestry except casually, not by design.
Table 2. **PRINCIPLE TREES FOR AGROFORESTRY SYSTEMS** (especially for hillsides)*

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>Principal Uses In Agroforestry</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acacia albida</em></td>
<td>Apple-ring acacia</td>
<td>terraces, dispersed trees, forage, nitrogen fixing</td>
</tr>
<tr>
<td><em>Acacia mearnsii</em></td>
<td>Black Wattle</td>
<td>terraces, borderlines, roads, fuel, nitrogen fixing</td>
</tr>
<tr>
<td><em>Bursera simaruba</em></td>
<td>Gumbo limbo</td>
<td>living fences, fuel</td>
</tr>
<tr>
<td><em>Calliandra calothyrsus</em></td>
<td>Calliandra</td>
<td>vegetation strips, fallows, windbreaks, fuel</td>
</tr>
<tr>
<td><em>Cassia siamea</em></td>
<td>Siamese acacia</td>
<td>terraces, fuel, nitrogen fixing</td>
</tr>
<tr>
<td><em>Erythrina berteroana</em></td>
<td>Dwarf machete</td>
<td>living fences, feed, rapid cover, nitrogen fixing</td>
</tr>
<tr>
<td><em>Gliricidia sepium</em></td>
<td>Mother of Cacao</td>
<td>living fences, feed, fuel, hardwood</td>
</tr>
<tr>
<td><em>Leucaena leucocephala</em></td>
<td>Leucaena</td>
<td>alley cropping, soil conservation, food, nitrogen fixing</td>
</tr>
<tr>
<td><em>Moringa oleifera</em></td>
<td>Drumstick</td>
<td>living fences, rapid cover</td>
</tr>
<tr>
<td><em>Sesbania sesban</em></td>
<td>Agati</td>
<td>rapid cover, feed, nitrogen fixing</td>
</tr>
</tbody>
</table>

*Any tree can be used in agroforestry systems, including all trees with edible products. In actual practice, very large trees are usually not used in agroforestry except casually, not by design.*

**See also Table 1**

Table 3. **SOME EXAMPLES OF SUCCESSFUL USES OF TREES ON SMALL FARMS**  
(not necessarily in combination with other corps)*

<table>
<thead>
<tr>
<th>Location</th>
<th>System</th>
<th>Tree Crop</th>
<th>Benefits</th>
<th>Other Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central America</td>
<td>Living fence</td>
<td><em>Erythrina, Yucca, Gliricidia</em></td>
<td>food, feed</td>
<td></td>
</tr>
<tr>
<td>Tropics</td>
<td>Windbreaks</td>
<td><em>Casuarina</em></td>
<td>fuel</td>
<td></td>
</tr>
<tr>
<td>Central Africa</td>
<td>Dispersed trees</td>
<td><em>Acacia albida</em></td>
<td>fuel, feed, erosion control</td>
<td></td>
</tr>
<tr>
<td>Niger</td>
<td>Improved fallows</td>
<td><em>Acacia mearnsii, Leucaena, Sesbania</em></td>
<td>soil fertility restoration</td>
<td>grasses</td>
</tr>
<tr>
<td>India</td>
<td>Earthworks</td>
<td><em>Dalbergia, Pongamia, Prosopis, others</em></td>
<td>food, soil conservation</td>
<td>napier grass, mando grass</td>
</tr>
<tr>
<td>Tropical Africa</td>
<td>Gully Protection</td>
<td><em>Tamarix</em></td>
<td>food, soil conservation</td>
<td>grasses</td>
</tr>
</tbody>
</table>

* only a very small part of the potential uses.
Table 4. **SOME EXAMPLES OF SUCCESSFUL AGROFORESTRY SYSTEMS OF TREES AND CROPS.**

<table>
<thead>
<tr>
<th>Location</th>
<th>System</th>
<th>Tree Crop</th>
<th>Benefits</th>
<th>Understory Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costa Rica</td>
<td>dispersed trees</td>
<td><em>Cordia almifolia</em></td>
<td>lumber, shade, nutrients</td>
<td>coffee</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>dispersed trees</td>
<td><em>Erythrina</em> spp.</td>
<td>nitrogen, fuel, shade, nutrients</td>
<td>coffee</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>dispersed trees</td>
<td><em>Inga</em> spp.</td>
<td>shade, nitrogen, fuel, wood</td>
<td>coffee, bananas, root crops</td>
</tr>
<tr>
<td>El Salvador</td>
<td>dispersed trees</td>
<td><em>Inga</em> spp.</td>
<td>fuel, nitrogen, shade</td>
<td>coffee, cacao</td>
</tr>
<tr>
<td>Central America</td>
<td>dispersed trees</td>
<td>leguminous trees, <em>Acacia albida</em></td>
<td>lumber, fuel, shade, special products, nitrogen</td>
<td>grains, pasture</td>
</tr>
<tr>
<td>Malaysia</td>
<td>dispersed trees</td>
<td>dwarf coconut</td>
<td>food, lumber</td>
<td>cacao</td>
</tr>
<tr>
<td>Tropics</td>
<td>dispersed trees</td>
<td>coconut</td>
<td>food, feed</td>
<td>pasture</td>
</tr>
<tr>
<td>Mexico</td>
<td>dispersed trees</td>
<td><em>Brosimim</em></td>
<td>food, lumber</td>
<td>wide variety of crops, pasture</td>
</tr>
<tr>
<td>Haiti</td>
<td>home garden</td>
<td>mango</td>
<td>fruit</td>
<td>rice</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>mixed perennials</td>
<td>many fruit trees</td>
<td>fruit, other products</td>
<td>spices, vegetables</td>
</tr>
<tr>
<td>Philippines</td>
<td>home garden</td>
<td>various fruit trees</td>
<td>fruits, edible leaves</td>
<td>many vegetables</td>
</tr>
<tr>
<td>West Africa</td>
<td>home garden</td>
<td>fruit trees</td>
<td>fruits</td>
<td>vegetables</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>mixed perennials</td>
<td>cacao, bananas</td>
<td>food</td>
<td>yams</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>mixed perennials</td>
<td>oranges, avocados, bananas</td>
<td>food, nutrients</td>
<td>coffee, root crops</td>
</tr>
<tr>
<td>Tropics</td>
<td>alley crop</td>
<td><em>Leucaena leucocephala</em></td>
<td>erosion control, fuel, nitrogen, nutrients</td>
<td>annuals, grasses</td>
</tr>
<tr>
<td>Nigeria</td>
<td>alley crop</td>
<td><em>Gliricidia sepium</em></td>
<td>erosion control, fuel, nitrogen, nutrients</td>
<td>root crops, grains</td>
</tr>
<tr>
<td>Rwanda</td>
<td>vegetative strips</td>
<td><em>Grevillia, Albizia, Leucaena</em></td>
<td>erosion control, fuel, nitrogen, nutrients</td>
<td></td>
</tr>
</tbody>
</table>

**GETTING STARTED WITH AGROFORESTRY SYSTEMS**

Steps in the decision-making process:

1. **Decide whether agroforestry systems are appropriate**
   - Describe family and community needs.
   - Find the limiting constraints in agriculture, including markets and marketing.
   - List the potential benefits of an agroforestry system in the region in question, and their relative importance.
   - Then decide if it is worth the effort to develop one.
   - Consider whether the people of the region are willing or capable of adopting a system.

2. **Design a system**
   - Select the area.
   - Characterize it (describe it, its strengths, weaknesses) with respect to existing soil, water, and crops.
   - List the needs that could be met with an agroforestry system.
   - Characterize the crops desired by minimum space requirements, water and fertilizer needs, and shade tolerance.
   - Select the trees, shrubs, or grasses to be used.
3. If the system is temporary
   • Plan the features of soil erosion control, earthworks, and gully maintenance first.
   • Plan spacing of fruit trees according to final spacing requirements.
   • Plan a succession of annual or short-lived perennials beginning with the most shade tolerant for the final years of intercropping.

If the system is permanent
   • Plan the proportion of the permanent fruit and lumber trees on the basis of relative importance to the farmer.
   • Plan the spacing of long-term trees on the basis of final space requirements times 0.5.
   • Plan succession of annual and perennial understory crops, including crops for soil protection and enrichment.
   • As large permanent trees grow, adjust planting plan to place shade tolerant crops in most shady areas.

4. In temporary and permanent systems:
   • Keep all ground in crops or protective covers at all times.
   • Try the system on a small scale first.
   • Measure the inputs and outputs of the system.
   • Evaluate whether the benefits expected have been achieved.
   • Look for the desired plant materials or for suitable substitutes locally (Table 5).
   • Expand or extend any new system cautiously.

### SEED SOURCES FOR AGROFORESTRY TREES

<table>
<thead>
<tr>
<th>TREE SPECIES</th>
<th>ADAPTATION*</th>
<th>POSSIBLE SOURCE OF SEEDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia albida</td>
<td>hot, dry tropics</td>
<td>CATIE, ILCA, KI, SSC, TSP</td>
</tr>
<tr>
<td>Acacia mearnsii</td>
<td>hot, dry tropics</td>
<td>CSIRO, KFSC, KI, SSC, TSP</td>
</tr>
<tr>
<td>Bursera simaruba</td>
<td>hot, dry tropics</td>
<td>FKNN, SFF</td>
</tr>
<tr>
<td>Calliandra calothyrsis</td>
<td>wet tropics</td>
<td>CATIE, TBAIF, TSP</td>
</tr>
<tr>
<td>Cassia siamea</td>
<td>intermediate tropics</td>
<td>CATIE, ILCA, KFSC, KI, SSC</td>
</tr>
<tr>
<td>Erythrina berteroana</td>
<td>intermediate tropics</td>
<td>CATIE</td>
</tr>
<tr>
<td>Gliricidia sepium</td>
<td>intermediate tropics</td>
<td>CATIE, ILCA, KI, TBAIF, TSP</td>
</tr>
<tr>
<td>Leucaena leucocephala</td>
<td>intermediate tropics</td>
<td>CATIE, ECHO, ILCA, KFSC, KI</td>
</tr>
<tr>
<td>Moringa oleifera</td>
<td>intermediate tropics</td>
<td>CATIE, ECHO, ILCA, SSC, TBAIF</td>
</tr>
<tr>
<td>Sesbania grandiflora</td>
<td>intermediate tropics</td>
<td>CATIE, ILCA, KI, SSC, TBAIF</td>
</tr>
<tr>
<td>Sesbania sesban</td>
<td>intermediate tropics</td>
<td>KI, TBAIF, TSP, UH</td>
</tr>
</tbody>
</table>

* Intermediate condition suggests a region of intermediate rainfall.

**Source Abbreviations**
- ATSC - Australian Tree Seed Centre
- CSIRO Division of Forestry and Forest Products, PO Box 4008 Queen Victoria Terrace, Canberra, ACT 2600, Australia
- CATIE - Centro Agronomico Tropical de Investigacion y Esperanza
  Turrialba, Cartage, Costa Rica
- ECHO - Educational Concerns for Hunger Organization
  17391 Durrance Rd., North Ft. Myers, FL 33917, USA
Agroforestry

FKNN- Florida Keys Native Nursery
   102 Mohawk St., Travernier, FL  33070, USA
ILCA- International Livestock Center for Africa
   P.O. Box 5689, Addis Ababa, Ethiopia
KFSC- Kenya Forestry Seed Centre
   KARI, P.O. Box 74, Kikuyu, Kenya
KI- Kumar International
   Ajitmal 206121, Etawah (UP), India
SFF- Southern Florida Forests
SSC- Shivalik Seeds Corporation
   Panditwari, P.O. Prem Nagar, Dehra Dun - 248007 (UP), India
TBAIF- The Bharatiya Agro Industries Foundation
   'Kamdhenu', Senapat Bapat Marag, Pune-411 016, India
TSP- Tree Seed Program
   Ministry of Energy & Regional Development, P.O. Box 21552, Nairobi, Kenya
UH- University of Hawaii
   Department of Agronomy & Soil Science, U. of H. at Manoa, 190 East-West Road, Honolulu, HI  96822, USA

RELATED RESOURCES & ORGANIZATIONS

Agroforestry Seed Information Clearing House (Pamela Fernandez, Department of Agronomy, University of the Philippines at Los Banos, College, Laguna 3720, Philippines). Information.

CARE (660 First Ave., New York, NY  10016, USA). Information.

Carter Seed Co. (475 Mar Vista Drive, Vista CA  92083, USA). Seeds.

Centro de Mejoramiento Genetico y Banco de Semillas Forestales de Nicaragua (Magaly Urbina M., Director, Km. 12 1/2 Carretera Norte, Managua, Nicaragua, phone; 505-2 31622, fax: 505-2 31623). Seeds.

DANIDA (Forest Seed Centre, Krogerupvij 3A, DK-3050, Humleback, DENMARK). A project of the Danish International Development Agency offering information and library service, publications and training to countries which Denmark renders support. Information.

Forestry Fuelwood Research and Development Project (F/FRED, Winrock International, 1611N. Kent St. Suite 600, Arlington, VA 22209, USA). Information.

Forestry Support Program (International Forestry, USDA Forest Service, P.O. Box 96090, Washington, DC 20090-6090). Provides technical assistance in forestry and natural resources to USAID and U.S. Peace Corps.

Henry Doubleday Research Association (Dr. Phil Harris, Overseas Projects Coordinator, HDRA, Ryton-on-Dunsmore, Coventry, CV8 3LG, UK). Information & seed for groups working in Africa and the Indian sub-continent, especially drought tolerant Prosopis species.


Institute of Tropical Forestry (P.O. Box 25000, Rio Piedras, PR 00928-2500, USA). Information.
International Centre for Research in Agroforestry (ICRAF, P.O. Box 30677, Nairobi, Kenya, e mail: icraf@cgnet.com) Newsletter, Information & Seeds.

International Society of Tropical Foresters (ISTF, 5400 Grosvenor Lane, Bethesda, MD 20814, USA). Newsletter and Information.


KENGO (P.O. Box 48197, Nairobi, Kenya). Information.

Kimseed (Australian Revegetation Corporation Ltd., 51 King Edward Road, Osborne Park 6017, Western Australia). Extensive inventory of arid land trees & shrubs and equipment for planting, harvesting etc.


NiTAL Project (Department of Agronomy and Soil Science, University of Hawaii, P.O. Box 0, Paia, HI 96779, USA). Rhizobia.

Oxford Forestry Institute (Plant Science Department, South Parks Road, Oxford OX1 3RB, UK). Seeds.


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