

Practical Approaches to Species Selection

Trees for Improving Sustainability, Resource Conservation, and Profitability on Farms and Ranches

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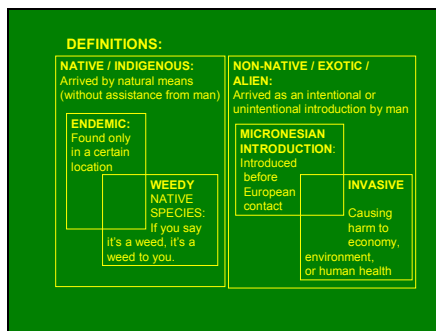
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Slide 1



In the Pacific there are many hundreds of species of native trees. Many other species have been introduced by the original Micronesian settlers of the islands, while others have been introduced since Western contact. Agroforestry programs in the Pacific in the past focused on a few, non-native species, but today there is great interest in learning how to grow and use traditional and native species. One way of selecting among all these species is to run potential choices through a series of questions or filters to help select trees that will work in a particular situation.

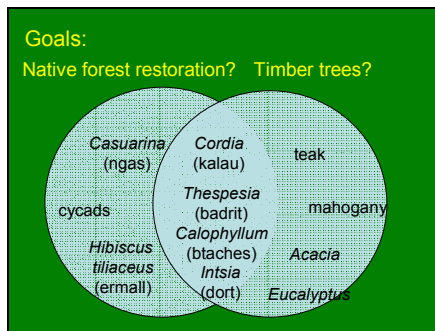
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Some definitions are in order. Native or indigenous trees arrived by natural means (hitchhiking on birds, blown on the wind, or carried in the ocean waves) without assistance of man. 'A'ali'i, *Dodonea viscosa*, is an example of an indigenous tree in Hawai'i that is native both to Hawai'i and many other places in the tropics. Endemic trees are a subset of indigenous trees. These evolved in a certain location and are found only there. Koa and 'ōhi'a are both endemic to Hawaii and found nowhere else. Native trees may

be weeds, if they interfere with agriculture or other land uses. Non-native, alien, or exotic trees are those that people brought to a place. A special subset of these trees are those like kukui (*Aleurites moluccana*) and kamani (*Calophyllum inophyllum*) in Hawaii that the aboriginal Polynesian settlers brought with them. Invasive plants are those non-native plants which cause either economic or ecological harm. Most alien species are not invasive.

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The first question should be ‘what are your goals for planting trees?’ Do you want to restore native forests? Do you want to grow timber? Do you want to restore degraded lands? In Micronesia, native tree species that are prime timbers include *Cordia subcordata* (kalau or niyoron), *Thespesia populnea* (badrit or kilulo), *Calophyllum inophyllum* (btaches or daog), and *Intsia bijuga* (dort or ifit). Exotic timber species that have been planted in Micronesia include many species of *Eucalyptus*, *Acacia*, and mahogany. Of course, many different tree species can be grown on one farm.

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Your goals may include food production for your family or for commercial sale.

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Trees may be part of a cropping system on a farm in an agroforestry system where they provide services such as windbreaks or shade for coffee. Trees may also be part of a farming system, where they are not in proximity to other crops but are another potential source of farm income.

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Your goals may also include creating a beautiful place to live.

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Trees can help hold soil, improve microclimates, and help bring degraded sites back to life. Species chosen to rehabilitate these sites need to be able to survive in poor sites with flooding, acid soils, dry sandy soils, exposed to wind, or exposed to fire, and grow quickly. Other, more useful species may be planted later.

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The next set of questions to help narrow down tree choices are about what trees can grow on your land. Most trees are adapted to wetter or drier locations. While we think of elevation as important, really elevation and latitude represent changes in temperature and rainfall. Hawai'i is at a relatively high latitude in the tropics and therefore relatively cool, so trees that grow at higher elevations near the equator might only grow well at lower elevations here. While most soils in Hawaii are acidic clay soils, on the Big Island many soils are very young and over either 'a'ā or pāhoehoe lava. Many species of trees do not do well on young, thin soils. Since the world literature holds little information on performance of trees on lava soils, your best bet is to rely on Hawai'i experiences. Pests and diseases such as koa wilt or nematodes may be more severe at lower, warmer elevations.

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In the forestry business there are large economies of scale. Growers need to think about what markets they can supply. A single mahogany tree may have value for its wood for storyboards, whereas you need tens of thousands of acres of eucalyptus to enter the chip market. Small acreages of high value cabinet timber may find local markets in Pacific Islands today. Markets will improve as better technology for harvesting and processing wood becomes available, but competition from other tropical countries will also increase.

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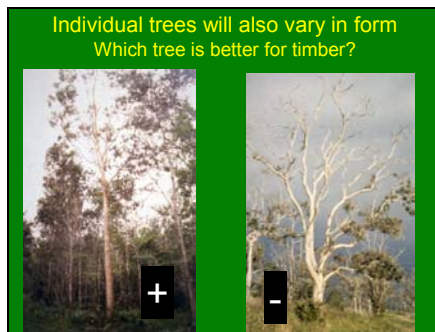
Trees are good for more than timber. Trees on farms can provide many other products and services, such as shade for coffee and other shade loving crops, forage for animals, soil fertility improvements, and service as windbreaks. Start by asking what agroforestry products and services are needed on your farm, then what species of trees can provide these.

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The work isn't done once a species is chosen. Within species, it is important to choose trees with the best genetics. If genetically improved stock is available it is worth the cost. If you are collecting your own seed, collect seed from genetically superior trees. Characteristics such as height, straightness, and growth rate are inherited from the parent trees, so if the seed is collected from superior trees the progeny will inherit those characteristics. The photo shows a *Eucalyptus* plantation in Hawai'i.


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In a given location, individual trees may vary greatly in form. Seed should be collected from the best trees available. The photos show two koa trees growing in the Kona region. The tall, straight tree on the left will likely produce tall, straight offspring if all goes well with the plantation. The tree on the right may be crooked because it was damaged as a young tree, or it may have poor genetics. If it is genetically crooked, the seedlings will likewise tend to be crooked.

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Does the species have the potential to become a problem weed?
Valuable trees which have become ecological pests



Falcataria moluccana, aka *Paraserianthes falcataria*, *Albizia falcataria*
albizia

The last decision to make about what trees to plant is whether the chosen species are likely to escape cultivation and become weeds. Of the hundreds of trees introduced to Hawai'i for forestry, several dozen have become weed that are serious pests of natural ecosystems and range lands. One of the worst is albizia, *Falcataria moluccana*.

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- Huge trees
- One of the fastest-growing the in the world
- Used for lumber, pulp, agroforestry
- Nitrogen-fixer

Albizia was planted because it is one of the fastest growing trees in the world and was thought to have the potential to make a contribution to Hawai'i forestry. It is an important pulp species in Asia. It fixes nitrogen and improves the soil fertility. It is not a bad tree. But in Hawai'i...

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But... also one of the worst pests
Currently invading and destroying wet native 'ohi'a forest in Hawai'i



ALBIZIA
THE TREE THAT STEALS PUNA
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© 2006 Fred Hughes

Albizia has become one of Hawaii's worst invasive species. It has the ability to invade intact 'ohi'a forests in Puna, O'ahu, and Kaua'i, where it overtops the native trees and shades them out. It facilitates invasion of strawberry guava (*Psidium cattianum*) in the understory and may even create habitat for coqui frogs. It is also an economic burden. Huge albizia trees that break easily in storms are a hazard for nearby houses and roads.

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**Hawai'i - Pacific
Weed Risk Assessment**

- A quantitative assessment of how likely a plant is to escape cultivation and become a weed
- Developed by UH Botany and USDA Forest Service
- Questions such as does the plant fix N, is the seed wind or bird dispersed, and is it a problem weed elsewhere
- Scores over 6 are likely to be weeds; less than zero are OK
- Examples: *Dalbergia sissoo* (13) problem, *Araucaria columnaris* (-5) OK
- Over 500 species tested so far
- www.botany.hawaii.edu or CD



The best single tool to help you decide whether a tree is an invasive species, aside from your own experience, is the Hawaii - Pacific Weed Risk Assessment system. This system, developed by the Curt Daehler at the UH Botany Department and Julie Denslow at the USDA Forest Service, creates a numerical score for each species based on answers to questions such as whether the species fixes nitrogen, is wind or bird dispersed, and most importantly whether it is a problem weed elsewhere in the world. The scores for each question are totaled and compared to a standard. Scores over 6 indicate that the tree is likely to become an invasive weed and should be avoided. Scores below 0 mean the tree is probably ok. Some trees fall in the middle and need further evaluation. Examples are the Indian rosewood, *Dalbergia sissoo*, which scores a 13 and indeed is a pest in Florida and Queensland, and Cook Island Pine, *Araucaria columnaris*, which has been safely grow in Hawaii for decades and scores a low -5.

More than 300 plant species have been scored so far, including many tree species. The scores and more about the system can be seen on the UH Botany website, <http://www.botany.hawaii.edu/faculty/daehler/wra/>.

Much information on weediness

of Pacific Island species is contained on the Pacific Island Ecosystems at Risk CD, produced by Jim Space and the USDA Forest Service.

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Assess the potential for a tree to become invasive

Acacia mangium

- N-fixer
- Adaptable, fast growing
- Merchantable wood
- No HPWRA rating but...






<i>Acacia eucalyptiformis</i>	Darwin Black Wattle	13 H
<i>Acacia confusa</i>	Formosan koa	10 H
<i>Acacia crassicaarpa</i>	northern wattle	7 H
<i>Acacia farnesiana</i>	sweet acacia	14 H
<i>Acacia longifolia</i>	Sidney goldern wattle	10 H
<i>Acacia mearnsii</i>	Australian acacia	15 H
<i>Acacia melanoxylon</i>	Australian blackwood	12 H
<i>Acacia nilotica</i>	gum arabic tree	14 H
<i>Acacia parramattensis</i>	Parramatta green wattle	9 H

If the tree you want to plant has no Weed Risk Assessment score, you can still assess whether it is likely to become a weed by comparing it with other species in the genus. Since most *Acacia* species are potentially invasive, probably *Acacia mangium* would not be a good tree to plant in an area where it is not growing already.

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Choose alternatives based on what functions the tree serves

- N-fixing
- Fast-growing
- Agroforestry uses
- Valuable timber

<i>Samanea saman</i> , monkeypod	<i>Pterocarpus indicus</i> , narra
HWRA = 4, low	HWRA = 4, low

You should choose safer alternatives to potentially weedy species. Consider what products or services the trees you want provide and then ask what other trees may provide the same products and services. Monkeypod (*Samanea saman*) and narra (*Pterocarpus indicus*) are both fast-growing, N-fixing trees, but neither is likely to travel far from where they are cultivated and become weeds.

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With the Weed Risk Assessment process, we are screening out some non-native tree species that have been useful but have the potential to become problem weeds. Rather than being left with a reduced number of trees in our toolkit, however, we can add new species, particularly native species that have been overlooked. Pacific Island foresters do not need to be limited to what American, or European, or Australian foresters have found to be useful. Pacific Islanders have a rich history of developing stable agroforestry systems before Western science was introduced to the islands and a wealth of traditional knowledge that precedes Western-style education. The needs of today, however, are for more the subsistence, and there are new challenges such as wildfire and severe erosion on large areas. The opportunity in all this is to identify native Pacific Island tree species that will provide the products and serve the purposes of the trees we now use without the threat of harming the native ecosystems.

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A new focus on tree domestication for the Pacific Islands

Bringing species into wider cultivation through a farmer-driven and market-led process

Paradigm shift away from:

- tree improvement - which is focused on trees
- reforestation activities - which are focused on environmental goals

World Agroforestry Centre

The following slides were modified from a slide show on Tree Domestication – An Overview, by James M. Roshetko

A talk presented at the Regional Workshop on the Domestication of Indigenous Tree Species Hanoi, Vietnam 17-21 March 2003

ICRAF & Winrock International – Bogor, Indonesia

www.worldagroforestrycentre.org/sea

Tree domestication may be thought of as the process of bring trees into cultivation. Key points are that the process is market driven and farmer led. Farmers, of course, have been doing tree domestication for millennia, and many of the common agroforestry trees of the Pacific were introduced there by the original inhabitants of the islands. Nonetheless, much is still unknown about their cultivation and use in the modern market economy and the modern environment.

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Tree Domestication Process: A continuum of activities

Marketing and Utilization

Silviculture techniques

Germplasm distribution

Germplasm multiplication

Propagation techniques

Tree breeding

Evaluation

Exploration and collection

- Can be repeated
- Does not proceed step-by-step
- Step can be omitted or other steps included

World Agroforestry Centre

“The process of tree domestication involves the identification, production, management and adoption of desired germplasm to meet farmer-driven or market-led needs. The domestication strategies used for individual species vary according to their functional use, biology, target environment, and the domesticator-researcher or farmer. Tree domestication can be as “naturalization” of a

species to improve its use by human kind, where the key input to the process is **germplasm** and **its quality**.” (Roshetko 2003).

Tree domestication does not proceed in a straight line. Farmers may find that markets demand a certain quality, and they may select trees to provide those products. If new markets develop for wild products, farmers will have an incentive to bring those trees into cultivation.

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The examples shown here include *Cordia subcordata*, called kalau in Palau, a valued Pacific Island tree. While the tree was common in traditional times, it is now becoming rare. Modern demands such as wood for carving crafts for tourists markets and lack of suitable coastal planting sites have contributed to the decline of the tree. While the tree is already “domesticated”, in the sense that people have valued it, more work needs to be done on selection, silviculture and management, and distribution of the tree. Foresters can develop extension literature and teach clients about growing alternative trees. Domestication is not just tree breeding. In fact, breeding is relatively unimportant for most agroforestry species.

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Tree Domestication for the Pacific and Nitrogen Fixing Trees

- What products are needed?
- What services are needed?
- Are the special qualities of NFTs needed?
- What native or non-invasive alien species can meet these needs?
- How can science help?



To start a tree domestication program, foresters and tree farmers need to think about what tree products are needed and what environmental services trees perform. The next question is what special qualities of trees - the ability to improve the soil, the ability to colonize poor sites, and the ability to produce high protein forages - are important to meeting those goals. If any of the species are invasive, are there either native or non-invasive alien trees which can serve the same purposes? How can western science and we help in tree domestication?

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www.traditionaltree.org



www.hawaii.edu
Search for "Forestry Extension"



Forestry trees

For information on various useful forestry and agroforestry trees in Hawaii and the Pacific, go to the "trees" page on the Hawaii Forestry Extension website, <http://www.ctahr.hawaii.edu/forestry/Data/trees.asp>. Here you will find photographs and information on many popular species in Hawaii and links to other web-based databases such as the Traditional Tree website (www.traditionaltree.org) or CD and the World Agroforestry Centre Agroforestry database (<http://www.worldagroforestrycentre.org/Sites/TreeDBS/AFT/AFT.htm>). Consult with professional foresters, with the University, and the USDA Natural Resources Conservation Service. Lastly, talk with your neighbors and see what is doing well on neighborhood farms.