NFT Highlights

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A quick guide to useful nitrogen fixing trees from around the world

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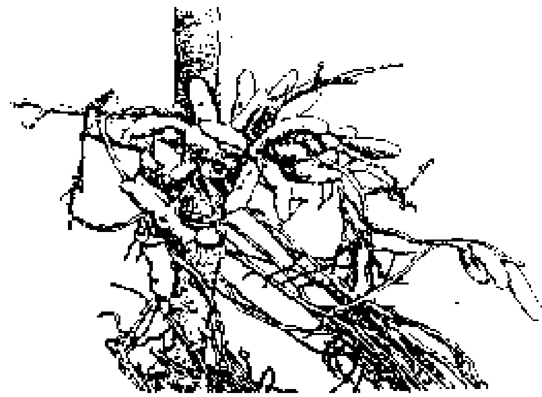
Why Nitrogen Fixing Trees?

Nitrogen fixing plants are key constituents in many natural ecosystems in the world. They are the major source of all nitrogen that enters the nitrogen cycle in these ecosystems. Many nitrogen fixing plants are woody perennials, or nitrogen fixing trees (NFTs), most of these being found in the tropics. In temperate areas, the nitrogen fixers tend to be herbaceous.

NFTs have been removed or reduced in most man-made ecosystems, such as agricultural and forest lands and urban environments. These lands require expensive chemical fertilizer inputs in order to maintain their productivity. Manmade systems can be improved by learning and adopting from natural ecosystems. For example, the reintroduction of NFTs, with appropriate management, can increase and sustain productivity. Agroforestry land-use practices do this.

No plant grows without nitrogen, and many tropical soils have low supplies of this nutrient. NFTs do not depend solely on soil nitrogen, but "fix" nitrogen through symbiotic microorganisms that live in root nodules and convert atmospheric nitrogen into a usable form.

Botany: There are two basic types of N-fixing systems found in trees, based on two different symbiotic microorganisms. Bacteria of the genus *Rhizobium* inoculate trees in the families Leguminosae and Ulmaceae, while an actinomycete of the genus *Frankia* inoculates several other families:



Nitrogen fixing trees "fix" nitrogen with symbiotic microorganisms. These legume tree roots have nodulated through an association with Rhizobium.

Family	Genera
Betuleceae	*Alnus*
Casuarinaceae	*Allocasuarina, Casuarina, Gymnostoma*
Coriariaceae	*Coriaria*
Elaeagnaceae	*Elaeagnus, Hippophae, Shepherdia*
Myricaceae	*Comptonia, Myrica*
Rhamnaceae	*Ceanothus, Colletia, Descaria, Kentrothamnus, Retanilla, Talguena, Trevoa*
Rosaceae	*Cercocarpus, Chamaebatia, Cowania, Dryas, Purshia*

The Leguminosae, however, make up a vast majority of the 650 known NFT species. This family is broken into three distinct sub-families:

Sub-family	# Species	% Fixers	Representative NFT Genera
Caesalpinioideae	1,900	23	*Chamaecrista, Cordeauxia*
Mimosoideae	2,800	90	*Acacia, Albizia, Calliandra,*

			Enterolobium, Leucaena, Mimosa, Paraserianthes, Pithecellobium
Papilionoideae	12,300	97	*Cajanus, Dalbergia, Erythrina, Flemingia, Gliricidia, Pterocarpus, Robinia, Sesbania, Tephrosia*

Uses: Many NFTs are important to rural households throughout the tropics providing a variety of products and services:

Firewood and charcoal are the primary energy sources for almost one half the world's population. Fast-growing, high density NFTs make excellent fuelwood and charcoal. Many re-sprout, or coppice, vigorously after cutting, allowing repeated harvests without replanting.

Fodder to feed animals is a constant concern to many farmers in developing countries. The highly nutritious and digestible leaves of some NFTs make them excellent feed for annuals. The deeply penetrating roots of NFTs can reach retreating moisture and provide fresh feed during dry seasons.

Soil fertility is critical to crop production, but many resource-poor farmers cannot afford chemical fertilizers. Leaves of many NFTs are high in nitrogen and other plant nutrients and can be a renewable, free source of fertilizer.

Timber and poles are needed all over the world for house and other general construction. NFTs include both fast growing trees for rough wood, and some of the most valuable luxury timbers in the world.

Human food is harvested from several species of NFT in various parts of the world, in some instances supplying important seasonal staples.

Planting Systems: Depending on local needs and preferences, a variety of different planting schemes with NFTs can be utilized yielding a wide variety of products and staples.

Living fences and hedges protect crops from large pests such as wildlife, domestic animals, and man, and are often managed for fuelwood and fodder production. Trees are arranged densely, or planted as fence posts, and trimmed frequently to attain the desired form. *Pithecellobium dulce* is a favored hedge species in coastal East Africa.

Windbreaks are single or multiple rows of trees planted on windward field boundaries. Windbreaks help prevent soil desiccation and yield secondary tree products. Consistent foliage closure is achieved by choosing trees with dense canopies and by managing the canopy to encourage lateral branching. *Erythrina variegata* is commonly planted as a windbreak in Hawaii and other Pacific Islands.

Alley farming, or intercropping, is a labor intensive management system which leads to major crop yield increases through alternating rows of tree hedges and crops. Cut leaves and green twigs are incorporated into or laid on top of the soil for multiple benefits of green manuring, soil and water conservation, and weed control. This practice is successfully being introduced on steep sloped hillsides in the Philippines using several NFT species, including *Flemingia macrphylla*.

Shade and support are attained quickly from fast-growing NFTs. Shade is an important benefit in hot climates for some crops, such as cacao, coffee, and tea, as well as for humans and animals. Living, soil-enriching support is quickly established for vining crops such as yarns, vanilla, and black pepper. *Gliricidia sepium* has been used for all these purposes.

Fodder banks are intensive plantings of fodder plants, spaced to maximize production, and provide a source of "cut and carry" fodder. Many NFTs have leaves or pods that are very high in protein. *Leucaena leucocephala* is called the "alfalfa of the tropics" because of its extensive use as fodder.

Pasture improvement is achieved through increased grass production, tree fodder browsed directly by animals, and shade; livestock digest more efficiently when shade is available. *Acacia* species are found throughout the African savanna grazing lands.

Home gardens utilize NFTs for soil fertility, as well as for edible fruits, leaves, or flowers, and as medicinals. *Parkia* species are important seasonal food sources in both Southeast Asia and West Africa.

Woodlots planted with fast growing NFTs can yield quick returns, especially in less productive areas of the farm. Coppicing (sprouting) trees are the species of choice, particularly for stands of fuelwood. *Calliandra calothyrsus* is an important woodlot tree in Indonesia.

Improved fallow is most useful in areas where slash and burn agriculture is practiced. When a field is exhausted of its nutrients from intensive cultivation, NFTs can be planted for soil enrichment, and hasten the return of fertility. *Sesbania sesban* is utilized for this in western Kenya.

Land reclamation using NFTs is commonly practiced on eroded mountainsides, exhausted grazing areas, unproductive mined areas, and for dune stabilization. *Casuarina* has been planted for dune stabilization in over 1,000,000 hectares in China.

Silviculture: Most NFTs can be grown readily from seed. Many have seeds with thick coats, allowing long storage, but require scarification for moisture uptake. Some NFTs are easily propagated vegetatively. NFTs are fast-growing, many coppice readily, and can be managed for multiple products.

Genetic Improvement: Many NFT species have unique potential amongst trees for genetic improvement because of their short seed-to-seed cycles, often less than one year. Many are also highly variable in the wild, offering unique opportunities for selection.

Why Not NFTs: There are alternatives to NFTs for people who need tree products, soil improvement, or other services. Some non-fixing trees are easily established, grow rapidly, coppice readily, and produce desirable products and services. The lack of nitrogen fixation capability may be a drawback, but may not be needed in rich soils or uses which do not require rapid growth, such as watershed protection. Trees that are not harvested can establish a nutrient cycle in which little nitrogen is lost.

Weediness is another potential problem with NFTs. Since some NFTs are aggressive pioneer species adapted to rapid colonization, they may become pests. Species that cannot be controlled by grazing because of thorns or noxious plant chemicals can become especially weedy.

Chemical fertilizers may not necessarily be replaced by NFTs. The role of herbaceous N-fixing plants in soil management is also distinct, and may be a viable alternative to tree species. Local traditions, farmers' preference, and site conditions will dictate the choice of species, which may not include N-fixers.

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