AUSTRALIAN TREES ABROAD

As well as providing fuelwood, pulpwood, building timber, shade and shelter, they are reclaiming weed-infested land and being developed as a food source

The deforestation of many Third World countries continues apace, despite Western concern. The nations involved must exploit their hardwood forests if they are to meet their citizens' desires for material and political progress, to garner the foreign currency they need to pay for advancements in health, education and other services for rapidly expanding populations and to meet the massive debts they owe Western lending institutions.

Especially in tropical regions, however, the exploitation of rainforests leads to losses that far outweigh its short-term benefits. Clearfelling leads to the extinction of plants and animals, and exposes nutrient-poor rainforest soil to torrential rain. Most of the nutrients are rapidly leached out, and the soil washes away to leave hillsides bare and useless for reforestation or the subsistence agriculture that feeds the bulk of tropical populations. Silt-laden rain-water chokes streams and rivers, destroying village-based fishing industries... and eventually kills coastal reefs, destroying the fishing industries those reefs once supported and, in turn, coastal populations dependent on fishing for survival.

In less mountainous areas, where soil is deeper and erosion is not so severe, the sudden exposure of the forest floor to desiccating sunlight promptly kills rainforest tree seedlings (which can only grow when they are sheltered by taller trees) and understorey plants, leaving a literally clear field for invasion by grasses such as *Imperata* sp. (known as blady grass in Australia), which has taken over more than 20 million hectares of formerly forested land in South-east Asia.

Imperata's dense root system denies competitors access to sunlight and water and, because it stores most of its energy below ground, it can withstand drought and fire. It cannot be defeated by burning-off or clearing, making

Illustration: Brian Gosnell

agriculture impossible and leading to the depopulation of rural areas... exacerbating even further the economic difficulties that logging attempts to cure!

Mr Khongsak Pinyopusarerk, a scientist based at the CSIRO Division of Forestry's Canberra headquarters, is studying a biological control method that can address many of these problems — as well as providing the shelter that is an essential prerequisite for the regeneration of tropical rainforests.

In a forestry project funded by the Australian Centre for International Agricultural Research (ACIAR) with Thailand's Royal Forest Department, he had been growing a wide range of Australian species of *Acacia*, *Eucalyptus* and *Casuarina* (using seed collected by the Australian Tree Seed Centre), looking for characteristics such as good wood production and straight stems for use in reclaiming cleared rainforest land.

His primary aim was to combine these qualities in a tree that would be useful in a variety of tropical Third World situations. Many acacia species (for example, *A. auriculiformis*, *A. mangium*, *A. crassicarpa* and *A. aulacocarpa*) have shown great promise, but he was delighted to discover that a northern Australian variety of *A. oraria* that seemed to have few of the characteristics he was looking for — it is multi-stemmed and shrubby, with a relatively dense canopy — performed brilliantly at suppressing *Imperata*. This wattle grows quickly and produces a thick mat of leaf litter, so it not only shades out *Imperata* but also prevents grass seeds receiving sunlight.

Australian Tree Seed Centre

China's 'Great Green Wall' of *Casuarina equisetifolia* guards coastal areas against storms and wind erosion, enabling areas previously regarded as hopelessly degraded to be used for agriculture and settlement.

Although Mr Pinyopusarerk's project is still in its early days, it appears to offer a means of halting the loss of agricultural land that is associated with invasion by *Imperata* grass, and he is now working in collaboration with Thai scientists on plantings of *A. oraria* to reclaim *Imperata*-infested land in northern Thailand.

A. oraria can be grown on a short rotation system (over as few as 8 years) for use as pulpwood or fuelwood, or left longer to produce sawn timber. Its nitrogen-fixing root system and heavy leaf-fall quickly increase soil nutrients, making agriculture or reforestation with local rainforest species possible in just a few years, so it can be employed immediately to stabilise soil after logging, providing a basis for the re-establishment of forests that are vital to the economies of many tropical nations.

This project is one of the latest undertaken by the Centre, which, with the valued support of the Australian International Development and Assistance Bureau (AIDAB) and working in collaboration with ACIAR, has won itself an international reputation over the past 25 years (see *Ecos* 38 and 60) for its work in the collection, selection, improvement and effective use of native Australian trees around the world. From its collection of more than 19 000 seedlots, it has supplied tree seed to more than 100 countries and has provided on-site consultancies to 28 nations in the past 10 years.

Fast-growing, ideal for firewood or building, capable of flourishing in poor soil and drought, Australian trees have become so popular outside this continent that 40% of tropical hardwood plantations around the world now consist of Australian trees. Yet in places they have failed to provide the benefits for which they were chosen. In some cases they are inappropriate to the environments in which they are planted; the very qualities that make them attractive to farmers or plantation managers can lead to a virtual monoculture, since eucalypts in particular are efficient competitors for water, nutrients and space.

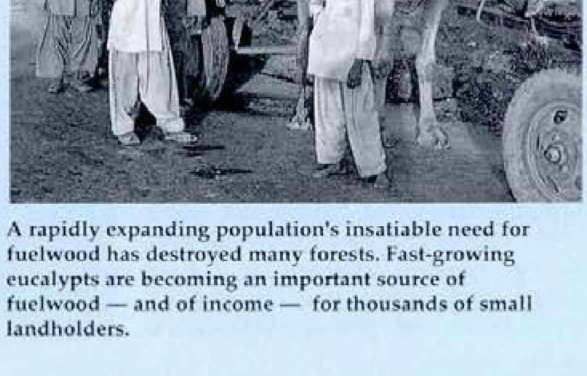
In many cases, however, disappointing 'performance' by Australian trees is the problem — a lack of vigour or productivity that is the legacy of initial

In India, money does grow on trees

Over recent years, India's burgeoning population and growing industrial base have placed intolerable demands on the nation's forests: satellite information indicates that government-owned forests shrank from 17% of land coverage in 1972–75 to 14% in 1980–82 — a net loss of 1·5 million ha a year.

That depletion was fuelled by both large-scale and domestic pressures. State governments offered industry access to forests in order to attract investment, with little control over conservation or renewal, and villagers have depleted saplings in their search for fuelwood (always a scarce resource in tree-poor India) or have allowed cattle to graze in newly planted areas when common land has been stripped of all fodder.

Between 1981 and 1986, however, about a million hectares of trees were planted outside designated forest areas, under a government scheme to encourage villagers to grow their own fuel and fodder. Although the scheme did not succeed, farmers soon discovered that wood was a profitable crop. Demand has pushed prices to the point where growing eucalypts, which mature in 7 years on unirrigated land, can compete with agriculture. It costs farmers around 10 Australian cents to grow a eucalypt: at a density of 1500 per ha, that means a farmer with unirrigated land selling the 1000 best trees for $A5 each and the rest of the crop for fuel at $30 a tonne makes a profit of $600 per ha — a considerably better income than from any other crop.



Australian Tree Seed Centre

A rapidly expanding population's insatiable need for fuelwood has destroyed many forests. Fast-growing eucalypts are becoming an important source of fuelwood — and of income — for thousands of small landholders.

Photos: Australian Tree Seed Centre

Researchers with the Australian Tree Seed Centre are waging a successful war against *Imperata* with acacias, which manage to out-compete the grass and rehabilitate the land.

In sub-Sahelian western Africa, the crushed, baked seed of Australian acacias offers an invaluable source of food in times of famine.

seed collections from trees chosen for their convenience rather than their desirability for, say, wood production. In the early days of seed exports, little thought was given to identifying such desirable characteristics. Seed might have come from only one or two trees, or from a part of the species' range poorly suited to the overseas environment. The 'land race' that develops from such a narrow or unsuitable genetic base often shows poor form, reduced vigour or low resistance to pests or diseases.

Advice on how to make use of the genetic base provided by seed collected from carefully selected Australian populations is becoming an increasingly important part of the Tree Seed Centre's operations. As Mr Stephen Midgley (formerly Officer-in-Charge at the Centre and now on secondment in the People's Republic of China) points out, it costs as much to establish a plantation with poor-quality seed as it does using seed of the highest genetic potential: in short, good seed does not cost but pays — through improved productivity, quality and profitability.

The Centre seeks to maximise those benefits through constant research into seed germination, collection, extraction and storage, and through regular monitoring of seed performance in the field. Each seedlot carries a five-digit number that provides a ready record of its provenance ('parent' trees must be a minimum distance apart to minimise the number of closely related individuals included in each seedlot), enabling both the Centre and clients to assess productivity and performance, and is accompanied by a record of geographic origin, viability and so on.

The 3000-kilometre 'Great Green Wall' of *Casuarina equisetifolia* in southern China — which is stabilising sand dunes and protecting agricultural land from salt-laden winds and cyclones, allowing crops to be grown in areas previously regarded as hopelessly degraded — may be the most spectacular of the reafforestation activities in which the Centre has been involved, but it is neither the largest such project, nor the most urgently needed. This Great Wall, like its forebear, was the work of the Chinese people, but the Australian Tree Seed Centre is now co-ordinating seed collections from across the range of *Casuarina equisetifolia*, and developing plans to evaluate this material in international trials that will form an excellent base for the genetic improvement of the species.

In another program, researchers at the Centre are assessing the potential of various species of *Acacia* as a food source. At least 40 members of this genus, including *A. holosericea* and *A. cowleana*, from the dry-zone tropics of northern Australia, have been important elements in the traditional diet of the local Aboriginal people for millennia. The bean-like pods of some species are eaten raw or cooked in ashes; dry seeds are ground to flour, mixed with water and eaten as a paste or baked to form a cake.

While forestry usually concentrates on breeding trees that are taller, straighter and produce more wood, the Centre's researchers have been looking at selection from a fresh perspective, seeking to make these perennial shrubs produce larger amounts of seed. Seed from the African species *Faidherbia albida* (closely related to the acacias) is already used as an emergency food in times of famine in several African countries. The Centre is looking to develop the use of Australian species such as *Acacia holosericea* and *A. tumida*, which produce heavy seed crops at a much earlier age, appear to be more palatable and do not need the extensive processing required to remove toxins from *Faidherbia*.

Centre researchers are co-ordinating further nutritional testing of seeds from the most promising species, and are planning research and development programs with appropriate countries to develop this potential food source.

Acacia mangium, *A. crassicarpa*, *A. auriculiformis* and *A. aulacocarpa*, all from the moist tropics of northern Australia and New Guinea, are also being investigated as sources of pulpwood for paper manufacture in countries such as Indonesia. Plantations of *Acacia* for future seed supplies, genetic conservation and tree improvement have been established in northern Queensland, in collaboration with the Queensland Forest Service, and on Melville Island, with the co-operation of the Conservation Commission of the Northern Territory and the Tiwi Land Council. If modern plant breeding methods can improve these fast-growing trees — which have a generation time of only 10 to 12 years — they may help reduce harvesting pressure on the tropics and thus reduce land degradation.

Tropical agriculture and revegetation in Africa are also benefiting from work by the Centre's Dr Chris Harwood on silky oak (*Grevillea robusta*).

Growing to almost 40 m in height, this tree is the largest member of the family Proteaceae (which includes about 260 other species, including macadamias, banksias and waratahs). It has long been grown as an ornamental tree in its native Australia, but was less successful in Australian plantations than other natives such as hoop pine.

Today the silky oak is seldom planted for wood production here, but other nations were quick to take advantage of its light, fern-like foliage: in the 1860s, seed from a stand of cultivated trees in Melbourne was sent to the Royal Botanic Gardens in Ceylon — modern Sri Lanka — from where it was taken up by tea-planters throughout Ceylon and southern India, providing light shade for tea bushes and protecting the soil with a dense, deep layer of leaf litter. It is still in such demand in those regions that in 1985 the Indian government donated 500 kg of seed to Sri Lanka for replanting of shade trees on farms and tea estates. Cut silky oak leaves are also a common sight in the flower stalls of Rome.

The species was introduced into Africa before the turn of the century as a shade tree for tea and, later, coffee plantations, but has recently become one of the most important agroforestry trees in the highlands of eastern and central Africa, from Ethiopia to Kenya, Tanzania, Uganda, Rwanda, Zaire and Madagascar. In fact, the benefits it provided for the farmers of Kenya once led to it being regarded as an 'honorary native' species in Kenya.

Dr Harwood admits that the silky oak does not possess any single quality that could account for its remarkable popularity: rather, its combination of virtues has made it a multi-purpose tree ideal for developing nations.

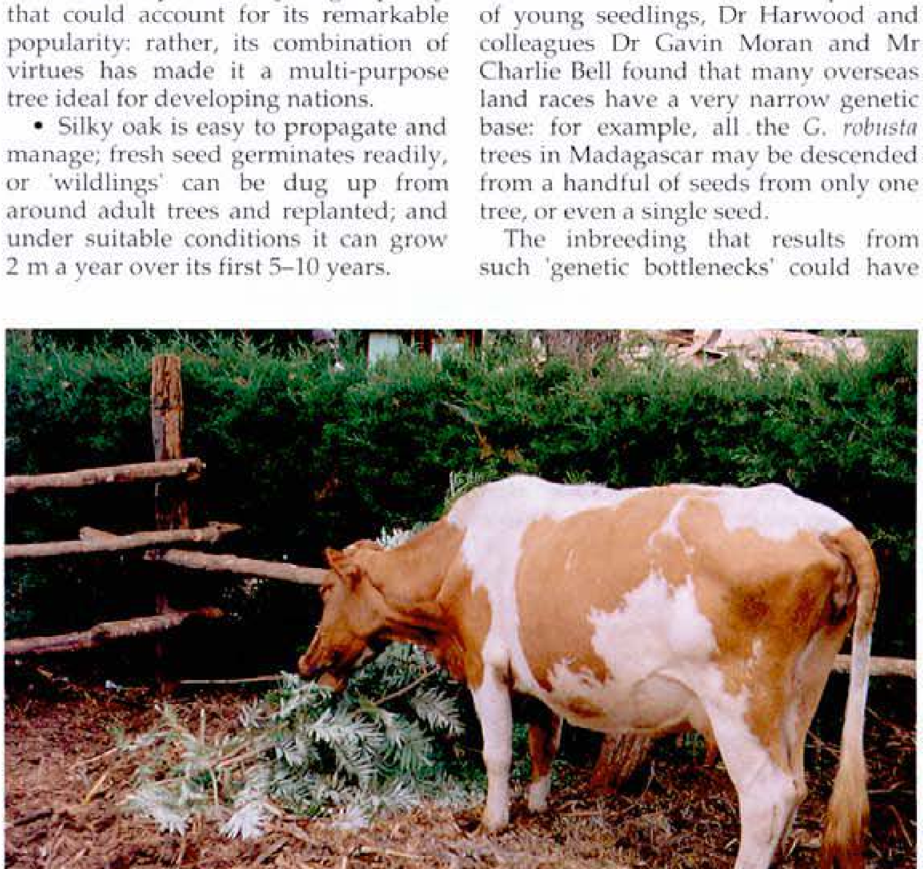
- Silky oak is easy to propagate and manage; fresh seed germinates readily, or 'wildlings' can be dug up from around adult trees and replanted; and under suitable conditions it can grow 2 m a year over its first 5–10 years.
- It provides a good supply of poles and wood for fuel; small sawlogs can be harvested after 15–20 years, with regular harvests of branches and poles from pruning before then. It is light, easy to split or saw and burns easily, and can be used to make light furniture, cabinets, flooring or plywoods.
- Perhaps its greatest advantage for the farmer is that the species competes so little with adjacent food and cash crops that these can be grown right to its base. The tree's roots are far deeper than those of agricultural crops, and it recycles soil nutrients for use by crops in the form of leaf litter; living leaves can also provide cattle fodder in times of drought.

While preparing a bibliography of *Grevillea robusta* (published in 1989), Dr Harwood realised that almost nothing is known about genetic variation in the species. Working with other Tree Seed Centre staff and overseas researchers co-ordinated by the International Council for Research in Agroforestry, he obtained collections of seed from the species' natural range and from several African 'land races'. Then, using a technique called isozyme analysis, which studies variations in the proteins of young seedlings, Dr Harwood and colleagues Dr Gavin Moran and Mr Charlie Bell found that many overseas land races have a very narrow genetic base: for example, all the *G. robusta* trees in Madagascar may be descended from a handful of seeds from only one tree, or even a single seed.

The inbreeding that results from such 'genetic bottlenecks' could have substantially reduced the performance of the species, so the Centre has since sent comprehensive seed collections from across the silky oak's natural range to research organisations in many countries so they can be evaluated in field trials and used to improve the genetic base for tree-breeding programs. There are already clear indications that some of the natural provenance trees out-perform the local land race in Rwanda.

Carson Creagh

***Grevillea robusta*, the silky oak, was introduced into Ceylon (now Sri Lanka) as a shade tree for tea plantations. It is now widespread throughout tropical and subtropical countries.**



In Kenya, *Grevillea robusta* leaves are harvested as emergency fodder for cattle — a use unknown in Australia.

More about the topic

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