Peninsular Malaysian market during the 1990s. Research is also being undertaken to utilise the large quantities (up to seven million tonnes per year by the year 2000) of oil palm trunks for pulp and paper, and other composite products (Lim and Khoo, 1986).

References

Lim, S.C. and Khoo, K.C. 1986. Characteristics of oil palm trunk and its potential utilisation. The Malayan Forester 49(1): 3-22.

Johari, Baharuddin. 1987. An appraisal of the compensatory plantation programme in Peninsular Malaysia. Seminar on the future role of forest plantations in the national economy and incentives required to encourage investments in forest plantation development. Nov-Dec, 1987, Kota Kinabalu, Malaysia. 29pp.

Tang, H.T. 1988. Eucalypts and acacia plantations in Malaysia. Proc. International Forestry Conference for the Australian Bicentenary, 1988.13pp.

Yong, C.T. 1985. Compensatory plantations in Peninsular Malaysia. In Liew *et al,* (eds). Proceedings of seminar on forest plantation development in Malaysia. July 1984, Kota Kinabalu, Malaysia. 10pp.

New Zealanders currently associated with Malaysian plantations:

Ralph Douglas, Sabah Softwoods Sdn, Bhd

John Leith, Sabah Forestry Development Authority.

Don Mead, Forestry Dept., Peninuslar Malaysia.

Rob Miller, Sabah Forestry Development Authority.

Hugh Speechly, Forestry Dept., Peninusar Malaysia.

Sri Lanka – a wood-based economy in trouble

J.R. Purey-Cust

In 1983, the World Bank commissioned a "master plan" study of the forest resources and economy of Sri Lanka. Master plans are a standard World Bank tactic and have been written for many countries. Whilst derided in some quarters as imposing external solutions on internal problems, the master plan in fact is largely descriptive, describing forest resources and the demands on them, and where necessary offering solutions. Proposed solutions are essentially stop-gap and short-term initiatives to plug immediate holes until the country in question has time to devise its own solutions. The initiative remains firmly with the nation in question.

The contract for the Sri Lanka study in the Forest Resources Development Project (FRDP) was awarded to Jaakko Poyry Oy, a Finnish forestry consulting firm, and ran from 1983 to 1987. A number of New Zealand foresters were involved.

Plantation programme

John Purey-Cust – Plantation Adviser 1986-87.

Dr Mike Wilcox – Plantation Research Adviser.

Master plan studies

Dr Sandy McGuire – on the best use of less favoured timbers.

Len Wilson – logging and timber transport.

The Plantation Adviser's position was the only residential post, the others calling for single or periodic visits of a month or so.

SRI LANKA

Sri Lanka is a small country of 6m ha (about one-fifth the size of New Zealand) with a population of 16m growing at 1.7% per year. It has a respectably long history of civilised human occupation, with achievements concentrated in two main fields:

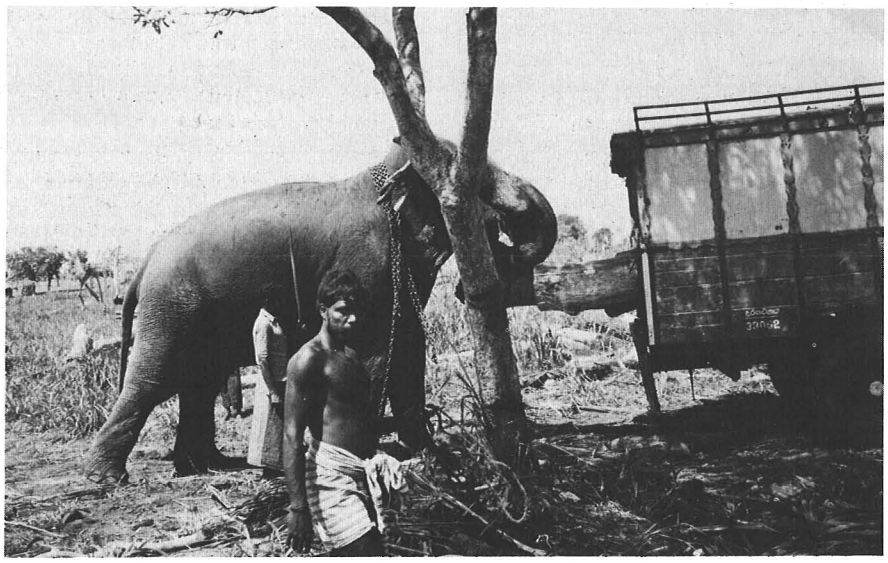
- As a centre of Buddhism from which the faith spread to Burma and Thailand while languishing in India, its birth place.
- The development of city states with a high level of culture, based on complex systems of irrigated rice production.

The sense of trusteeship for World Buddhism threatened by amorphous and all-embracing Hinduism lies at the root of Sri Lanka's present political troubles.

Irrigated agriculture based on communally stored water is by necessity a socially intricate and centralised system, requiring strong authority for success. Without that strong control, the system falls apart, be the cause war or a predominant royal interest in moral uplift, learning or the bed chamber. The kingdoms throve under strong practical kings and fell when the royal mind wandered. When they fell, so did the population, drastically, and malaria ruled.

Thus the historical population of Sri Lanka never rose above 5m, and was often much less. Now, with malaria contained, it rises steadily and by the year 2030 should top 20m.

The country has no natural assets beyond its soils, seas and people, apart from a few gems and a little hydro-electricity. There is no coal, oil, or metals, and though Sri Lanka sits on a cross roads of world trade, busy since time began, it has never been a trading nation and still is not. The bulk of the people are still rural, and apart from Colombo



Elephant loading logs. The logging and sawmilling industry is not highly developed, but pragmatic and well suited to a country where small enterprises do better than large ones. But elephants are trade unionists and won't work after noon.

The author, John Purey-Cust, is a Senior Forestry Consultant with Groome Poyry.

(½m people) there are no cities of consequence.

The Study

The study highlighted an interesting if in places alarming situation:

- Between 1956 and 1981/83 the natural forest cover of Sri Lanka fell from 2.9m ha to 1.75m ha. If reduction continues at this rate, all natural forest (including parks and reserves) will be gone by the year 2030. Some of this reduction is due to large agricultural development schemes necessary to settle people on the land and to achieve some measure of self-sufficiency in food. But the prime cause remains shifting cultivation and cattle grazing, over which there is little control.
- 71% of the national energy supply is from wood, with 94% of the domestic energy component based on wood. If this wood were to be replaced by oil (imported) the cost would be about twice the present total national annual export income (of which oil already takes the lion's share).
- 50% of saw logs and 80% of fuel wood come from non-forest sources such as gardens, plantations, roadside trees and agricultural residues.
- There is almost no export of wood-based products and imports are largely restricted to pulp, paper and plywood. The sawn wood and fuel wood markets are in balance to the extent that there is no surplus supply or obvious deficit, but an improved alternative is constrained by heavy duty and customer ability to pay.
- There are sufficient local resources to supply demand until the late 1990s, but thereafter there will be increasing shortages of both sawn and fuel wood. Pressure to use protected areas will increase.

Plantation Management

The plantation management segment of the project was based on advanced knowledge of some of these trends. With an active forest management history (the Forest Department celebrated its centenary in 1987), there has been much plantation establishment, though management has concentrated more on conservation and protection than use.

However plantation establishment has generally been concentrated in the high "up-country" (where the tea is) and in parts of the more densely inhabited Wet Zone (the 25% of the country in the south-west quadrant). The Dry Zone (75% of the country in the north and east) was largely left as uninhabited and a haunt of malaria.

So the Plantation Adviser's responsibility fell into two parts:

Ripping in the dry season. Track slip on a hard dry surface prevents full penetration. Timing is the essence of success in the dry zone.

- To develop use and replanting systems for the up-country plantations round Nuwara Eliya at an altitude of around 2000m and in an equable climate.
- To evolve systems for successful plantation establishment in the lowland Dry Zone, where the rains (if they do not fail) fall only in October-December and with a daily temperature in the mid 30s centigrade.

The Dry Zone

The Dry Zone occupies 75% of Sri Lanka and belies the common image of a lush green land overhung with palm trees. It is hot, dry and dusty and much has been converted by agriculture and grazing to grassland with scattered trees, burnt annually. It needs trees and is also the only part where there is yet land suitable for forest plantations without conflict with agriculture. As there is little experience of such work, the Plantation Adviser was located in the Dry Zone and spent 75% of his time there.

Earlier work had been in a Taungya system using teak and sometimes *Eucalyptus camaldulensis*. This had worked well but has since been abandoned as a conservation measure and now the farmers convert the forest to grass and degrade the soil. The forest goes as before but is no longer replaced.

The directive therefore was to see what could be done to improve matters by more intensive methods.

The rain comes in October with the north east monsoon, bringing instant green and life to a formerly brown empty land. No spring was ever so dramatic. By December the rain has tailed off to scattered showers sufficient to keep the grass green only. From May to October there will be no rain, only a continuous dry south-west wind. By July all is burnt and in August tempers rise with no work or money and sickness from polluted wells.

The afforestation problems in such a situation are:

- A very compacted and degraded soil structure.
- A loss of all shelter and, in the dry season, unrelenting exposure to the sun and continuous dry winds, with a high fire risk.
- A very constrained and unreliable rainy season in which all work must be done.

To get trees to grow at all is difficult and the first priority is to restore a forest climate and soil. Work therefore concentrated on these fields of enquiry:

- A search for robust species with site plasticity, timber utility and speed of growth.
- The impact on survival and growth of soil cultivation and grass control. The grasses present were mostly clump grasses such as guinea grass *(Panicum maximum)*. The pest of all tropical work, illuk *(Imperatum cylindricum)*, was confined to flat valley bottom season swamps.

Grass Control

Traditional control is to uproot and burn grass clumps immediately before the rains. This cannot be well done because of the hardness of the ground, and after a month of rain all is as before, the grass a metre tall and in flower. Spraying is a difficult task since before the rain there is nothing to spray, and two weeks after the rains start plants are too big. In the interval it may rain continually.

The most efficient chemical proved to be glyphosate, but it has the disadvan-

tage of demanding clean water when all that is available is mud soup.

In the face of a formidable logistical problem, where failure is likely and expensive, and in a situation where chemicals may harm workers and be used indiscriminately, it is better to rely on manual methods. The recommended solution is to cultivate planting strips and to commence hand weeding as soon as grass plants are large enough to pull out, whether planting has been done or not.

Cultivation

For reasons of hardness of the soil, cultivation by hand tools or light machines is not possible until rain has softened the ground, and that is the time when all **must** be done.

- spraying, while grass is yet small enough;
- planting, for there is great advantage in planting as early as possible in the rains, in case they fail.

So not only is there much to be done in a very short time, but much confusion and contradiction of operations. So if at all possible, cultivation must be done in the dry season before the rains. That means heavy machinery (for deep ripping to 50 cm, a 200 HP tracked tractor, readily available), but if left after August, tracks slip on the hard ground and full penetration cannot be achieved.

An initial trial to compare surface cultivation methods (by hand, ripping to 15cm, disc ploughing) showed considerable advantage to cultivation, but little to method. There was general increase in survival but the impact on height growth varied with species (the trial was also a species and provenance trial).

A second trial was therefore put in to test the impact of deep ripping (to 50cm), surface cultivation and total weed control. The result was considerable improvement.

		E. camaldulensis	*E. tereticornis*
Trial 1	(Surface cultivation only Age 21 months	5.21m 74% survival	4.26m 86%
Trial 2	(Deep ripping and total weed control) Age 10 months	– –	2.95m 95%+

Trial 1 compared many species and provenances and more details follow. Trial 2 concentrated on *E. tereticornis* and *Albigia odoratissima,* but the latter were devoured by porcupines. For eucalypts, comparable field performance was a height growth in 10 months of no more than 1 metre, survivals of usually less than 30% and general stagnation.

Species and Provenance

It has slowly become clear that for many eucalypts provenance is at least as important as species, and that for other vigorous species much may be achieved by controlled seed selection to improve tree form. This is particularly true of eucalypts favoured for dry zone planting (*E. tereticornis* and *E. camaldulensis*) and for the two most vigorous local species, *Azaderachta indica* (margosa, neem) and *Albigia odoratissima* (suriyamara), both of which have very poor form.

The following species were tried. () = no. of provenances where morfe than 1.

Local Species

Albigia odoratissima (suriyamara)
Azaderachta indica (margosa, neem)
Chukrasia velutina (hulanhik)
Melia azaderach (lunumidella)
Terminalia aryuna (kumbuk)

Introduced Species
Acacias-A. aulococarpa, A. auriculae formis
A. crassicarpa, A. mangium (2)
Eucalypts-*E. brassiana (2), E. camaldulensis,*
E. pellita, E. tereticornis (3), E. torelliana,
E. urophylla
Casuarina cunninghamia
Gmelina arborea
Swietenia mahogani
Tectona grandis

The following species suffered from drought, irregular growth, and survival and were not therefore recommended.

Acacias-*A. aulococarpa, A. crassicarpa, A. mangium*
Eucalypts-*E. alba, E. brassiana, E. pellita, E. torreliana, E. urophylla, Gmelina arborea.*

Of promise, but on good, well drained, sheltered sites only were *Casuarina cunninghamia*
Chukrasia velutina
Melia azaderach
Swietenia mahogani
Tectona grandis.

Terminalia aryuna showed possibility on wet sites, and suitable for field planting on all but wet sites were:
Acacia auriculiformis
Albigia odoratissima
Azaderachta indica
Eucalyptus camaldulensis and *E. tereticornis.*

However within this last group there is room for discrimination. The eucalypts are of unknown timber value and wholly dependent on correct choice of provenance and a very high standard of establishment technique. They are seriously attacked by termites after planting and the cure (dipping nursery plants in an Aldrin solution) is hazardous to both the environment and worker health. Their choice seems a product of fashion or easy seed availability.

Acacia auriculiformis has exceptional vigour and health, but very poor form. It has utility for shelter and possibly for fuel, but not yet for timber.

Both suriyamara and margosa are drought tolerant and apparently less demanding of high establishment standards than the eucalypts. Both have a locally established value as high quality timbers. Both have poor form and a need for local breeding programmes. Margosa is also much used for medicine and it has insecticidal properties. Suriyamara is a very fast early grower (it outgrew the eucalypts but is very difficult to measure accurately as its leadings shoot droops), and it may be regarded as a very suitable species for dry zone planting both in Sri Lanka and in other places with a similar climate.

Constraints on forest establishment in the Dry Zone sorted themselves out as chiefly:

- A good ability to recognise site variation (of which there is much) in a generally almost flat landscape.
- A need to constrain the programme to a size where all work (cultivation, planting, first weeding) is completed by the end of November, or six weeks after the rain starts. If New Zealanders solve their problems by throwing money and machines at them, Asians solve theirs by throwing people, and a large planting site looks like a Christmas Eve shopping rush. Planting programmes must be split into autonomous units of not more than 100 ha each.
- A need to weed when weeding is easy (when plants are small and the ground soft), not when planting is finished.

The Up-country

Problems in the Up-country are fewer as there is already much experience of species and the natural forest is of low stature and productivity. So existing knowledge can be tapped and there is no lack of example to follow. At the same time the climate is generally benign with a reasonable distribution of rain and soils are not debased by farming.

The plantations where logging was to start lay in high country (above 2000m)

to the south-west of Nuwara Eliya, in an area where the north-east and south-west monsoons compete for influence. As such it is often a Scotsman's paradise of wind, fog and drizzle with leeches for savour; a microclimate unique in Sri Lanka. The significance of this was not realised when planting restarted.

The original planting was a mix of various eucalypts (chiefly *E. grandis* and *E. robusta*) with cypresses and *Acacia melanoxylon*. The cypress is a rough tree, often a hybrid of macrocarpa and lusitanica, a descendant of vast and ancient trees round Nuwara Eliya Town. *E. robusta* seldom exceeds a pole, and *E. grandis*, though of fair size and gun barrel straightness, is a sawmiller's despair. *A. melanoxylon* is considered "difficult" to saw.

In consequence there was a search for a new species and in the new plantings *E. microcarys* and *E. pilularis* predominated. They had done very well in the drier and slightly lower country to the east and saw and season easily. However, no sooner planted than a leaf fungus struck, not fatal but totally debilitating. After rough identification as a cylindrocladium, relief was attempted by spraying with Bavistan. This worked well with small trees but they soon grew beyond reach and were afflicted anew.

The solution therefore had to be a change of species, but what? *A. melanoxylon* and cypress are devoured by rabbits and deer and the form of the cypress requires much work on breeding and provenance. *E. grandis* was not too badly affected, but not welcomed by sawmillers. There appeared to be no suitable local species.

Trials, both old (there were several arboreta going back to the 1930s) and new, were checked for susceptibility, and all eucalypts were found to be infected to one degree or another. However there was found to be significant difference and favoured were those species from the colder and wetter areas of Australia, notably *E. fastigata, E. regnans,* and *E. saligna. E globulus* proved a very fast starter until overtaken by infection and was dropped, but *E. nitens,* newly tried, appeared to have both vigour and resistance.

Conclusions

The master plan study was very successful in defining the problems facing Sri Lankan forests and wood use but it was less successful in getting them acknowledged. One local environmental group even went so far as to claim that the plan prescribed for the extinction of the forest by 2030 rather than describing the path if nothing was done to halt the rate of descent.

The main obstacle in the way of a solution is the extreme individuality stressed in the local cultures. Proposal of a solution in one quarter is but a demand for a dozen alternatives from others, each of whom will give nothing to any of the others.

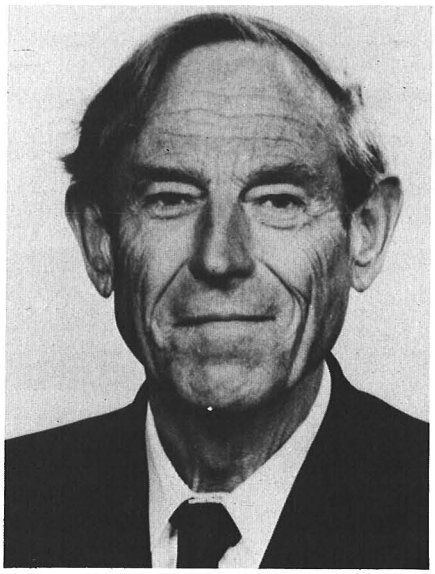
Regretfully it must be concluded that a solution is not likely to be agreed on. New Zealand forest economists should place Sri Lanka on their list of potential markets as a country which has foregone its forests. But it is a poor country and may not be able to buy. That, for the poorer 75% of the population, will be a tragedy. The others will continue to enjoy the luxury of argument.

Forestry beyond the rim

Dennis Richardson

Travellers in the less populated areas of the world soon discover that when hosts and guest have no common language, the ritual of the toast – in whatever hokonui is available – provides a means of communicating professional goodwill, and a protection against what can seem to be importunate curiosity. As time passes, the focus of the toast becomes more improbable and contrived (and less clearly recalled the next day). In June, 1985, in the remote village of Khugert in the People's Republic of Mongolia, the objectives of the NZ Institute of Forestry were acclaimed and linked with the exploits of Ghenghis Khan: in 1988, in Mozhugongka – alongside the Lhasa river in the Tibetan Autonomous Region of China – solidarity with the legendary epic hero King Gesar was affirmed in like manner. The links are not without some inebriated logic. Ghenghis Khan, who in the 13th century controlled an empire more extensive (as a percentage of the known world) than any ruler before or since, did so by means of a communications network staged along routes marked by planted trees; Gesar, reputedly sent to establish order and justice on earth, fought with the demons that gripped mankind and introduced juniper and walnut trees to Tibet (some believe he may return again if needed – as he most surely is at the present time).

The author, Dennis Richardson, has held several prestigious positions in the forest industry, science and research and academia. He is currently a practising forestry adviser and amongst his present responsibilities are Director-at-Large, International Society of Tropical Foresters, USA and Governing Councillor, Commonwealth Forestry Association, UK. He is also an Honorary Member and an inaugural Fellow of this Institute.



Dr S.D. (Dennis) Richardson.

Outer Mongolia and Tibet

Ecologically and culturally, Outer Mongolia (OM) and Tibet (TAR) have striking similarities (and some equally impressive differences). Though located in different latitudes (42° – 52°N, and 27° – 40°N respectively), longitudes, and altitudes, the high plateau countries have similar climates (harsh and intractable, with annual temperature ranges of 45°C and extremes from −47°C to +40° C, exposed to high winds and dust storms, but with very little precipitation). Their land areas and populations are of the same order (1.6 million km^2, supporting 1.7 million people in OM; and 1.25 million km^2 – 2.00 million km^2, comprising 1.9 million – 3.0 million people, in Tibet, depending on whether the cartographer is Tibetan or Han Chinese).

There is little between them in economic development: there are extremes of poverty and conspicuous wealth. The TAR has the lowest rural household incomes and the highest urban per capita income in all China: it has the highest birth, illiteracy and mortality rates – and the highest social security expenditure. OM publishes no statistics but impressions are of similar levels. (A difference, perhaps, is that the conspicuousness of the wealth in TAR is in the non-produc-