

use of these diagnostic criteria. Compared with the response to nitrogen documented by Hunter (1982) for radiata pine in New Zealand the kauri stand showed a slower but longer period of response. The negligible effect of heavy thinning on stand basal area increment indicates that thinning was compensated by increased diameter growth of individual stems.

Growing plantation kauri as a commercial venture is not competitive with radiata pine, given current technology and price structures (Barton and Horgan 1980). Profitability of radiata pine plantation forestry has been assisted by a multi-million-dollar annual expenditure on research. Barton and Horgan (1980) indicated that profitability of kauri forestry could be materially improved by reducing establishment costs. Results here indicate that growth of existing kauri stands can be manipulated by silvicultural treatment. There is a clear need to examine the costs and benefits of kauri silviculture on a range of sites to establish optimum management regimes and a realistic economic evaluation of potential kauri management alternatives. Such research would be inexpensive by current standards but could have significant value in the wise future management of this widespread resource.

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Thinned pole-stand of kauri in the trial area.  
Photo: Forest Research Institute.

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## Forestry on Erromango Island, Vanuatu

T. Thorpe and P. E. Neil

### ABSTRACT

*The rugged, sparsely populated island of Erromango in the South Pacific nation of Vanuatu remains largely underdeveloped despite past European exploitation of its natural stands of kauri and sandalwood. Logging of native timber is poised to continue but exotic plantations have been established with the assistance of New Zealand aid and there are firm proposals for a significant area of kauri reserve to be established.*

Vanuatu has extensive areas of forest but much of it is on broken or mountainous terrain, and resources of indigenous millable timbers are small. There is much forest of a secondary nature disturbed by cyclone or fire. One of the best timber resources in Vanuatu occurs on Erromango.

Erromango, the third largest of 80 islands in Vanuatu, previously the New Hebrides, has had an interesting forestry background. Between 1825 and 1865, not long after European discovery of sandalwood (*Santalum australcaledonicum*) in the Pacific, the wood was traded from several islands in Vanuatu, notably Erromango, which had the largest resource. A hundred years later a French logging company extracted kauri (*Agathis macrophylla*) from the island for several years. More recently plantation forestry has been introduced to the island, and today there are plans to continue logging of the kauri and other native species. There are also firm proposals to set up a kauri reserve on Erromango, an event that

would be of international significance to those interested in the reservation of tropical rainforest in general and kauri species in particular.

It is hoped forestry will play an important developmental role. The potential for long-term logging is limited. However there is suitable land available for plantation forestry which is unlikely to be put to other productive uses. Population pressure is low — 1000 people over a land area of 887 square kilometres — and arguments about ownership are less of a problem than on more populous islands. In the future tourism may be attracted to the proposed kauri reserve. The local people find forestry compatible to their way of life and can see the potential benefits it will bring to the island.

### Kauri Logging

On Erromango, kauri forest is concentrated in central and eastern areas in largely subtropical forest. An inventory carried out on the island in 1971 identified 14,100 ha as a "potentially productive" forest. Within this area, scattered groups of kauri were found, with a total volume of c. 118,100m<sup>3</sup> (17% of merchantable stems were over 60cm d.b.h.). The kauri stands were mostly between 200m and 400m elevation on basaltic soils. The distribution was patchy, but principally the best kauri stands were found in the southeast of the island with small groves around Mount William in the central north.

The main kauri-rich areas in the southeast were logged by Société d'Agathis from 1968 to 1974 from a base establishment at Ipota, which included a sawmill with a capacity of 400m<sup>3</sup> per month. An area of about 5000 ha was logged. This produced about 60,000m<sup>3</sup> of kauri mainly for export as logs to France, and to a lesser extent

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New Zealand. Some 17,700m<sup>3</sup> of tamanu (*Calophyllum neobudicum*) and other species were also logged and either sawn locally or exported to New Caledonia.

A cyclone caused damage to the installations at Ipota in 1972 and later a fire occurred in the sawmill. In November 1973, Société decided to cease operations as a further 25km of roads would have had to be built to reach the remaining kauri. Although a large volume of tamanu was still uncut, the continuation of the project was not considered viable.

The sawmill was sold and transported to Efaté but the various buildings at Ipota remained. These have been used as the base for one of the two New Zealand funded plantation projects on Erromango.

### Plantation Forestry

The Vanuatu Forest Service (within the Department of Agriculture) has been in operation since 1970. Consequently plantation forestry development is at a similar stage to that of New Zealand during the early 1920s. Much of the research effort is concerned with species trials, nursery techniques and plantation establishment and practices.

New Zealand agreed to support two forestry plantations on Erromango following a visit to Vanuatu by Andy Kirkland\* as part of a New Zealand aid mission in 1982.

The two projects situated at Dillons Bay and Ipota respectively were originally designated Industrial Forestry Projects designed to produce timber for export markets. Dillons Bay was reclassified as a Local Supply Plantation in 1985 to produce timber for local needs within Vanuatu.

From the outset recognition was given to the need for New Zealand to remain involved with the projects for at least 10 years while management techniques were investigated. *Pinus caribaea* (Honduras) has been planted at Dillons Bay and *Cordia allidora* (South America) at Ipota, but trials with other exotic species and some indigenous species have also been established. A low-key approach has been adopted, keeping early capital investment to a minimum. Assistance has involved the provision of resources, aid funds and technical assistance through forestry advisers. Nevertheless significant contributions have been made to the local economy through wages — up to 100 labourers employed at any one time — and the development of ancillary services such as radio communications, rural water supplies and support for the local health officer. It is particularly pleasing to note the role of women within the project — up to half the labour force on occasions.

\*The Assistant Director General, NZ Forest Service (1982)



Kauri regeneration on Erromango. (Photo P. Neil)



Large Kauri (*Agathis macrophylla*) of 2.8m diameter in the proposed Kauri reserve. (Photo P. Neil)

### Further Logging

In recent years, interest has again been shown in the exploitation of Erromango's forests. As a result of tenders inviting logging in 1985, Monterro S.A. was granted a licence to log and mill on Erromango for a period of ten years. Kauri, tamanu and milktree (*Antiaris toxicaria*) are the main species to be logged.

Although equipment has arrived from New Caledonia and some roads have been constructed, including one through the middle of the young pine plantation at Dillons Bay, no actual logging has yet taken place under this agreement. Discussions are underway between Monterro S.A. and an Australian peeling and veneer firm over the establishment of a veneer plant in Vanuatu. If such a plant was established, it is likely that the Monterro S.A. operation would become more viable, as would other logging operations in the country.

### Kauri Reserve

Although a timber licence has been issued for logging on Erromango, one of the conditions of the licence is that the Government has the right to establish a reserve for kauri on the island. *A. macrophylla* is distributed on other islands in Vanuatu but only found extensively on Erromango.

The importance and value of the kauri forest has long been recognized. In 1971 the Royal Society Percy Sladen Expedition to the then New Hebrides recommended that a reserve for the species should be created on Erromango.\* The original reserve proposal

\*Tony Beveridge, formerly of FRI, was involved in the Royal Society expedition and worked on the ecology of kauri in Vanuatu. He followed this up in 1981 when he was involved in drawing up proposals for forest management on Erromango.

and subsequent proposals were not acted on but in 1985 a new proposal prepared by the Vanuatu Forest Service was accepted in principle by the Vanuatu Government's Council of Ministers.

Many of the characteristics of *Agathis macrophylla*, notably good form and reasonably good growth rates, are highly desirable silviculturally. The species occurs in Santa Cruz, Vanuatu and Fiji and plantation trials in Vanuatu have shown that *A. macrophylla* from Vanuatu outperforms other kauri species in both shaded and unshaded conditions. It is also extremely wind resistant as a mature tree and is capable of withstanding drought stress. With this potential importance as a plantation species, it is likely that an international demand will develop for seed of Vanuatu kauri. For both local and international reasons therefore, it has been recognized that Vanuatu must attempt to conserve the genetic variation in as many stands of kauri as possible as they may be very important for future seed.

In early 1986, Australia funded a feasibility study for the reserve on Erromango. This was carried out by Dr Andy Gillison, CSIRO, and Peter Neil and showed that it was technically feasible to establish a reserve worthy of inclusion in the World Heritage List. The necessary legislation is already available in Vanuatu and the local people "man-Erromango" are strongly in favour of the reserve.

A better understanding of the ecology of *A. macrophylla* was achieved during this study. In particular information was obtained on seed dispersal, regeneration in logged and unlogged areas, soil types on which kauri occurs, phenology, associated vegetation types and seral stages. Gillison and Neil (1986) noted that "the maintenance of population viability and genetic heterozygosity in the long term may well depend on the presence of representative sequences of vegetation types from pioneer to mature forest, i.e. a biotope". To determine this more accurately, it was recommended that an inventory and ecological survey of about 3000 ha be carried out in the Lampounari river catchment to determine whether sufficient vegetation sequences can be accommodated in either this or a smaller area. This catchment includes all the areas previously proposed for the reserve. As this area is remote from the areas already contracted for logging, or likely to be considered for plantation forestry, there should be no immediate risk from exploitation.

The ecological study has yet to be carried out but it is hoped that the data collected will provide the necessary ecological and environmental information to obtain financial support from potential international donor agencies to enable the reserve to be established. If the reserve is created, it will be an important precedent for Vanuatu and other Pacific island nations. Not only will it provide a unique forest type for scientific study, but also it could prove to be of great interest to tourists who rarely get the opportunity to see true natural forest stands, especially tropical rain forest, in today's world of rapid forest exploitation.

### The Future

The future for forestry on Erromango in its broadest sense looks promising. Plantations of *Cordia* have been established for six years, and studies indicate that kauri and other species may be also suitable as plantation species. Logging operations with concurrent roading and other infrastructural developments are a real possibility, while the proposed kauri reserve should provide for timely preservation of an important resource.

Interest has also been revived in management of sandalwood. Sandalwood is still to be found on Erromango but the small remaining trees are being rapidly exploited by man-Erromango for ready cash (60cents/kilo). Trials with sandalwood establishment have already been undertaken and in the future this species may once more become common on Erromango.

### FOOTNOTE

Cyclone Umma passed through the Islands of Southern Vanuatu on February 7-8 this year. On Erromango, there was considera-



Harvest of Kauri (*Agathis macrophylla*) cones for seed. (Photo P. Neil)

ble damage to the plantations at Ipota and Dillons Bay. At Ipota 140 of the 207 ha planted were damaged; 20-40% of the *Cordia* planted between 1980 and 1984 were snapped, windblown or leaning. At Dillons Bay the *Pinus caribaea* suffered severe damage.

The total area of forest is only 45 ha and planting had finished in 1985.

### Reference

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