

Enrichment and rehabilitation in the permanent forest estate

An ITTO project in Peninsular Malaysia has developed guidelines for matching species with site in forest restoration and rehabilitation

by Mohd Basri Hamzah

Project Lead Consultant

Attached to the Forestry
Department Peninsular Malaysia
basri_hamzah@hotmail.com

THE degradation of forest soil is a worldwide phenomenon caused by agents such as fire, deforestation and logging that create wide canopy openings and/or disturb and expose the mineral soils.

In Peninsular Malaysia, where annual rainfall generally exceeds 2000 mm, uncontrolled disturbance in the hill dipterocarp forest—which constitutes the bulk of the permanent forest estate (PFE)—may easily lead to soil degradation. For example, it has been estimated that about 3.7% of the PFE is sufficiently disturbed to require restoration interventions.

The Forestry Department Peninsular Malaysia began implementing ITTO PROJECT PD 115/90 REV.1 (F): 'Rehabilitation of natural forests' in 1993. Its main objective was to develop appropriate silvicultural measures to rehabilitate degraded forests so as to restore the productivity of these areas. In particular, the aim was to identify the species most suitable for enrichment and supplementary planting in degraded and secondary forests.

Implementation strategy

The choice of species to be used in the site-species matching trials was based on the need to identify ecologically and silviculturally desirable species suitable for planting in areas where the current stocking of such species was too low. However, the socioeconomic relevance of species to local Orang Asli communities was also an important criterion in species selection; providing incentives for these communities to become involved in forest restoration and management will reduce the need for traditional shifting cultivation, which is becoming less sustainable in Peninsular Malaysia as fallow periods become shorter. Species were therefore chosen for their high survival rates, productivity, nitrogen-fixing and soil-stabilising abilities, multiple-use potential, local acceptance and commercial viability.

The project provides clear evidence that high-value timber species, which are mostly climax species (dipterocarps, mahogany), can thrive in disturbed areas characteristic of succession stages.

In total, 17 species were chosen for the site-suitability trial. All produce commercial timber except for the three bamboo (_B) and one rattan (_R) species and all but three (_E) are indigenous; the bamboos are also good soil-stabilisers. Two species (_D) were from the dominant dipterocarp



Climbing to success: planting rattan on marginal sites can boost site recovery and the revenue-generating potential of the forest. Photo: A. Sarre

family, three were legumes (_L) and ten produce additional products such as fruits (_F), bamboo shoots (_B), rubber latex (_X) and medicines/insecticides (_M). The species were *Acacia mangium*_{EL}, *Durio zibethinus* (*durian*_F), *Parkia speciosa* (*petai*_F), *Pithecellobium bubalinum* (*kerdas*_{FL}), *Elatiospermum tapos* (*perah*_F), *Gigantochloa levis* (*buluh beting*_B), *Gigantochloa ligulata* (*buluh tumpat*_B), *Dendrocalamus asper* (*buluh betong*_B), *Calamus manan* (*rotan manau*_R), *Swietenia macrophylla* (*mahogany*_E), *Shorea parvifolia* (*meranti sarang punai*_D), *Shorea leprosula* (*meranti tembaga*_D), *Hevea brasiliensis* (*rubber*_{EX}, Clone PB260), *Scaphium* spp (*kembang semangkok*_F), *Endospermum malaccense* (*sesendok*), *Azadirachta excelsa* (*sentang*_M) and *Intsia palembanica* (*merbau*_L).

Project area

Five compartments in two forest reserves were chosen for the trial: compartments 6 and 181 in the Korbu Forest Reserve and compartments 103, 105 and 106 in the Piah Forest Reserve. Both reserves are located in the Kuala

Kangsar Forest District some 5° north of the equator in the state of Perak, about 280 km north of Kuala Lumpur. The selected compartments were all accessible and contained sufficient areas of abandoned shifting cultivation and recent logging activity.

The trial area comprised lowland dipterocarp forest below 400 m above-sea-level, with terrain ranging from undulating to steep. It was stratified into 'sites' on the basis of stand disturbance: abandoned shifting cultivation area (SCA); old logged-over forest (LOFO); and recently logged-over forest (LOFN). A pre-felling inventory showed an average timber volume of 39 m³/hectare. The SCA and LOFO, abandoned for more than seven years, were characteristically weed-infested. All compartments were managed under the Selective Management System (SMS), a tropical variant of the shelterwood system that is applied to the PFE throughout Peninsular Malaysia. The soils in the area were all ultisols—characteristically highly leached, acidic and nutrient-poor—but within this broad type there was variation between sites.

Silvicultural treatments

Twenty-two treatments (including controls) were carried out in the form of species-site trials, weed controls and stand improvement. Permanent sample plots were either rectangular or irregular; in the latter, plantings were conducted along roads and skid trails in the LOFN. Plantings in rectangular plots comprised either one or two species, but randomised multiculture planting was also carried out in the SCA to test inter-species compatibility. Multistorey planting, in which *meranti tembaga* eventually replaced an overstorey nurse crop of *Acacia mangium*, was conducted in the SCA and on former log landings of the LOFN. Each treatment was conducted in 3–5 replicate blocks at each site.

Measurements

Measurements were taken twice a year for two years. Ten parameters were recorded for planted seedlings: mortality, crown lighting, site features, stem collar diameter, height above ground, crown diameter, crown length, branch number, and stem and crown form. For control plots in the SCA and LOFN, parameters recorded included species (all sizes), frequency (seedlings), diameter at breast height (dbh), clear bole height and tree class (trees >5 cm dbh), crown lighting, lianas, crown form, and stem grade (trees >15 cm dbh). Bamboos were measured for shoot and stem number and rattan for stem length, leaf number and stem class.

Economic and financial analyses

Thirteen species with superior survival and growth performance were selected for subsequent economic and financial analysis; these were *kembang semangkok*, mahogany, *sentang*, rubber, *meranti tembaga*, *meranti sarang punai*, *petai*, *durian*, *perah*, *merbau*, *sesendok*, *kerdas* and *Acacia mangium*. Projected yield data were analysed using a net present value (NPV) of 8% over a 60-year period. Short-rotation species required three to four cycles for this duration.

Species-site matching

The most tangible outcome of these trials was the development of guidelines for species-site matching. Of the 13 species selected for economic and financial analysis, ten were ultimately recommended for various degradation types based on their NPV values, which all exceeded RM4000 per hectare (US\$1 = RM3.8). The site-species matches for the study area are as follows:

- restorative planting in the SCA: *durian*, *petai*, mahogany, *meranti tembaga*, *sentang*, *kembang semangkok*, *buluh tumpat* and *buluh betong*;

- enrichment planting in the LOFO: *meranti sarang punai*, *meranti tembaga*, and *kembang semangkok*; and
- restorative planting in the LOFN: *durian*, *petai*, mahogany and *buluh betong*.

In addition, the study was able to identify optimal light and site conditions for species during establishment. It is thus possible to identify those microsites and the degree of shade manipulation needed for individual species. In general, the project was able to evaluate the rehabilitation capacity of a species, including its socioeconomic relevance and specific environmental functions.

Implications for forest management and the rural economy

Techniques for rapid soil stabilisation in hill forests (approximately 20% of the area affected) are becoming increasingly important as these forests are logged. Project results offer effective soil management options through restorative and productive plantings of proven species contributing directly to environmental and economic sustainability.

The project provides clear evidence that high-value timber species, which are mostly climax species (dipterocarps, mahogany), can thrive in disturbed areas characteristic of succession stages. Their use in enrichment planting should thus provide a new opportunity for producing quality timber in disturbed areas. Although monoculture plantings proved more productive than multicultures, the latter arrangement appeared effective in avoiding insect damage in the valuable timber species mahogany.

Under proper compartment stratification, naturally unproductive areas (infertile, stony, thin soils, steep slopes) can be demarcated and the marginal sites planted with proven restorative species such as bamboo (and also *rotan manau* as a 'bonus' crop). Such integrated utilisation can help maximise stand productivity.

The performance of rubber in restorative plantings, although rated lowest in NPV returns, nevertheless offers the potential to boost the (currently declining) supply of rubberwood to the Malaysian furniture export industry (worth RM6 billion in 1999). However, the decision to use rubber and other exotic species must be made on the understanding that this may cause a fundamental shift in the ecological character of the natural forest.

The outstanding restorative performance of traditional agroforestry species such as *durian*, *petai* and to a lesser extent bamboo provides a readily acceptable way of involving rural communities in forest restoration and reforestation as avenues for rural development.

The project made a number of recommendations for the restoration and rehabilitation of degraded forest in the PFE of Peninsular Malaysia, and also published guidelines (which can be obtained from the Forestry Department Peninsular Malaysia, naaman@forestry.gov.my). However, these recommendations and guidelines are based on a relatively short assessment period; it is important that the research sites are maintained and monitored over the next decade or more to ensure the effectiveness of the restoration and rehabilitation measures.

The author acknowledges the contributions of Associate Professor Ashari Muktar, Universiti Putra Malaysia, and Dato' Hj Mohamed Darus Hj Mahmud, formerly the Director General of the Forestry Department Peninsular Malaysia.