Potentialities of new line planting technique of Enrichment planting in Peninsular Malaysia: A review of resource sustainability and economic feasibility

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Potentialities of new line planting technique of Enrichment planting in Peninsular Malaysia: A review of resource sustainability and economic feasibility

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Abstract

It has been few decades since the measures were taken to rehabilitate the forest after logging in peninsular Malaysia. Enrichment planting is one of the potential rehabilitation measures. The technical issues like line planting technique, spacing, species-site matching are crucially related to the success of rehabilitation effort. Different factors are directly or indirectly related to the success of it. These factors affect the overall performance of the plantation. The performance of different techniques varies from each other. The features of the new line planting technique are different from the other conventional planting techniques to some extent. Techniques of enrichment planting, thus, are needed to be reviewed to determine the role of new technique towards sustainability.

The study focused on the potentialities of line planting technique of enrichment planting in Peninsular Malaysia. It emphasized on sustainability perspective as well economic feasibility of the technique. The overview of the present enrichment planting indicates that the plantations following line planting technique have good growth performance that leads to an increase in resource base. The salient criteria of line planting considers few aspects of planting technique that are required to be followed by the forest managers to make it sustainable. The use of improved techniques, thus, ensures the necessary conditions for regeneration of forest, its expected growth and sustainability. By carrying out a financial analysis, it was seen that the technique is also economically feasible. The Net Present Value and Internal Rate of Return of the enrichment planting with new technique are higher than the enrichment planting with other techniques. In order to ensure it's more scientific implementation, furthered in depth technical assessment such as species-site matching, biodiversity aspects and adequate information are necessary to establish it towards sustainable forest resource base.

Keywords*:* Enrichment planting, line planning, Financial Analysis, Logged over forest, Rehabilitation measures

Introduction

Enrichment planting is such a method of silvicultural management that rehabilitate poorly stocked logged-over forest without eliminating the existing individuals. It is essentially a process of supplementing the natural regeneration with seedlings of commercial species [3]. Usually indigenous species are planted in enrichment planting. It is followed for the degraded patches of the forests for successfully rehabilitation with the species such as pine (predominently *Pinus caribaea*), Kapur (*Dryobalanops aromatica*), Meranti tembaga (*Shorea laprosula*), Balau Kumus (*Shorea laevis*), Meranti Seraya and Mahogany (*Swietenia macrophylla*). In the past, enrichment planting was practiced by following traditional method. But due to its low performance some technical modifications were made. Especially, the recent development of enrichment planting stressed on line planning technique. The new technique is associated with different features that results improved scenario. For instance, the species such as *Shorea parvifolia* was planted following line planting technique in a poorly stocked forest at Bukit Tapah Forest Reserve, Perak which showed a promising finding. The annual mortality rate decreased as the plantation grew older. In the first year, it was 10 percent but in the following three years it decreased up to 5 percent. The mean annual height increment ranged

between 1.2 and 1.5 m while the mean annual diameter increment ranged between 1.3 and 1.5cm [10]. This result indicated that enrichment planting under "single cropping" could be extended at a larger scale. As an outcome of this success, a total of 25,857 hectares had been planted by following the enrichment planting program with dipterocarps and non-dipterocarps timber species throughout Peninsular Malaysia [1].

Assessment of potentials of Enrichment Planting

There are vital issues to be resolved regarding the successful enrichment planting towards resource sustainability. Flowering and fruiting behaviour, seed storage and the light regimes of different species are the most important physical factors in determining survival and development of seedlings in tropical rain forest [8]. In the following section, the aspects of enrichment planting are discussed towards successful plantation and its sustainability.

Table 1 shows the growth and yield performance of the enrichment planting of different forest reserve in Peninsular Malaysia. The size of sample plot was 1 hectare in each state. Almost all plots were more than 24 years old. These areas were planted by the Forestry Department with the indigenous species such as Meranti rambai daun (*Shorea accuminata*), Meranti Tembaga (*Shorea leprosula*), Meranti Sarang Punai (*Shorea parvifolia*), Chengal (*Neobalanocarpus heimii*), Kapur (*Dryobalanops aromatica*) and Keladan (*Dryobalanops oblongifolia*). The growth of the trees was better, though some trees failed to survive due to natural courses. The observed growth performance of the trees in the EPSP (Enrichment Planting Sample Plot) was compared to the growth of the indigenous tree species reported in other plantation and planting trials [13, 3]. However, 59 years old Kapur planted in Kanching Forest Reserve showed a very low growth in diameter and height compared to 26 years old Kapur (*D. aromatica*) planted in Gunung Bongsu Forest Reserve. Zuhaidi and Weinland [13] reported that 45 years old Kapur at FRIM (Forest Research Institute Malaysia) plantation trial plots had a diameter of 52.6 cm. At 26th year, the diameter was 30 cm. Keladan (Dryobalanops *oblongifolia*) seemed to be the fast growers among the species in the EPSP (Enrichment Planting Sample Plot) . At 29th year of age, Keladan showed the highest diameter of 50.8 cm, followed by Meranti Sarang Punai (*Shorea parvifolia*), Meranti Tembaga (*Shorea laprosula*) and Meranti Rambai Daun (*Shorea accuminata*) at 33.8 cm, 28.8 cm and 28.6 cm (average of 2 sites) respectively.

Table 1: Growth performances for species planted in the early implementation of enrichment planting in peninsular Malaysia (2002)

Species	Stand age (yr)	Avg. Diam. (cm)	Avg. Height (m)	Avg. $MAI_{diam.}$ (cm/yr)	Avg. $_{diam.}$ $\geq$ 30 cm dbh (cm/yr)	Avg. $MAI_{diam.}$ $\geq$ 30 cm dbh (cm/yr)
Meranti Tembaga	29	28.8	14.3	0.9	39.8	1.3
Shorea leprosula	32	40.6	21.1	1.2	44.6	1.3
	24	34.1	22.4	1.3	11.1	1.7
Meranti Sarang Punai	29	33.8	13.7	1.1	38.9	1.3
Shorea parvifolia	30	36.3	24.4	1.1	47.9	1.4
	32	32.3	25.4	0.9	37.0	1.1
Meranti rambai daun (*Shorea*	29	28.2	16.9	0.9	38.2	1.2
acuminata	29	29.0	13.3	1.0	37.4	1.2
Kapur (*Dryobalanops aromatica)*	59	29.9	16.4	0.5	38.5	0.7
	26	34.5	24.8	1.3	43.2	1.7
Keladan (*Dryobalanops oblongifolia)*	29	50.8	17.8	1.8	51.3	1.8
Chengal (*Neobalanocarpus hemeii)*	80	37.1	27.6	0.4	44.7	0.5
Sesenduk (*Endospermum alaccense)*	29	26.8	17.8	0.9	28.3	1.0
Pelong (*Pentaspadon motleyi)*	31	25.2	24.1	0.8	30.4	1.0
Surian (*Toona sureni)*	29	26.8	17.8	0.9	28.7	1.0

Source: field survey, 2002

Comparison (Table 2) of the growth among different trees above 30 cm diameter at different plots also showed almost same result. The growth of the trees planted under enrichment planting was lower than the trees planted in Kepong plantation sample plots (Ng and Tang, 1974). It also showed that the trees planted in Arboretum, Kepong had higher growth than the trees in Enrichment Planting areas (EPSP).

Generally, from this growth assessment, it seems that individual tree has a successfully growth performances in terms of diameter and height. Mean Annual Increment (MAI) in diameter of selected tree was 0.5 cm to 1.8 cm per year at more than 30 cm dbh.

Table 2: Comparison of diameter growth between three different planting options

Species	Stand Age (yr)	Average $_{diam}$ > 30 cm planted trees under enrichment planting (cm)	Average $_{diam}$ > 30 cm of Largest trees in FRIM Sample Plot (cm)	Average $_{diam}$ > 30 cm of Largest trees in FRIM Arboretum (cm)
Shorea leprosula	30	44.6 (Bukit Tapah FR, Perak)	43.0	70
Shorea parvifolia	30	47.9 (Bukit Tapah FR, Perak)	61.6	-
Shorea accuminata	30	38.2 (Bukit Belata FR, Selangor)	41.7	61.5
Dryobalanops aromatica	25	43.2 (Gunung Bongsu FR, Kedah)	37.5	36.4
Dryobalanops oblongifolia	30	51.3 (Tersang FR, Pahang)	61.1	71
Neobalanocarpus heimii	80	44.7 (Rotan Tunggal FR, Pahang)	-	53.4 (age of 45 yrs)
Endospermum malaccense	30	28.3 (Relai FR, Kelantan)	42.2	-

Source: field survey, 2002

At the present, only Line Planting method is applied for enrichment planting in logged-over forest under the Selective Management System (SMS) in Malaysia. In Line Planting method, inter-line distance and intra-line distance are 10m and 3m respectively. At the same time a clearing of 1m to 2m width is given to each planting line. The success of line planting almost depends on light penetration. A survey [9] showed that insufficient light may cause high mortality. Light conditions are related to the line width and stand height [4]. It has been that 20m distance between lines is the best relative reception of light intensity compared to other line width. Emphasis is also due to canopy opening and intensive vertical tending, especially at early stage of enrichment planting. Hence, direction of line, width and maintenance method of line planting are important for its success.

A general guideline for line planting is given by Appanah and Weinland [3] and Lamprecht [6]. They recommend a north-south direction rather than an east-west direction to minimize the duration of sunlight fall on the seedlings. Moreover, Lamprecht [6] stated that an east-west direction is more effective for favourable light conditions. Adjers [2] reports that line direction seems to have a little effect on survival or growth rate of the planted species. The studies also indicated that southeast-northwest is the best planting direction for *Shorea johorensis* that results good growth performance. *S.leprosula* seems to be benefited slightly from more open conditions [12], while, Wan Razali [11] showed that *S.parvifolia* grow well in open conditions. However, by considering establishment cost and work load in the forest, 2 m line clearing in width is preferable for enrichment planting.

Currently, most of the maintenance works along the planting line include cleaning grasses, shrubs and climbers that disturb the planted trees. The surrounding trees are left untouched (horizontal tending). All vegetations are slashed within 2m width of planting line without considering whether the vegetation is marketable species. This procedure of cleaning has no affect to reduce the obstacle of the canopy for light penetration. As a result of it, the seedlings remain shaded by branches of trees. Adjers [2] showed that *S. johorensis* and *S. leprosula* tend to be benefited from horizontal and horizontal-vertical tending. Based on these results, it is recommended to keep planting lines open with horizontal and vertical tending in order to allow overhead light for the dipterocarp trees. Vertical tending is done by removing branches that prevents the overhead light to reach the forest floor of the planting line. Besides, clearing the planting lines is to be done properly following established guideline. Planting lines of 2m width are to be cleared through the existing secondary vegetation to reduce competition for light. The width of the line opening is required to be around 2 to 3 m. Otherwise; the plants may become scalded during dry seasons. The direction of the lines is to be along the east-west axis to ensure maximum available sunlight during the day. The lines are to be spaced at 20 m intervals.

Table 3 shows the comparison between the results of financial analyses carried out for enrichment planting activity at Bubu F.R., Kuala Kangsar (May, 1996) and the enrichment planting with new line planting technique. The Net Present Value (NPV) and Internal Rate of Return (IRR) of the enrichment planting with new technique are higher than the enrichment planting of Kuala Kangsar. The difference of NPV between these two activities is RM261.43 that indicated the higher feasibility of the new technique for enrichment planting at 5 percent discount rate. The analysis used three different discount rates to examine the sensitivity of NPV and IRR to the discount rate. Among the three alternative discount rates, 5 and 10 percent give the positive NPV. Net Present Value of enrichment planting is higher at 5 percent than 10 percent discount rate.

Table 3: Financial Analysis of enrichment planting with new technique

Indicator	Different discount rates	Enrichment Planting activity at Bubu F.R., Kuala Kangsar (A)	New technique of enrichment planting activity (B)	Difference between NPVs (B-A)
Net Present Value (NPV)	5%	2,437.86	2699.29	261.43
	10%	107.60	115.13	7.53
	15%	-420.56	-423.76	-3.2
Internal Return Rate (IRR)	5%	11%	11.2%	-
	10%	11%	11.2%	-
	15%	11%	11.2%	-

Source: field survey, 2002

Conclusion and Recommendation

Enrichment planting with the features of line planting techniques is an effective measure towards rehabilitating the poorly logged over forest. The traditional technique of enrichment planting is associated with some drawbacks that lead to low growth performance of the seedlings. The new planting technique and others modified measures may accelerate and upgrade the situation by removing the shortfalls. The financial analysis of the study shows that by implementing modified line planting technique the financial net present value is possible to increase. Internal rate of return of the new technique also indicates more feasibility of enrichment planning. Based on the findings of the study, it is to be recommended that a) Effort should be made in addressing the issue of species-site matching b) Biodiversity aspects should be considered as a partial concern in implementing enrichment planting c) Efforts should be made to gather information regarding more technical perspective so that initiative towards its development is possible.

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