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Enrichment Planting Study of Teak (*T. grandis linn.f.*) in Ngalaik Reserved Forest, Pyinmana

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ပျဉ်းမနားမြို့ နယ်၊ ငလိုက်ကြိုးဝိုင်းရှိ သဘာဝတော အတွင်း ကျွန်းပင်များအား လိုင်းအလိုက် ဖြည့်စွက်စိုက်ပျိုးခြင်း နည်းစနစ်ကို စူးစမ်းလေ့လာခြင်း

ဦးညီညီကျော်၊ B.Sc.(Forestry), M.Sc.(Forestry, trop.)
ဦးစီးအရာရှိ၊ သစ်တောသုတေသနဌာန၊ ရေဆင်း။

စာတမ်းအကျဉ်းချုပ်

သဘာဝတောများအတွင်းမှ သစ်ထုတ်ယူသုံးစွဲခြင်းကြောင့် ရောင်းတန်းဝင် သစ်မျိုးများ လျော့နည်းသွားခြင်း မရှိစေရန် ပြန်လည် ဖြည့်ဆည်းပေးသည့် သဘာဝမျိုးဆက်ခြင်းနှင့် ပြုစုထိန်းသိမ်းခြင်း လုပ်ငန်းများ အနက် ပိုမိုတိုးတက် ကောင်းမွန်သော နည်းပညာနှင့် နည်းလမ်းများအား ရှာဖွေစူးစမ်း လေ့လာ ထားခြင်းဖြစ် ပါသည်။ သဘာဝတောများအတွင်း ၁၀ မီတာအကျယ် လိုင်းများကို အရှေ့အနောက် လားရာအတိုင်း ဖောက်လုပ်ကာ လိုင်းအလယ်တွင် ကျွန်းပျိုးပင်များအား စိုက်ပျိုးပြီး ပေါင်းသင်ရှင်းလင်းခြင်း အကြိမ် ၃ မျိုး၏ အကျိုးသက်ရောက်မှုကို စမ်းသပ် ခဲ့ပါသည်။ ထို့အပြင် ငလိုက်ကြိုးဝိုင်း အကွက်(၁၈)၏ အပင်ပေါက်ရောက်မှု အခြေအနေကို လေ့လာဆန်းစစ် တင်ပြထားပါသည်။

Enrichment Planting Study of Teak (*Tectona grandis Linn.f.*) in Ngalaik Reserved Forest, Pyinmana.

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The research was conducted to find ways and techniques of improving natural regeneration and cultural operations in order to replenish what has been exploited in natural forests. Teak seedlings were Planted on the axis of 10 m width planting lines in East - West direction and three different frequencies of weeding operations were tested. Stand structure of Compartment 18, Ngalaik Reserve was also analyzed.

Contents

1. Introduction

In Myanmar, almost all of the teak and the hardwoods that are being exploited are from the natural stands. In order to maintain sustainable yield of timber and forest products., silvicultural operations to improve the natural regeneration are being carried out in the natural forest in order to replenish what has been exploited.

The original Brandis selection system, modified into Myanmar Selection System in 1920, is still in use up to the present time. Under the Myanmar Selection System, scattered single trees or small groups of all marketable trees which have attained a fixed exploitable girth size are selected for cutting. The fixed exploitable girth size varies with the type of forest. In good (moist) teak forest, the girth limit at breast height (1.3m) is 2.3m (7'6") and in poor (dry) forest 2.0m (6'6"). If seed bearers are scarce, a few high quality stems are left as seed trees. The seedlings which are regenerated in different ways contribute to the stand structure of the forests which includes large, medium and small size trees. In sustained yield forest management, tree populations are maintained in a 'normal' or 'balanced' or 'desirable' stand structure with higher number of small trees and sloping down as the size increases. (K.Tint 1995). Regeneration is theoretically in continuous progress through the forest to provide sufficient young trees to maintain the growth and production at a sustained level. This has not been observed, especially in teak (C.Doo 1986).

One of the regeneration systems that can be used for rehabilitating the degraded forest is enrichment planting. Enrichment planting is seen as one possibility to increase the commercial potential of the forests. If there is an insufficient number of economically valuable trees in the initial stand, or if there is a complete lack of such trees (e.g. in logged-over forests), then enrichment may be a better option than improvement. Research was conducted in order to demonstrate the need for enrichment planting (a stand structure analysis), and some techniques for line planting is developed, based on measurements of growth rates of teak seedlings. Changes in the growing stock of Ngalaik reserve from 1928-30 to 1999 are discussed. The aim of this study is to work out a silvicultural concept for treating selectively used natural teak forests as the basis for an environmentally sound management of the natural forests of Myanmar. Besides structural analysis, other important parts of the study are the identification of areas insufficiently regenerated with commercial timbers and the basic needs for the success of enrichment planting.

2. Literature Review

In reviewing the publications on enrichment planting one notices that most articles originated in the late period of 1950s and the beginning of 1960s. Then, there was silence about these methods, perhaps because of the plantation euphoria of the late 1960s and 1970s. However, more and more attention is now being given again to the techniques of enrichment.

The best known enrichment system is no doubt line planting, the so-called "*enrichissement par layons*" which has been propagated in French-speaking Africa for 50 years, especially by AUBREVILLE (1937). The original method was later modified by Catinot and a number of variation is now found in many parts of the tropics. (Lamprecht 1989).

In the following cases line enrichment may be applicable. (Weidelt 1991) .

- logged - over areas, where seed trees and regeneration are lacking or present in insufficient density

- secondary forest after shifting cultivation, which are now intended for wood production. Experience has show that in many cases the proportion of economic species is low and regeneration slow in such forests.
- forests that are poor in economic species by their nature, but have a potential for wood production.

The original method of line enrichment consisted of the following phases:

(a) operation of parallel lines, 10-25 m distance, in East-West direction.
(b) in the centre a 2 m wide s trip is cleared for planting by cutting all vegetation
(c) next to this on a 4 m wide strip on both sides all trees up to 4 m height are cut
(d) planting distance 3-5 m on the central strip.
(e) for the success of enrichment planting proper maintenance is of utmost importance:
    - up to 3x weeding etc. In the fist year, later cleaning at longer intervals.
    - good development of trees in the lines requires that the non-economic stand between the lines will be eliminated progressively, so that the final stand will be dominated by the planted commercial trees. (Weidelt 1991).

A major drawback of the original system is the unfavorable light conditions on the lines. The light conditions on the planting lines depend on

- width of lines
- height of adjacent forests
- direction of lines.

Catinot cited that east-west orientation results is the most favourable light conditions, the greater the line width, the better the light conditions and the greater the height of surrounding trees, the more unfavourable the light conditions.

Muuβ (1997) stated that enrichment plantings can only be successful if suitable growth conditions can be created for the planted trees: small line widths of less than 5m should be avoided especially in view of the growth dynamism of the surrounding populations.

3. Material and Methods

3.1 Area of investigation

The area under investigation lies in Ngalaik Reserved Forest, Compartment 18 and is part of a larger connected middle Bago range of mixed deciduous forests. It is situated about 40 km west of Pyinmana and extends from latitude 19° 56' north to longitude 95° 58' east. Within this area, which was selectively extracted by the Myanmar Selection System until 1960, the area chosen for investigation was the particular area, which was designated for enrichment, with an area of 485 hectares. To study the changes of growing stock of Ngalaik reserve, data sources used were 1966-67 forest inventory in Yemathin Division and diagnostic sampling survey at Compartment 18, Ngalaik Reserve in December 1999.

3.2 Structural Analysis

For the purpose of structural description. systematic sampling method was carried out in 20m directly adjoining sample plots of 20m² . The extent of sampling

was 6 ha for plot A (tree population with ≥ 10cm dbh), and 1.5 ha for plot B (trees with ≥ 5 and < 10cm dbh), Fig 1 and 2 show the method of structure sampling and the design of the sample plots.

The survey, carried out on the lines of the linear survey method developed in the Philippines (Barnard and Flemmich, 1950; Wiyatt-Smith 1963; Weidelt and Banaag, 1982), and designed to ascertain the natural regeneration, its spatial distribution and silvicultural value. The following works carried out;

(a) Enumeration of all tree species 10 cm dbh and over in plot A.
(b) Enumeration of all tree species 5 cm dbh to 9.9 cm dbh in plot B.

Sampling intensities of plot A and plot B are 1.2% and 0,3% respectively.

3.3 Enrichment experiment

An experimental plot of 3 ha for enrichment planting of teak was laid down in Compartment 18, Ngalaik reserve in Pyinmana Township. In each one hectare plot, parallel lines were cut down in strips 10m wide at 20m intervals in an East-West direction. On both sides of the axis of each line a strip 1 m wide is completely cleared. Up to distance of 5m on both sides of the axis of the line, all climbers are cut and the brushwood layers together with young trees (with the exception of economic species) up to a height of about 2-4 m removed. All wide crown lower-storey trees are also removed.

Teak seedlings were planted on the axis of the line at a distance of 5m. Seedlings were raised in a nursery and outplanted at the height of 45cm in June 1999. Each one hectare plot contains three planting rows. Weeding operations were carried out in circles of 1 m diameter (spot weeding). The weeds were scraped clean and soil working was also carried out around the plant. Three different frequencies of weeding (row 1, 1x weeding, row 2, 2x weedings and row 3, 3x weedings) were applied in each plots. First weeding was done just after planting in June, second and third weedings were carried out in August and November respectively. Measurement of height was taken in January 2000.

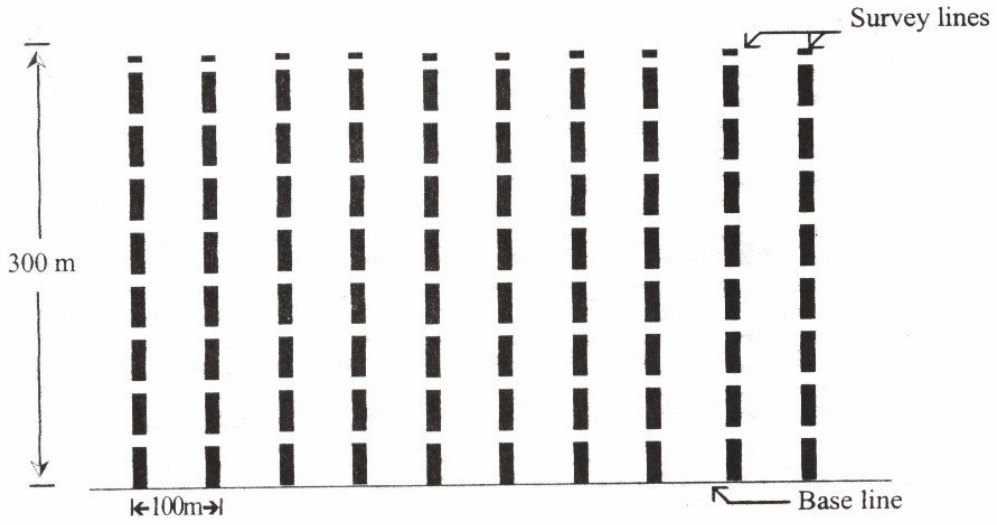


Fig. 1. Layout of survey lines

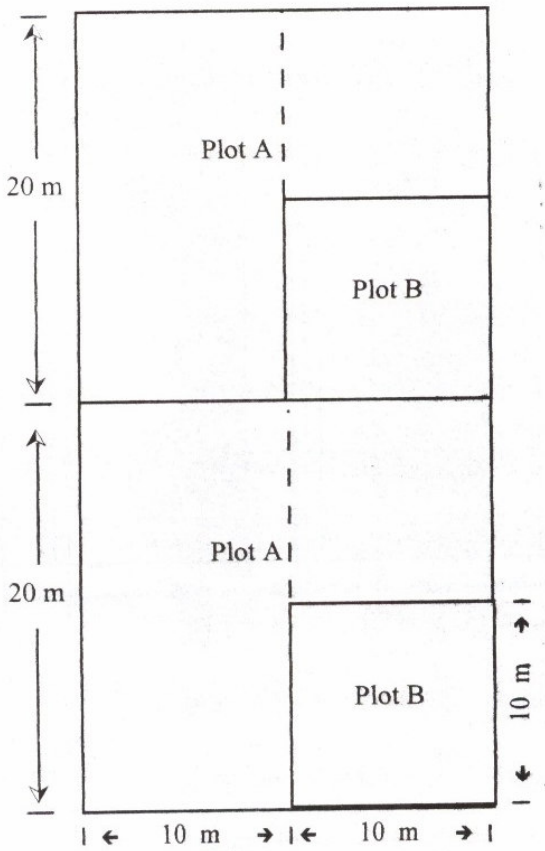
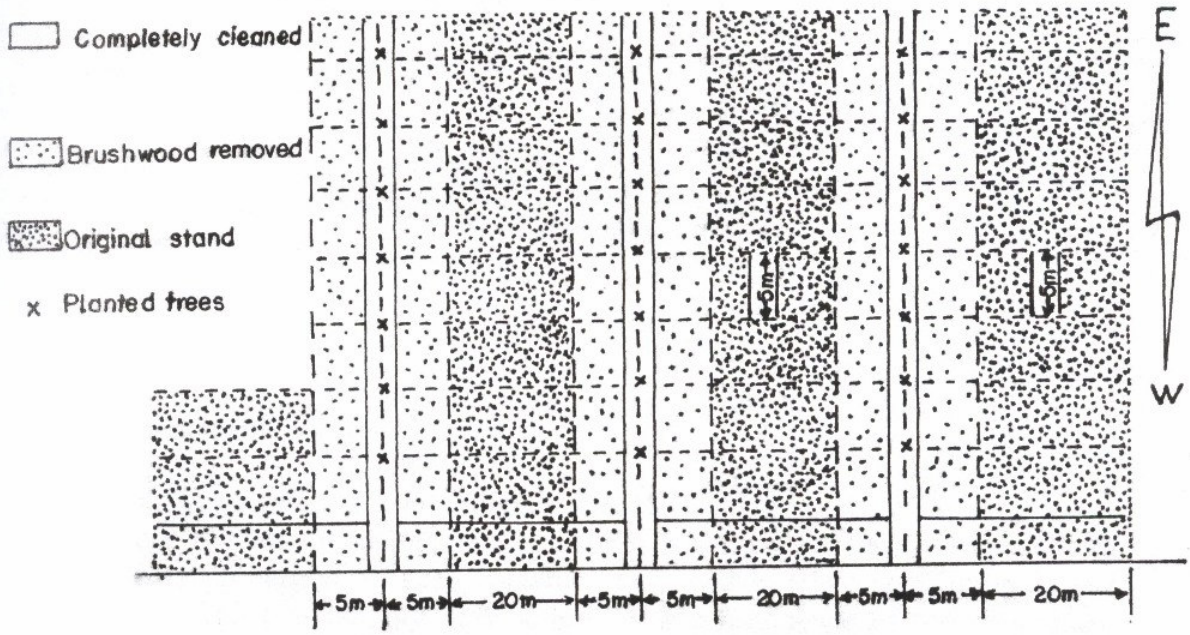


Fig. 2. Stratified sample plot

Plot A = trees ≥ 10 cm dbh
Plot B = poles 5.0 - 9.9 cm dbh

Fig3. Diagram of line enrichment planting

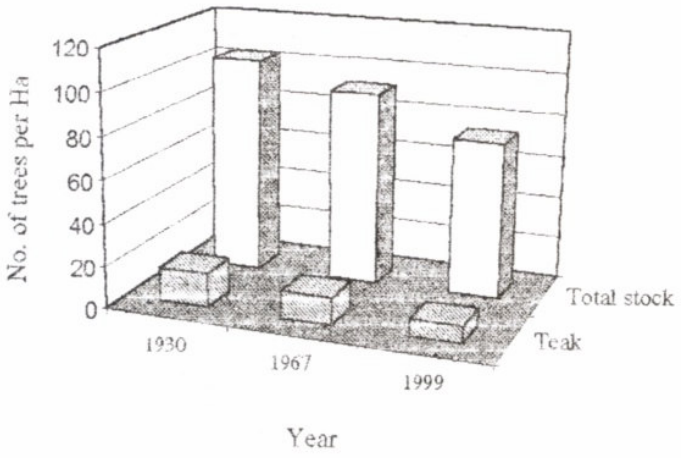


4. Results

4.1 Changes of growing stock

Changes in the growing stock of Ngalaik Reserve from 1928-30 to 1999 according to the inventory data of 1966-67 and 1999 are presented in Fig 4, Figures for Teak and other species only were received for comparison. Total stock decreases 11% in 1967 and 19% in 1999 and that of Teak 20% in 1967 and 36% in 1999 respectively.

Fig.4. Changes of total stock and Teak (20 cm dbh & up) in Ngalaik Reserve from 1930 to 1999

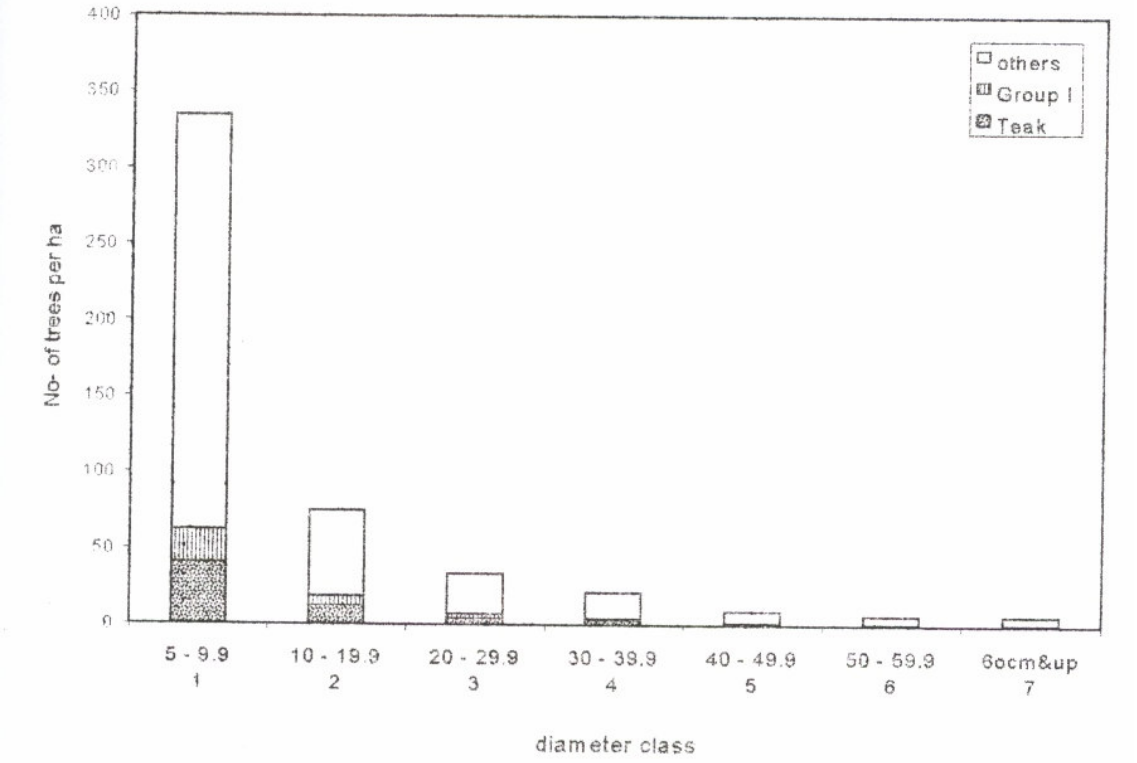


4.2 Structural analysis

Investigated area at Compartment 18, Ngalaik Reserve has an average number of trees of 483 per hectare. Fig 5 shows the stand structure with diameter proportion of Teak, valuable hardwood tree species (Group I) and others. The tree number distribution, as a consequence of the dynamism, shows a stock of lower diameter classes, with 69% of the tree numbers in diameter class 1 (5-9.9 cm), of which only 12% is Teak. The valuable hardwood tree species (Group I) are also poorly represented in all diameter classes. The stand structure in Fig.5. follows the ideal structure having more trees in smaller diameter classes. This indicates that the natural regeneration status in the study area is not significantly affected. Both natural conditions and silvicultural practices are in prefect harmony with the development of the stands. In terms of qualitative assessment, it is observed that teak and other commercial hardwood species in group 1 represent 12% and 7% respectively of the total growing stock. The lesser used species represent the rest of the growing stock (i.e 81%). Therefore appropriate measures are to be implemented to improve the quality rather than the quantity of the forest.

4.3 Stand Structure

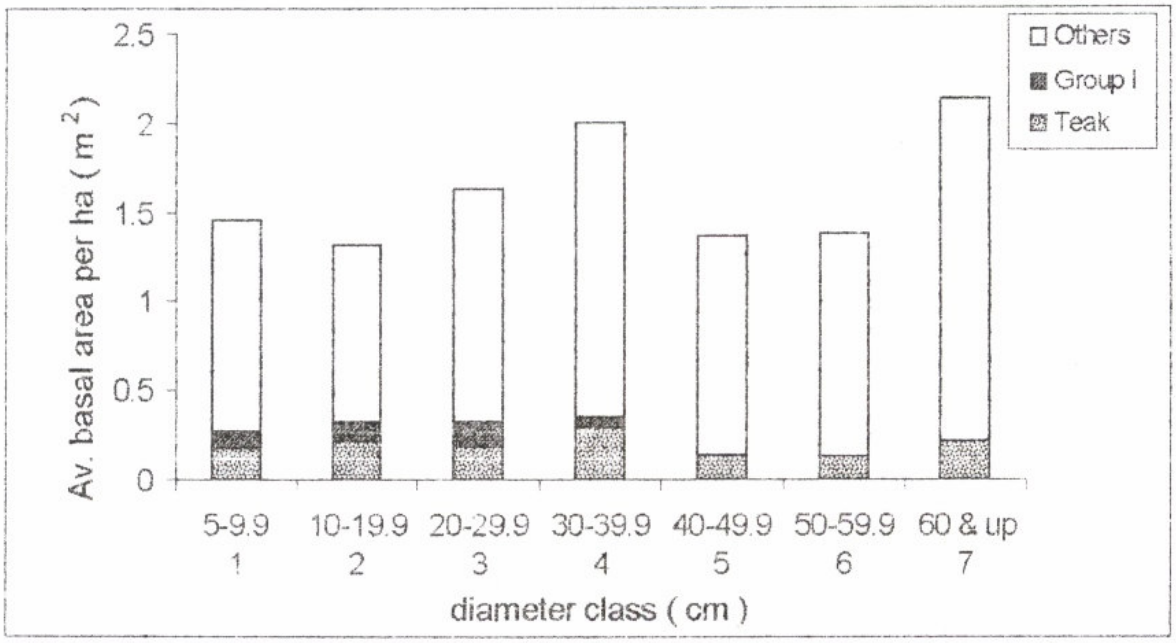
Fig.5. Stand Structure (diameter distribution indicating the portion of Teak, Valuable hardwood spp: (Group 1) and others



No. of trees per ha (Diameter distribution indicating the portion of teak valuable hardwood spp: and others)

Dia class (cm)	1 5-9.9	2 10-19.9	3 20-29.9	4 30-39.9	5 40-49.9	6 50-59.9	7 60cm&up
Teak	40	11.9	3.61	3.05	0.83	0.55	0.55
Valuable hardwood Spp: (Group 1)	22.22	6.66	3.05	0.55	-	-	-
Others	272.1	56.1	26.66	17.22	7.77	5.27	5
Total	334.42	74.66	33.32	20.82	8.6	5.82	5.55

Fig. 6. Average basal area per ha. [diameter distribution indicating the portion of Teak, valuable hardwood spp: (Group I) and others]



Average basal area (m^2) per ha (Diameter distribution indicating the portion of teak valuable hardwood spp: and others)

Dia class (cm)	1 5-9.9	2 10-19.9	3 20-29.9	4 30-39.9	5 40-49.9	6 50-59.9	7 60cm&up
Teak	0.174	0.208	0.176	0.292	0.131	0.130	0.211
Valuable hardwood Spp: (Group 1)	0.097	0.117	0.148	0.053	-	-	-
Others	1.184	0.984	1.301	1.651	1.233	1.249	1.92
Total	1.455	1.309	1.625	1.996	1.364	1.379	2.131

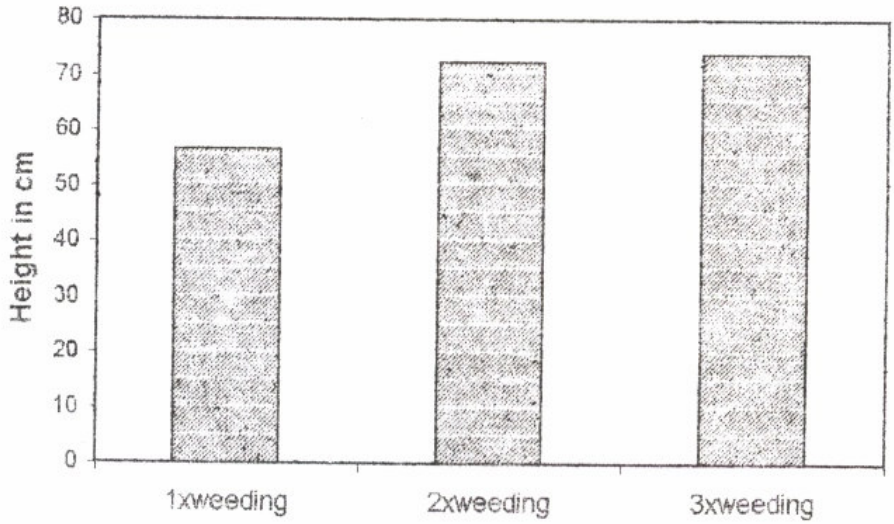
The inventory showed that more than 70% of the plots are stocked with non-commercial tree species in the leading position. The regeneration situation can be seen as critical when the dominant trees of teak and valuable hardwood stocks are low in the area of Ngalaik reserve.

4.4 Enrichment Planting experiment

Three frequencies of one, two and three weedings in the first year of planting were put on Trial in the experimental plots. The result indicated the growth of height was significantly different between one weeding and the other two frequencies of weeding. It was also observed that growth of teak seedlings in the enrichment planting

was less than that of teak plantation. The mean height of tree of plantation teak was 98 cm, which that of enrichment planting was only 67cm at the first year.

Fig. 7. Height growth



5. Discussion and Conclusion

The proportion of teak and other valuable economical tree species at Compartment 18, Ngalaik Reserve, are not silviculturally sound. In such areas one of the options to replenish with new regeneration is by enrichment planting which is now widely used in tropical countries. (Sella.M 1997).

To begin the planting, the area for enrichment should be diagnosed with the help of data collected from inventory operation. The sites so selected must be suitable and having favourable environmental and soil conditions for the good growth for the selected species planted.

From the weeding experiment, it can generally be concluded that at least two weeding operations in the first year of planting are necessary. The choice of varying line widths provides the opportunity for optimum design of growth conditions for specific species.

To combat the dwindling growing stock of commercial species, enrichment plantings teak account of an outstanding degree of demand for preserving floristic and faunistic biodiverity.

However, for more concrete result, further projected research programmes may be needed so as to ensure successful implementation of the enrichment plantings on a massive scale.

Appendix A

Enrichment Planting Experiment (Weeding Test)
Analysis of Variance for Height (cm)

S.V	D.F	S.S	M S	Calculated F	Tabular F 5%	1%
Replicate (R)	2	38.93	19.47	1.06^{ns}	6.94	18.0
Weeding (T)	2	556.28	278.14	15.1*	6.94	18.0
Error	4	73.22	18.30			
Total	**8**	**668.43**				

C.V = 6.98%
n.s = not significant
* = Significant at 5% Level
L S D = 7.44

Fig 8. Enrichment planting of Teak, Brushwood cutting line (10m. width)

Fig 9. Planted Teak seedling on the axis of cutting line
(1m. wide completely cleaned)

References

1. Catinot, R(1969), Results of enrichment planting in the tropics. (Report of the second session of the FAO committee on forestry development in the tropics.)
2. C.Doo, Saw (1986) Growth response of hardwood species in Pegu Yoma Forests. (FRI Research Paper 2/85-86)
3. Eh Dah, Saw (1999) Management of natural teak forests and Myanmar Selection System (Teaknet)
4. Ko Ko Gyi & K.Tint (1995) Status of Management of Natural Teak Forests. (Resource paper 1/FAO, the Second Regional Seminar on Teak)
5. Lamprecht (1989) Silviculture in the Tropics. (Deutsche Gesellschaft fur Technische zusammenarbeit Germany.)
6. Myint Tin, K.M. Kyaw. Forest Inventory in Yamethin Division.
   S. Tint & K. Tint (1967) (Forest Department, The Department of Forestry, RASU and The Department of Statistics, Institute of Economics.)
7. Uwe Muuβ. (1997). Anreicherungspflanaungen in Moorwaldern auf Sumatra. (Dissertation, University of Gottingen, Germany.)
8. Weidelt, H.-J. (1991). Waldbau der tropen.. (Institute of Tropical Silviculture, University of Gottingen, Germany.)