

## SITE CLASSIFICATION BASED ON SOIL IN NORTHERN MALAYSIA

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Soil was surveyed to gain information on the effective utilization of the land in Mata Ayer Forest Reserve of Northern Malaysia as this area has been proposed for the establishment of *Araucaria hunsteinii*, *Araucaria cunninghamii* and *Tectona grandis* plantations. Therefore, this study was specially focused on assessing suitable sites for these species. However, as considerably large areas did not appear to be suitable sites for these plantations, suitable sites for indigenous tree species were assessed within the area.

About 300 ha of *Tectona grandis* (teak) plantations have been established in Northern Malaysia from 1953 to 1969. Growth conditions of teak in these areas were compared with soil conditions in adopting the following criteria.

Optimum site: About 10% mortality including coppice trees and about 25 m in height.

Suitable site: 10% mortality and ca. 17 m in height

Adequate site: ca. 20% mortality and ca. 17 m in height

Poor site: ca. 50% mortality and ca. 17 m or less in height

Very poor site: ca. 75% mortality and less than 17 m in height.

Following results were obtained with regard to characteristics of suitable sites for teak plantations.

- (1) Suitable sites for teak are Alluvial Yellow Soil and Wet Yellow Soil
- (2) Adequate sites for teak are Typical Gley and Gleyey Soil
- (3) Poor sites for teak are Typical Laterite and Lateritic Soil.

*Araucaria* spp. have been planted in various parts of central Malaysia. Although the climate in this area is different from that in the northern part of the country, the results could supply adequate information on the growth of the species as compared with results from foreign countries. *Araucaria* growth was assessed in selecting as criterion the rough volume index which was calculated according to the following formula,  $Y$  (Volume Index) = Height  $\times$  Diameter<sup>2</sup>. The index was plotted against the age of the tree. Suitable sites were compared with poor ones on the basis of soil characteristics.

The following results were obtained with respect to characteristics of suitable sites.

- (1) The species shows better growth at higher elevations even on steep slopes.
- (2) Shallow soil is not suitable for *Araucaria*.
- (3) Gleyey soil is not suitable for *Araucaria*.

About 20 indigenous tree species were investigated from the angle of frequency in the surveyed areas. When the frequency was high in a given site, the site was assessed as being the optimum site for the species. Each species showed an optimum site. The results are indicated in Table 1.

Soil was surveyed and classified according to the soil series of Marbut's and Muckenhausen's soil classification systems along with the Japanese forest soil classification. The criteria for the soil classification are shown in Tables 2 and 3. The soil series were drawn on a 1/25,000 map. At that time, some soil series were combined or neglected as mapping units because these were very localized or assumed a mosaic-like distribution.

As a result, 7 soil groups and 19 soil series were identified and 14 soil units among 19 soil series were used for mapping.

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Table 1 Favourable habitats of useful timber tree species in Mata Ayer F.R.

	Dry Yellow Soil	Medium Yellow Soil	Wet Yellow Soil	Granitic Yellow Soil	Alluvial Yellow Soil	High Yellow Soil	Dark Red Soil	Lateritic Dark Red Soil	Laterite	Gley	Granitic Gley	Sera
<i>Shorea Talura</i>									○	○		○
<i>S. hypochra</i>			○					○				
<i>S. sericeiflora</i>		○										
<i>S. assamica</i>				○							○	
<i>Hopea odorata</i>							○					
<i>H. ferrea</i>	○											
<i>Dipterocarpus Kerrii</i>		○										
<i>D. Baudii</i>			○		○							
<i>Parashorea lucida</i>					○		○					
<i>Intsia palembanica</i>				○							○	
<i>Aromadendron elegans</i>			○									
<i>Shima noronhae</i>			○					○	○			
<i>Podocarpus blumei</i>						○						

Table 2 Soil classification key for soil groups

Yellow Soil:	Yellow weathered horizons (More yellowish than 7.5YR5/8 in B1 horizon) from parent materials.
Dark-red Soil:	Dark red weathered horizons (more reddish than 7.5YR5/8 in B1 horizon) from parent materials.
Laterite:	Laterite aggregate bed or plinthite which corresponds to coloured matrix with red iron spots within 1m. depth.
Surface Gley:	Bleached horizon and (reddish) yellow mottled horizon or reddish iron concretion horizon (iron pan).
Gley:	Bluish coloured continuously bleached horizon with or without (reddish) yellow iron spots because of the presence of underground water within 1m. depth.
Sera:	Redeposited calcium aggregation within 1m. depth.
Skeletal Soil:	Stony and gravelly soil in rocky areas Other soils are not frequently observed in the areas surveyed.

Table 3 Soil types which were observed in Mata Ayer F.R.

Soil Group	Soil Family	Soil Series
Yellow Soil	(Xeromorphic)	Dry Yellow Soil
	(Mesomorphic)	Medium Yellow Soil
		Granitic Medium Yellow Soil
	(Hydromorphic)	Wet Yellow Soil
		Granitic Wet Yellow Soil
	Alluvial Yellow Soil	Alluvial Yellow Soil
	High Yellow Soil	High Yellow Soil
Dark-red Soil	Typical Dark-red Soil	Typical Dark-red Soil
	Lateritic Dark-red Soil	Lateritic Dark-red Soil
		Red Soil
Laterite	Laterite	Typical Laterite
	Lateritic	Lateritic Soil
Gley	Surface Gley	Typical Surface Gley
		Surface Gleyey Soil
	Gley	Typical Gley
		Granitic Gley Gleyey Soil
Sera	Sera	Sera
Skeletal Soil	Skeletal Soil	Skeletal Soil

Following conclusions were obtained from the results mentioned above. Fourteen soil mapping units corresponded to utilization units for the land.

(1) Skeletal Soil is not useful for any kind of tree species.

(2) Dry Yellow Soil is only suitable for indigenous species. Enrichment planting or natural regeneration of *Hopea ferrea* could be recommended.

(3) Medium Yellow Soil could be used for *Araucaria* spp. plantation. Natural regeneration or enrichment planting of *Shorea sericeiflora* or *Dipterocarpus kerrii* is preferable to that of other indigenous species.

(4) Granitic Medium Yellow Soil could be used for *Araucaria* spp. and possibly for teak plantation. *Shorea hypochra*, *Shorea assamica* and *Dipterocarpus Kerrii* could be recommended for indigenous species.

(5) Wet Yellow Soil could be used for teak and *Araucaria* spp. Of the indigenous species, *Shorea hypochra*, *Hopea odorata*, *Anisoptera curtissii*, *Shorea sericeiflora*, *Shorea talura* and *Parashorea lucida* are recommended.

(6) Granitic Wet Yellow Soil is to be used for teak. *Shorea talura*, *Shorea assamica* and *Intsia palembanica* are recommended for enrichment planting or natural regeneration plots.

(7) Alluvial Yellow Soil is very good for teak and good for *Araucaria* spp. where the soil texture is silty. *Araucaria* is not recommended on sandy alluvial yellow soil. Almost all of the indigenous species which were found in Mata Ayer F.R. could be suitable for the area, especially *Parashorea lucida*, *Dipterocarpus Baudii* and *Hopea odorata*.

(8) High Yellow Soil could be suitable for *Araucaria* spp. This site is good for *Pinus caribaea* and *Pinus Merkusii*, too. Because of cool climate and existence of dry season, the area is to be used for seed orchards of these species. Indigenous species to be considered is *Podocarpus blumei*.

(9) Typical Dark Red Soil could be very good for *Araucaria* spp. and teak. *Parashorea lucida*, *Hopea odorata* and *Shorea Hypochra* might be considered for enrichment plantations.

(10) Lateritic Dark Red Soil is to be used for *Araucaria* and teak. *Shorea hypochra*, *Hopea odorata*, *Shorea sericeiflora* and sometimes *Intsia palembanica* could be suitable for the indigenous species plots.

(11) Laterite could be utilized for indigenous tree species. Combined method of natural regeneration and selective removing of miscellaneous spp. could be used for *Shorea talura* and sometimes *Shorea hypochra*. *Shorea talura* stands are worth expanding because of the high quality of timber and easy treatment of seeds and seedlings. *Bambusa multiplex* which is utilized for drying and smoking rubber sheets is another valuable species to be considered and also the species could grow as a second storey of the forest stand.

(12) Gley could be good for indigenous species. *Shorea talura* is recommended in areas for enrichment plantation or natural regeneration. Teak could be planted. Better growth of teak cannot be expected in some parts of the area.

(13) Granitic Gley is possibly good for indigenous tree species. However, teak plantation could be worth for test plots. *Intsia palembanica*, *Shorea assamica*, *Shorea hypochra* and possibly certain types of rattan could be planted.

(14) Sera which is a type of gley soil is good for indigenous species. As this soil is very rare in Malaysia, it should be preserved.

## Discussion

**Lee H. S.** (Malaysia): You mentioned the possibility of using vegetation as an indicator for site classification. I would like to know what frequency occurrence of species you would consider in a given area before you can associate species occurrence with soil series.

**Answer:** Major vegetation has been determined by the soil survey within 10–20 m radius from the soil pit. Also vegetation was checked according to the topography. Only in the case of large trees 50 m radius was considered.

**Tan C. H.** (Malaysia): According to your 3-year soil survey in Mata Ayer you reported that white Merantis are the dominant species of *Shorea* followed by *Hopea* group. Surprisingly, red Merantis spp. are not distributed in this area. 1) Could you please explain the cause of such a phenomenon? 2) Would you recommend that red Merantis be planted in that area?

**Answer:** 1) The absence of red Merantis in this area may be due to the existence of a long dry season. However, *Eushorea* which is physiologically similar to the red Merantis can be found. 2) For enrichment planting it is preferable to use indigenous trees as drastic changes of the forest should be avoided.

**Ohba, K** (Japan): Why did you use tree mortality as one of the criteria for site classification? Why do the trees die and at what age?

**Answer:** Tree mortality was used as one of the criteria for site classification because in some areas a large number of dead teak seedlings and saplings was observed. The cause of death was not established but may be related to factors such as competition with weeds or role of insects and termites.

**Tun Hla** (Burma): I agree with your studies in which you state that teak thrives best on deep, moist, alluvial yellow and lime stone based soil. However, teak growing on chalky soil is more valuable as it shows a black stripe structure, though the timber is smaller. Could you give some information on the structure of teak growing on lime stone based soil and on the cause of black stripe structure in teak from chalky soil?

**Answer:** So far, no information on the wood quality of teak growing on lime stone based soil is available in Malaysia because planted teak is still young (10–25 years). As for the structure of teak growing on chalky soil, the black stripe may result from the reaction between the polyphenol of the wood with free iron which is found abundantly in chalky soil.

**Liew T. C.** (Malaysia): Could the results of the studies be used to prescribe fertilizer regimes in the establishment of exotic plantations or seed orchards?

**Answer:** There is one example of fertilization of teak in the area surveyed. Fertilization is effective in the initial stages of transplanting so as to eliminate weeds or undesirable shrubs. However, as far as the wood quality is concerned fertilization is not recommended in a mature forest. Fertilization is also useful in the nursery stage so as to supply nutrients. In poor soils, fertilization at the early stages of development of the seedlings helps stimulate growth. At that time the nature of the fertilizers used is very important. We have applied mixed fertilizers and fish or bone meal which contain minor nutrients.

**Choob K.** (Thailand): You mentioned that teak can achieve moderate growth on gley soils which are usually poorly drained. How is the form of the trees as compared with that of trees growing on other soil types?

**Answer:** Teak growth in height was satisfactory but the form of the trees was not investigated. As far as soil is concerned, gleyey soil unlike surface gley soil contains a large amount of mineral nutrients.

**Zulmukhshar M. S.** (Malaysia) Comment: Teak planted in Mata Ayer has been sent to the plywood and boat-making industries to test the timber quality for these purposes. If the tests produce favourable results, further planting may be carried out in areas found suitable by Dr. Osumi so as to reduce Malaysia's dependence on imported teak.