

# LAND REHABILITATION OF THE LIGNITE MINE IN MAE MOH, LAMPANG, THAILAND

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*Received January 1994*

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**MUNGKORNDIN, S. 1994. Land rehabilitation of the lignite mine in Mae Moh, Lampang, Thailand.** The Mae Moh mine supplies lignite to the Electricity Generating Authority of Thailand. Since 1981 the Mae Moh Reclamation Study has attempted to identify methods of reclaiming the mined areas to return these areas to productive use. Reafforestation experiments were carried out using native and exotic species in three different land preparations: with topsoils, without topsoils and with mining residues. Reafforestation of mine tailings has been shown to be possible without topsoils, provided sufficient fertiliser is applied. The Reclamation Plan which provides for post-mining end uses is described.

Key words: Thailand - reafforestation - lignite mining - reclamation

**MUNGKORNDIN, S. 1994. Pemulihan tanah lombong lignit di Mae Moh, Lampang, Thailand.** Lombong Mae Moh membekalkan lignit kepada Lembaga Pembekal Elektrik Thailand. Sejak 1981, kajian Pemulihan Mae Moh telah mencuba untuk mengenalpasti kaedah memulih guna kawasan-kawasan yang telah dilombong supaya kawasan-kawasan ini dapat menjadi produktif semula. Ujikaji penghutanan semula telah dijalankan dengan spesies asli dan eksotik di tiga kawasan berlainan persediaan: dengan tanah atas, tanpa tanah atas dan dengan saki-baki perlombongan. Penghutanan semula tahi lombong didapati berkemungkinan tanpa tanah atas jika baja yang secukupnya dibekalkan. Pelan Pemulihan yang memberikan kegunaan lepas perlombongan dibincangkan.

## Introduction

The Mae Moh mine is the largest lignite mine in Thailand. It is situated 25 km east of Lampang, some 650 km north of Bangkok, at an elevation of 300 m (see Figure 1). The lignite basin is of the synclined type. It covers an area of 135 km<sup>2</sup>, with a maximum width of 8.8 km and a maximum length of 18.3 km. The total geological lignite reserves are estimated to be 1468 million tonnes.

The mine started operations in 1955. At present it supplies a maximum of 30 000 t of lignite to serve the 1425 megawatt Mae Moh power plant which is run by the Electricity Generating Authority of Thailand (EGAT). The ultimate installed capacity of 4725 mW will be achieved in the year 2001, with lignite production increasing to approximately 30 million tonnes per year (EGAT 1991). According to the Reclamation Master Plan, by 2024 post mining end use areas will cover approximately 8758 ha. The extraction of lignite by opencast mining leaves considerable barren areas. After the overburden and topsoils are dumped away from the pit, the mined areas become steep, unstable and prone to erosion. In

general, mining areas are abandoned and become wasteland, although mining laws provide for a tailings improvement fee of 5000 baht (about US\$200).

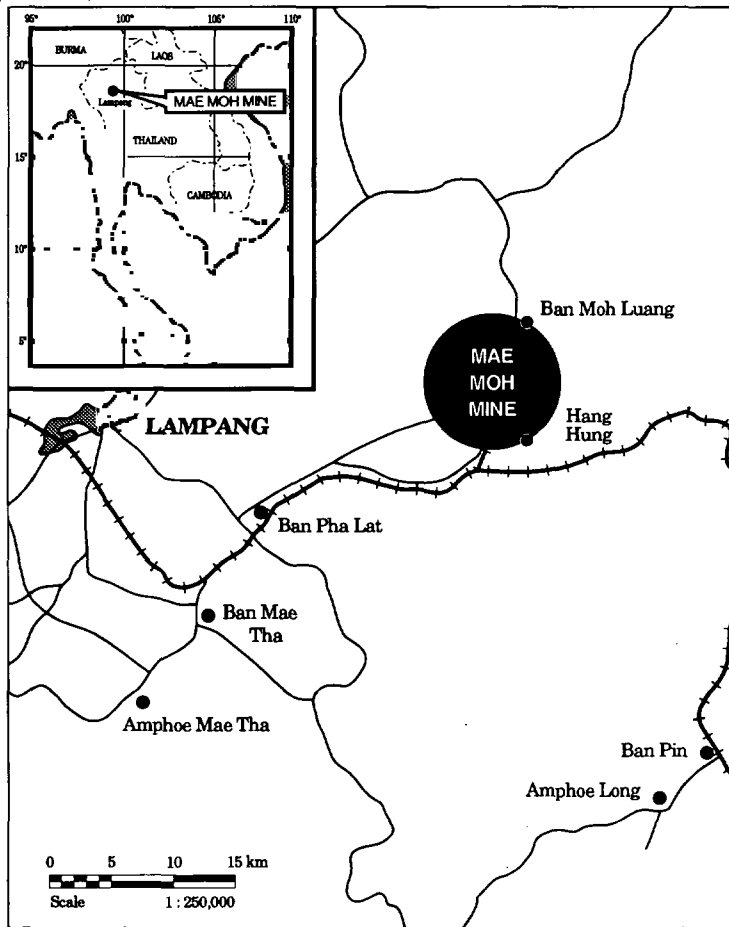


Figure 1. Location of the Mae Moh mine, Thailand

## The study

### *Objectives*

The Mae Moh Reclamation Study began in 1981, aimed to identify methods of reclaiming mined areas to prevent degradation and to return the areas to productive use as natural or plantation forests. The study team comprises Chulalongkorn University, the District Officer, teak plantation entrepreneurs, the Forest Industry Organisation (FIO) and a private consultant.

### *Climate*

The Mae Moh basin has a tropical climate with two distinct monsoons. Figure 2 shows average monthly rainfall from 1975 - 1989. Average annual rainfall for this

period was about 900 mm. Peak rainfall is in May and September. The temperature of the Mae Moh area ranges from approximately 4 °C in January to 41 °C in April. The mean maximum temperature is 37.6 °C and the mean minimum 12.1 °C.

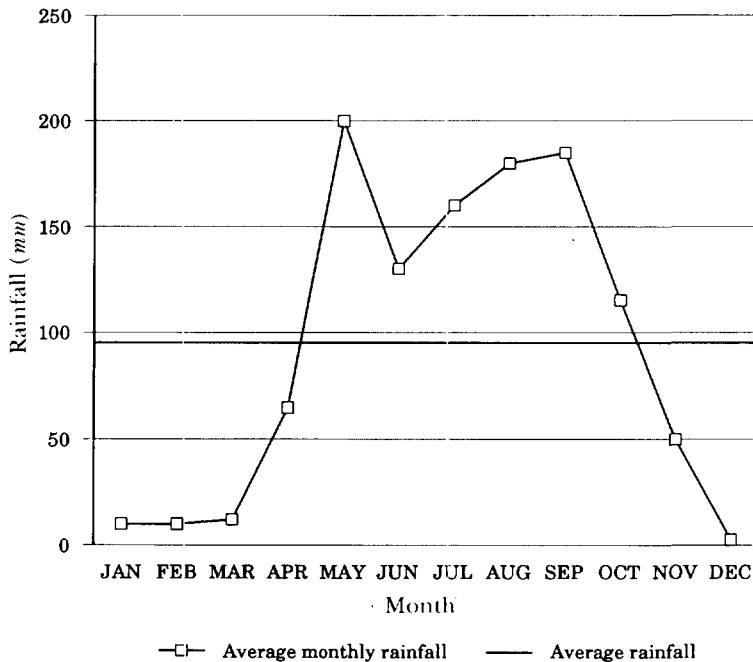


Figure 2. Average rainfall at Mae Moh 1975 - 1989

### Vegetation and soils

Forest resources in the area are of two main types: mixed deciduous forest and dry dipterocarp forest. Mixed deciduous forest species include *Tectona grandis*, *Lagerstroemia*, *Terminalia*, *Azelia*, *Xylia*, *Pterocarpus*, and *Dalbergia* spp. most of which are of high commercial value. In mixed deciduous forests between 50 and 600 m elevation, teak may predominate. The soils bearing teak forests are usually loamy to sandy loam, either calcareous or granitic.

Dry dipterocarp forests occur on undulating peneplains and ridges where the soils are either sandy or lateritic and are subject to extreme leaching, erosion and annual burning. Important tree genera include *Dipterocarpus* and *Shorea*.

Forests in this area have a history of exploitation. In 1924 a teak concession was granted to the Anglo Thai Company and this was worked until after World War 2. The concession was later given to the FIO, a State enterprise. Other commercial hardwoods and fuelwood were also cut annually for the Royal State Railways. Illegal cutting of teak and other woods has been widespread. Forest depletion is intensified by encroachment of forest reserves by agricultural lands (EGAT 1983). In parts of the Mae Moh basin EGAT has excavated lignite for generation of electric power.

### Socio-economic factors

The Mae Moh area has legal status as reserved national forest. This reserve includes villages, including the district centre, and farming areas. When EGAT obtained permission to mine parts of the Mae Moh basin some 600 households (2800 people) living in the mining area were relocated. According to EGAT (1991) resettlement brought about the following changes:

- . The agricultural society became urbanised;
- . Increase in size of holdings: former holdings averaged 0.5 ha (2-3 rai) per household; after resettlement each household was allocated 1 rai for residential area and 6-10 rai for farming;
- . Improved public facilities;
- . Increased income: previous to resettlement average incomes were 5000 baht/year (about US\$ 200); it is planned to raise income levels to 8000 - 1300 baht/year.

### Restoration methods

Three experiments were conducted: a reforestation project began in 1982, and two agricultural trials with one cash crop each year from 1986 and ground cover crops during 1983-84.

Reforestation experiments were done using three different land preparations: with top soils, without topsoils, and with mining residues. Growth rates were monitored for three years.

The species selected by the study team were:

- |                                    |                                     |
|------------------------------------|-------------------------------------|
| 1. <i>Gmelina arborea</i>          | 2. <i>Azadirachta indica</i>        |
| 3. <i>Cassia surattensis</i>       | 4. <i>Melia azadirach</i>           |
| 5. <i>Eucalyptus camaldulensis</i> | 6. <i>Delonix regia</i>             |
| 7. <i>Cassia floribunda</i>        | 8. <i>Leucaena leucocephala</i>     |
| 9. <i>Acacia auriculiformis</i>    | 10. <i>Peltophorum pterocarpum</i>  |
| 11. <i>Casuarina junghuhniana</i>  | 12. <i>Bauhinia bidentata</i>       |
| 13. <i>Lagerstroemia tomentosa</i> | 14. <i>Tamarindus indica</i>        |
| 15. <i>Tectona grandis</i>         | 16. <i>Pterocarpus macrocarpus</i>  |
| 17. <i>Diospyros mollis</i>        | 18. <i>Toona ciliata</i>            |
| 19. <i>Lagerstroemia speciosa</i>  | 20. <i>Pithecellobium dulce</i>     |
| 21. <i>Cassia siamea</i>           | 22. <i>Dendrocalamus asper</i>      |
| 23. <i>Mimusops elengi</i>         | 24. <i>Mangifera pentandra</i>      |
| 25. <i>Sandoricum koetjape</i>     | 26. <i>Pinus kesiya</i>             |
| 27. <i>Mangifera indica</i>        | 28. <i>Thevetia peruviana</i>       |
| 29. <i>Terminalia catappa</i>      | 30. <i>Terminalia chebula</i>       |
| 31. <i>Terminalia corticosa</i>    | 32. <i>Lagerstroemia floribunda</i> |
| 33. <i>Anacardium occidentale</i>  | 34. <i>Alstonia scholaris</i>       |
| 35. <i>Hymenodictyon excelsum</i>  | 36. <i>Millingtonia hortensis</i>   |
| 37. <i>Cassia fistula</i>          |                                     |

Trees were planted in 30 x 30 x 30 cm pits in which 6 litres of Bangkok Metropolitan compost, 100 g of urea, 200 g NPK 15-15-15 fertiliser and one can of rock phosphate (about 250 cm<sup>3</sup>) was placed. Survival rate after seven years was 84%.

Eighteen (No. 1 - 18) of the 37 species trialled were selected for further use on the basis of survival and growth rates. However, planting of eucalypts is controversial and has ceased. Self ignition of lignite is common and it was considered that the oil content of eucalypt leaves intensified the potential fire hazard. Also some environmental NGOs pleaded that the vigorous growth of the eucalypts would lead to water depletion and domination of indigenous species. Planting of economically useful species such as teak and *Pterocarpus macrocarpus* is emphasised. Native species such as *Azelia xylocarpa* and *Xylia kerrii* have been added to the list. Although these are slow growing they are of high future value.

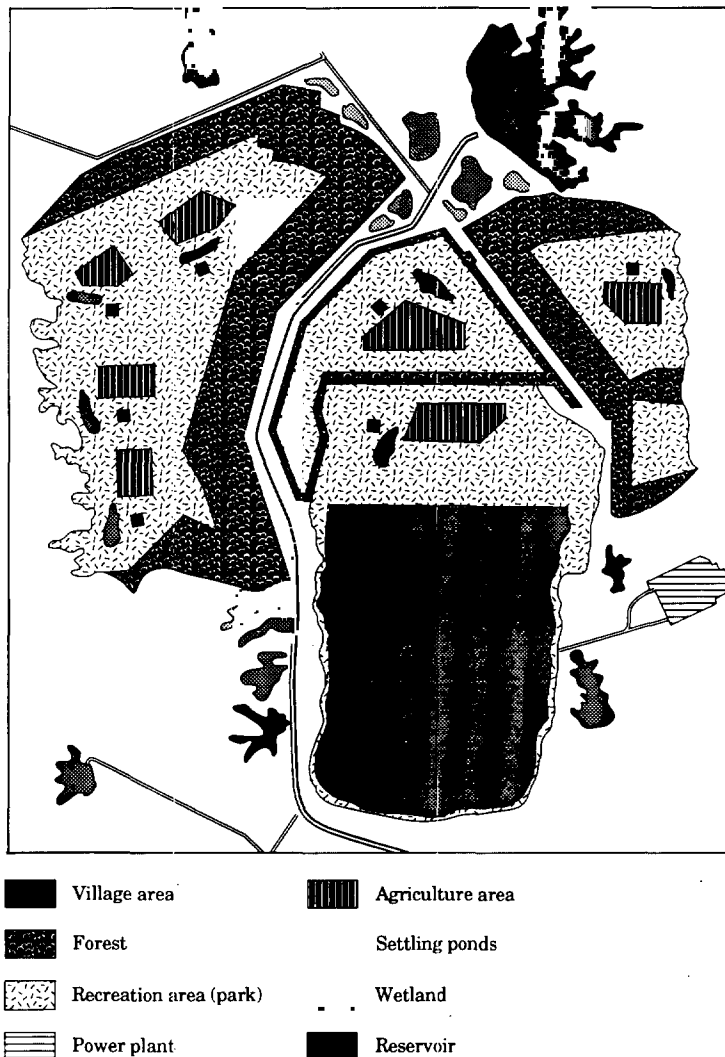


Figure 3. Reclamation plan for the Mae Moh mine area

*End use of the Mae Moh mine areas*

As part of the Mae Moh Unit 1-19 Mining Study, EGAT and the Australian International Development Assistance Bureau (AIDAB) prepared a Reclamation Plan which is depicted in Figure 3. The plan provides for post-mining end uses which are suited to the social and economic needs of the inhabitants. The plan integrates sub-catchment drainage gradients with wetland treatment of mine runoff.

Figure 4 shows post-mining end use and the programme for implementation of the Reclamation Plan to completion in the year 2024. Environmental Impact Control refers to establishment of sedimentation ponds, water treatment and mitigation of air pollution. Mine reclamation actually started in 1982, preceding the Reclamation Master Plan (EGAT 1990). The budget for the complete reclamation programme is 3133 million baht per 628 tons of useable coal. The average cost per ton of coal exploited is, therefore, 4.98 baht t<sup>-1</sup> or approximately US\$ 0.20 t<sup>-1</sup>.

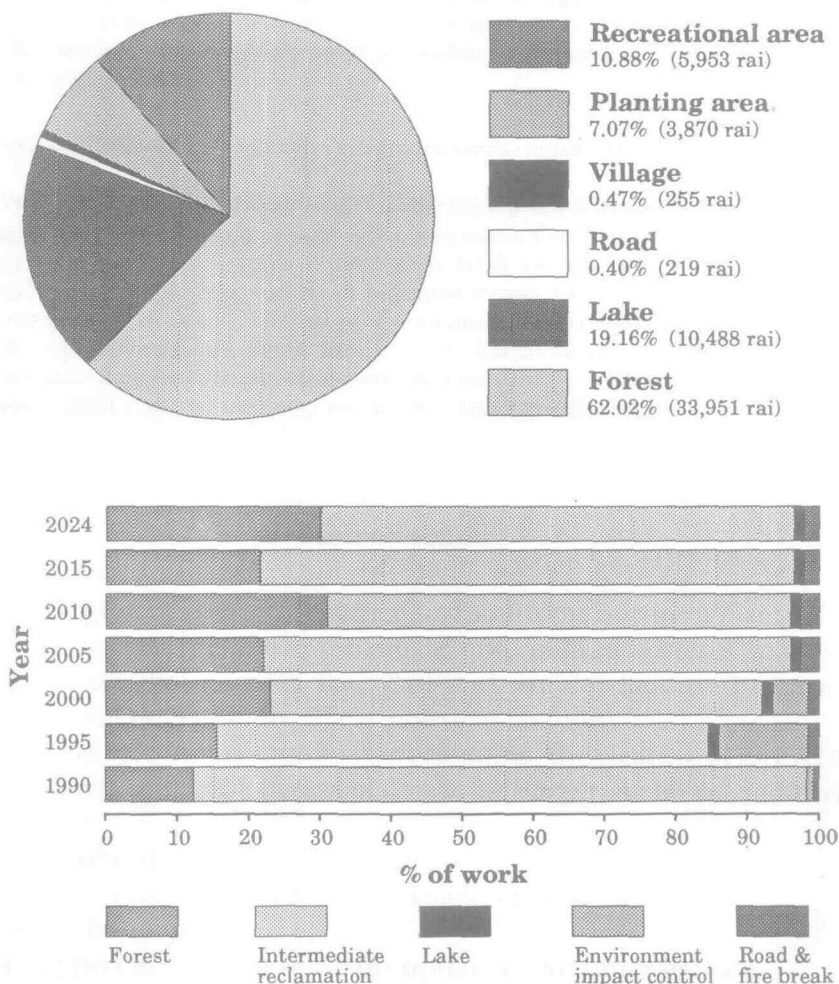


Figure 4. Programme for the implementation of the Mae Moh Reclamation Plan

## Conclusion

It is the responsibility of EGAT to reclaim the Mae Moh basin. Reclamation costs are higher than those usually charged to miners, i.e. 5000 baht per rai. Land use patterns have been totally changed in the conversion from rural to urban life, but it is envisaged that quality of life is improved. Reforestation of mine tailings is possible without topsoil, provided sufficient fertiliser is applied.

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