Soil Properties and Tree Composition of Rehabilitated Mining Area   
in Phangnga Forestry Research Station

**Jetsada Wongprom1, Roongreang Poolsiri2, Sapit Diloksumpun3   
and Chatchai Ngernsaengsaruay4**

1Faculty of Forestry, Kasetsart University, Chatuchak, Bangkok, Thailand; email: [fforjdw@ku.ac.th](mailto:fforjdw@ku.ac.th)  
2Department of Silviclture, Faculty of Forestry, Kasetsart University; email: [fforrrp@ku.ac.th](mailto:fforrrp@ku.ac.th)   
3Department of Silviclture, Faculty of Forestry, Kasetsart University; email: [sapit.d@ku.ac.th](mailto:sapit.d@ku.ac.th)   
4Department of Botany, Faculty of Science, Kasetsart University; email: [fsciccn@ku.ac.th](mailto:fsciccn@ku.ac.th)

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# INTRODUCTION

Mining is widely operated across global as well as Thailand. Mining activities were severely impacts on ecosystem condition. Vegetation and soil properties were extremely disturbed (Thaiutsa & Rungruangsilp 1990; Bradshaw 1997). *Acacia mangium* plantation was established in degraded lands for several reasons including wood production, forest restoration as well as soil improvement (Prasad 1991; Wang *et al.* 2010). Developments of soil properties and vegetation were significant process in mining restoration. The objectives of this study were to evaluated potential of *A. mangium* plantation on restoring soil properties and tree composition in mining area. These results were useful for degraded land restorations.

# Materials and methods

The study site was conducted on *A. mangium* plantation in Phangnga Forestry Research Station, southern of Thailand. In the past, this site was abandoned tin mining. The experimental plots were investigated in 27-year-old *A. mangium* plantation of sandy area (S27), clay area (C27) and mixed plantation (MP) including *Eucalyptus camaldulensis*, *A. mangium* and *Diptercapus alatus* in clay area. Moreover, soil properties and ecological characteristics in abandoned mining (AB), secondary forest (SF) and primary forest (PF) were investigated and compared with S27, C27 and MP.

**Soil properties**

Three experimental plots of 40x40 m were established in S27, C27, MP, AB, SF and PF for investigating soil properties. Soil samples from four soil depths (0-10, 10-20, 20-30 and 30-50 cm) were collected for analyzing physical and chemical properties of soil.

**Tree composition** Three permanent plots of 40x40 m were established in S27, C27, MP, SF and PF. Each plot was divided into sixteen subplots of 10x10 m plot size. Diameter at breast height (DBH) and total height (H) of trees were measured. Tree species in S27, C27, MP, SF and PF were identified.

**Data analyses** Physical and chemical properties of soil including bulk density, porosity, soil pH, total nitrogen (N), available phosphorus (P), organic matter (OM), exchangeable bases of potassium (K), calcium (Ca) and magnesium (Mg) were analyzed and means were tested using analysis of variance (ANOVA). The importance value index (IVI), tree diversity and similarity of tree were calculated.

**RESULTS AND DISCUSSION**

**Soil properties**

Soil bulk density of 0-10 soil depth in S27, C27, MP, SF and PF (1.04, 0.94, 0.90, 0.96 and 0.92 g m-3, respectively) was significantly lower than AB (1.31 g m-3). For subsoil layers, bulk density of S27, C27, MP, SF and PF was similar value. Overall, mostly soil nutrients namely OM, total N,P, K, Ca and Mg in S27, C27 and MP were higher than AB, and similar with SF. These results showed *A. mangium* plantation was important roles on improving physical property of soil and increasing soil nutrients. Mining restoration with nitrogen fixing tree had rapidly increased soil nutrients, especially N (Singh *et al*. 2004).

**Tree composition and ecological characteristics**

There were 22, 34, 42, 82 and 93 species in S27, C27, MP, SF and PF (Table 1). Dominant trees in PF comprised of *Swintonia schwenckii, D. kerrii*, *Canarium patentinervium* and *Mesua ferrea*, and in SF comprised of *Eurya acuminata*, *Mallotus paniculatus*, *Microcos paniculata*, *Barringtonia macrostachya* and *Vitex pinnata.* Dominant trees in S27, C27 and MP were *A. mangium* and pioneer trees including *Euodia roxburghiana*, *Aporosa planchoniana*, *Carallia brachiata,* *Bridelia tomentosa* and *V. pinnata*. Tree diversity under S27, C27 and MP was low compared with SF and PF. Vegetation development on abandoned mining was slow, especially S27. Soil properties were significantly influent on natural succession in mining areas (Zhao *et al.* 2013). Moreover, similarity index of trees in PF with S27, C27 and MP were low level (Table 2). Thus, enrichment planting with poorly dispersed shad tolerant trees in S27, C27 and MP should be required for restoration program.

Table 1Ecological characteristics of rehabilitated sites (S27, C27 and MP) and the reference sites (SF and PF).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Ecological characteristics | S27 | C27 | MP | SF | PF |
| Number of species | 22.00 | 34.00 | 42.00 | 82.00 | 93.00 |
| Basal area (m2 ha-1) | 219.96 | 132.20 | 144.31 | 138.76 | 259.86 |
| Density (stem ha-1) | 1,010.42 | 1,229.17 | 1,393.75 | 1,200.00 | 1,497.92 |
| Shannon - Wiener index *(H’)* | 1.43 | 2.51 | 2.77 | 3.86 | 3.91 |

Table 2 Similarity index of tree among S27, C27 and MP compared with SF and PF*.*

|  |  |  |
| --- | --- | --- |
| Site | Similarity index | |
| SF | PF |
| S27 | 17.48 | 5.83 |
| C27 | 22.61 | 6.98 |
| MP | 23.53 | 8.00 |
| SF | 100.00 | 31.03 |
| PF | 31.03 | 100.00 |

**CONCLUSIONS**

A**.** mangium plantation on abandoned mining area was an important role in soil improvement. Bulk density, soil nutrients and OM of rehabilitated sites in topsoil were similar with PF. Successional status of SF may be in mid succession and rehabilitated sites (S27, C27 and MP) were in early succession, which were agreed with similarity index.Enrichment planting with poorly dispersed shad tolerant trees in this area should be taken for increasing diversity and improving forest structure. In addition, pioneer trees under plantations and secondary forest might be considered for other degraded land restorations.

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