

## THE STATUS OF MANGROVES ECOSYSTEM: REFORESTED Of *Rhizophora apiculata* Bl. and NATURAL MANGROVE FOREST IN RIAU

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### ABSTRACT

Mangrove trees have a very significant impact to the coastal environment. The study was conducted on August 2007 at reforested 2, 3, 4, 5 and 6 year-old *R. apiculata* Bl. at Sungai Asam, Indragiri Hilir (INHIL), Riau and October 2009 at natural mangroves forest Pulau Ruku INHIL, Riau. This paper aims at brief discussion on growth of *R. apiculata* and the present status of utilization and management of mangrove forests in Riau. The rehabilitation had been done successfully with monoculture *R. apiculata* Bl. plantation in Sungai Asam. The result indicated that direct exploitation of *Rhizophora* especially for building construction. The anthropogenic activities had been degraded mangrove ecosystem, such as illegal logging in Pulau Ruku.

**Key words:** *Rhizophora apiculata* Bl., mangrove, growth, reforested

### INTRODUCTION

The restoration of mangrove have received a lot of attention worldwide for several reasons. Firstly, the long ignored ecological and environmental values of mangrove forests have been documented for many mangrove areas in the world. Secondly, there is a high subsistence dependence on natural resources from mangrove forests. In addition, large losses of mangrove have occurred throughout the world leading to coastal erosion, decline of fishery resources and other environmental consequences, some of which in need of urgent attention. Finally, governments throughout the world are showing commitments towards sustainable use of mangrove areas. Extensive research have been carried out on the ecology, structure and functioning on the mangrove ecosystem. However, the finding have not been interpreted in a management framework, thus mangrove forests around the world continue to be over-exploited, converted to aquaculture ponds, and polluted. The links between research and sustainable management of mangrove ecosystems should be established (Kairo et al., 2001).

Bakau (*Rhizophora apiculata* Bl.) is most economically important commercial species of mangrove trees, have been intensively exploited for their valuable wood for



house construction. There was reforested 2, 3, 4, 5 and 6 year-old *R. apiculata* at Sungai Asam, Indragiri Hilir (INHIL), Riau and the natural mangroves forest at Pulau Ruku INHIL, Riau. Both of mangrove forests are have different status recently.

This paper examines the human effects on the utilization of this rich but fragile resource, summarizes the problems of managing mangrove forests, and discusses protection and management techniques.

## METHODS

### Study site

In the study site, *R. apiculata* was planted and there were monoculture of 2, 3, 4, 5 and 6 year-old stands. Our research was carried out in Sungai Asam in The District of Indragiri Hilir, Riau, Indonesia. The site was located at 0° 44' S and 103° 18' E in South China Sea (Fig. 1). The ecological characteristics were: elevation 5.4 m above sea level; average salinity 20 ppt; pH soil 5.6; air temperature 30 oC; soil texture loam; twice inundation with 6 hour interval

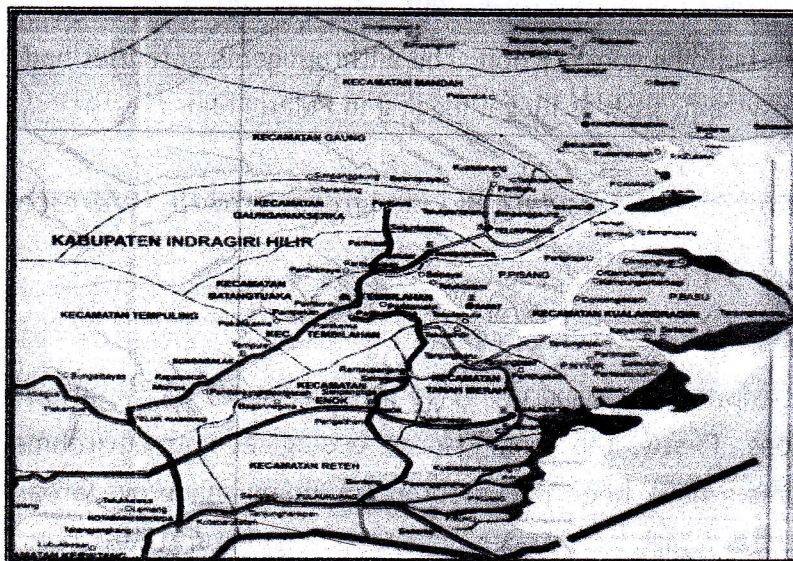


Figure 1. Research locations: Sungai Asam, Riau and Pulau Ruku, INHIL, Sumatera Island.

Measured parameters were trunk circle (Bengen, 2000). The model of growth was developed by allometric method measurement (Ross et al. ,2001) of reforested 2, 3, 4, 5, and 6 year old *R. apiculata* at Riau. Samples were 30 stands of *Rhizophora*, and the following measurements were recorded: total height (TOTHT), height to base of crown (CRWNHT), crown length and width (CRWNL and CRWNW), and diameter at 30 cm (D30) and 140 cm (D140) (for stems taller than 40 and 150 cm, respectively). The product [CRWNHT \* CRWNL \* CRWNW] provided an index of crown volume (CRWNV). Total Biomass in (kg/stand) then was determined with formula :  $\ln \text{TOTWT} = 2,528 + (1,129 \ln (\ln D2)) + (0,156 \ln (\ln \text{CRWNV})) \times \text{Wood Density}$ . Biomass of mangrove forest in (ton DW/ha) was obtained by multiplied the stand biomass with stand density per hectare.



The model was developed to stimulate the growth and production of well established stands of *R. apiculata*. Five major tree organs namely; canopy (leaves), branches, stems, prop roots and roots; plus three morphological variables (upper height of the canopy, lower height of the canopy and canopy coverage), were selected depending on their importance and effectiveness in order to illustrate the growth of *R. apiculata* (Asaeda and Kalibbala, 2009).

Soil samples down to the depth of about 25 cm were collected from the each area of research. Each soil sample was analysed for pH, C-organic, N-total, P-bray, exchangeable cations (K, Na, Mg, Ca), CEC, Al-dd, and texture at the Soil Fertility, Biology and Chemistry Laboratory, Soil Science Departement, Faculty of Agriculture, Sriwijaya University.

## RESULTS AND DISCUSSIONS

### Reforested *R. apiculata*

Tree total height of 2, 3, 4, 5 and 6 year-old stands was 2.5, 8.9, 7.3., 7.8, and 9.1 m respectively and stem diameter was 2.5, 4.6, 4.7, 4.7, and 6.0 cm respectively (Table 1). Stand density of 2, 3, 4, 5 and 6 year-old forest was 8300, 6900, 8900, 9700 and 15300 stems/ha, respectively (Table 2).

Table 1. Average of growth parameters of *R. apiculata* at Sungai Asam, Riau

No	Age (year)	Root height (cm)	Stem height (cm)	Crown height (cm)	Crown length (cm)	Crown width (cm)	Total Height (cm)	Stem diameter (cm)
1	2	48.40	48.53	99.77	169.80	181.00	245.10	2.53
2	3	58.43	97.07	610.50	185.87	213.87	894.43	4.57
3	4	56.33	267.00	251.00	172.33	213.00	730.67	4.69
4	5	59.97	386.20	270.37	135.83	163.37	776.50	4.70
5	6	68.83	404.00	373.00	185.00	219.33	914.67	5.97

Mangrove ecosystems or "mangal" occur world wide on tropical and sub-tropical coastline (Tomlinson, 1986). The mangrove is a unique and complex ecosystem. The contribution of marine mangrove (*R. apiculata*) towards the growth and primary production of mangrove ecosystems is remarkable. This is due to the fact that *R. apiculata* colonizes relatively faster, grows quicker and taller than other species (Ong et al., 1985; Tomlinson, 1986). *R. apiculata* is the most dominant and productive species (Putz and Chan, 1986). *R. apiculata* is the most important species of commercial mangrove timber in the Asia-Pacific region. Vast areas of mangrove in the region are dominated by *R. apiculata* forests, often as almost pure stands. A good understanding of



the growth characteristics of the species is thus vital for the management of these forests (Ong et al., 2004).

Table 2. Stand and forest of *R. apiculata* mangroves determinate by allometric method

No.	Age (years)	Density (ha-1)	Biomass	
			Stand (kg DW/stand)	Forest (ton DW/ha)
1.	2	8300	0.94	8.64
2.	3	6900	2.55	17.62
3.	4	8900	2.99	26.67
4.	5	9700	2.85	27.57
5.	6	15300	1.84	28.29

The rehabilitation had been done successfully with monoculture *R. apiculata* Bl. plantation in Sungai Asam. The result indicated that direct exploitation of *Rhizophora* especially for building construction (Fig. 2).

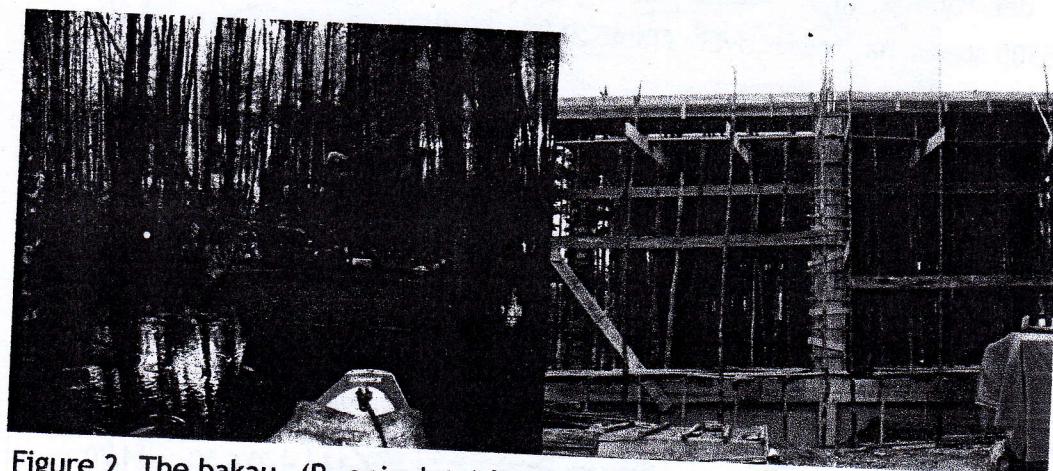


Figure 2. The bakau (*R. apiculata*) harvesting (left); and used for the building construction (right) in Sungai Asam, INHIL, Riau, Sumatera.

#### Natural forest

Recently, some people went to mangrove forest at Pulau Ruku for the order collected the wood of mangrove, especially *R. apiculata* for building or house construction (Fig. 3). The anthropogenic activities had been degraded mangrove ecosystem (Wantasen, 2002; Duke, 2006). The mangrove specieses founded at Pulau Ruku are *R. apiculata*, *R. mucronata*, *Avicennia alba*, *Bruguiera gymnorhiza*, *B. perviflora*, *Nypa fruticans*, dan *Acrostichum aureum*.





Figure. 3. Illegal logging of mangrove forest at Pulau Ruku, INHIL.

### CONCLUSIONS

The rehabilitation had been done successfully with monoculture *R. apiculata* BL. plantation in Sungai Asam. The result indicated that direct exploitation of *Rhizophora* especially for building construction. The anthropogenic activities had been degraded mangrove ecosystem, such as illegal logging in Pulau Ruku.

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