Contributions of Tree Improvement Program to Increase Forest Productivity and Achievement of Indonesian Nationally Determined Contributions (NDCs)

Mohammad Na'iem

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Dr. Mohammad Na'iem is currently the Professor in Faculty of Forestry, Universitas Gadjah Mada, Yogyakarta, Indonesia. He obtained Ph.D. in agricultural sciences from Graduate School of Agricultural Sciences, University of Tsukuba, Japan in 1992. His field of interest is tree improvement and has about more than 40 years of experience in tree improvement in some important species in Indonesia, i.e. Tectona grandis, Pinus merkusii and Dipterocarps species. He was Dean of Faculty of Forestry UGM during 2004-2012. He had many projects on forest productivity both in forest plantation and natural forest. He also published his research in papers including journals and chapters of books.

ABSTRACT

The forest area of Indonesia is the second-largest tropical forest in the world, with a total forest area of more than 120 million ha. Indonesia's tropical forest is one of the most biodiverse terrestrial ecosystems in terms of species richness and endemism, supporting 18.7% of the world's plant biodiversity. Thus, the existence of tropical forests is vital to reducing emissions and maintaining climate and resources. They provide timber, food materials, medicinal plants, and natural fibers, as well as recreation, aesthetic value, ecological benefits and more. However, Indonesia's tropical forests have been declining due to, among other things, forest fires, illegal logging, over-exploitation, and conversion of forests to other land uses. The highest rate of forest loss in Indonesia was in the period 1996-2000 (3.51 million ha), while the deforestation rate in the period 2019-2020 decreased by 75 percent to 115 thousand ha, the lowest rate since 1990. Preventing forest degradation could reduce around 15% of total greenhouse gas emissions, which would help combat climate change. Thus, Indonesia joined in signing the Paris Agreement for a better life and environment in the future.

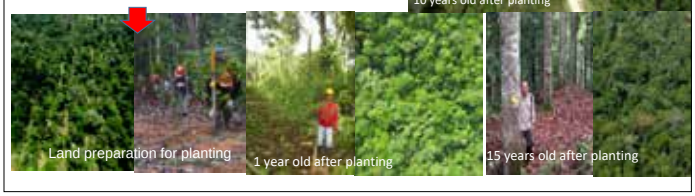
Based on the latest Nationally Determined Contribution (NDC) documents, Indonesia should reduce emissions by 31.89% (with self-effort) and up to 43.20% (with international support) by 2030. Of the total emission reduction targets from different sectors, almost 60 percent of the emission reduction targets will rely on the forestry sector. Thus, the government of Indonesia has an array of climate actions to achieve its Forest and Other Land Use Net Sink (FOLU Net Sink) 2030 targets. Some activities to achieve the FOLU Net Sink 2030 goals are the establishment of plantation forests, the sustainable management of natural forests, and the rehabilitation of forests on degraded lands.

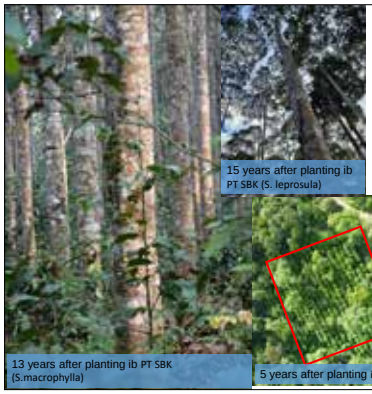
Forest rehabilitation uses improved seeds to increase forest productivity through intensive silviculture (SILIN), which consists of tree improvement, environment manipulation, and pest and disease management programs. For example, implementing tree improvement in clonal teak plantations could increase forest productivity by >300% compared to using unimproved teak seed. In 20 years after planting, the trunk diameter, timber volume, and carbon sequestration in the clonal teak plantation were 42 cm, 300 m^3/ha, and 200 tons C/ha, respectively. Meanwhile, the rehabilitation of natural forests dominated by dipterocarp species could be established by enrichment planting with native species such as *Shorea leprosula*, *S. parvifolia*, *S. johorensis*, *S. macrophylla*, and *S. platyclados*. Enrichment planting with native species could increase forest productivity from 25-30 m^3/ha to 200-300 m^3/ha in 25 years after planting. Furthermore, enrichment planting with native species increased carbon storage in the secondary natural forest, reaching 139.52 tons C/ha. This study suggested that tree improvement programs using the SILIN technique should be implemented to improve land forest cover and forest productivity and achieve Indonesia's NDCs.

LARGE SCALE LINE PLANTING PLANTATION OF DIPTEROCARP IN THE SECONDARY TROPICAL RAINFOREST

Enrichment planting is artificial regeneration by adding species in the logged forest to increase the density commercial tree and to timber stock for next cutting cycle (Kettle 2010; Lamb 2014).

Use of native species for enrichment planting in the secondary tropical rain forest





GAP PLANTING IN IN THE SECONDARY TROPICAL RAINFOREST

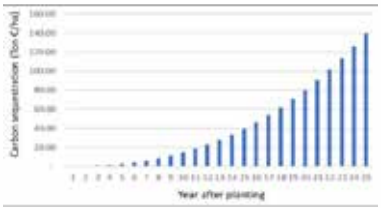
- The mean annual diameter increment of Shorea macrophylla = > 2 cm/year
- The mean annual diameter increment of Shorea leprosula = > 1,7 cm/year

ENRICHMENT PLANTING USING NATIVE SPECIES IN SECONDARY TROPICAL RAIN FOREST

TOTAL CARBON SEQUESNTRATION IN SECONDARY TROPICAL RAIN FOREST WITH ENRICHMENT PLANTING

Carbon sequestration in the secondary tropical rain forest	**= 81.59 ton C/ha**
Carbon sequestration of enrichment planting in secondary tropical forest	= 139.52 **ton C/ha**
Total carbon in Secondary tropical forest after 20years after planting	**= 221.11 ton C/ha**

CONTRIBUTION ENRICHMENT PLANTING TO INCREASE CARBON SEQUESTRATION IN THE SECONDARY TROPICAL RAINFOREST



Enrichment planting using line planting technique could improve carbon sequestration in secondary tropical rain forest = 139.52 ton C/ha

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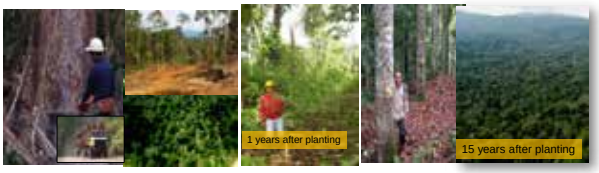
IMPLICATIONS FOR THE SUSTAINABLE MANAGEMENT OF TROPICAL RAINFORESTS



The enrichment planting on the logged forest using native species could:

- ❑ increase the standing stock of logged forest
- ❑ preserve the native species from extinction

Enrichment planting of dipterocarps could:

- ❑ restore the genetic diversity of logged forests and
- ❑ maintain forest productivity for the future, making forestry more sustainable, with high ecosystem services

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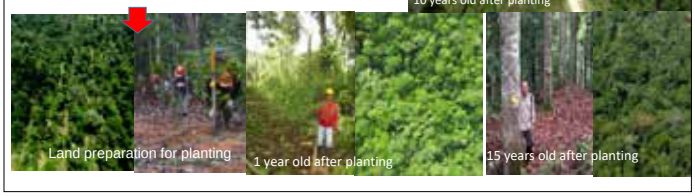

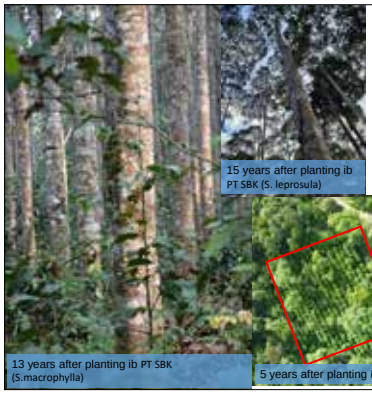

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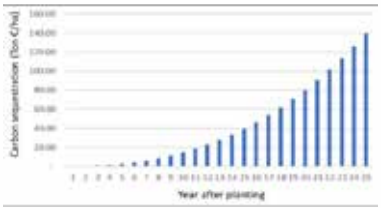

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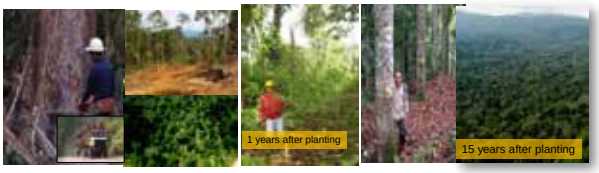

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SUCCESS STORY FOREST REHABILITATION IN WANAGAMA EDUCATION FOREST, 600 ha, GUNUNG KIDUL REGENCY YOGYAKARTA
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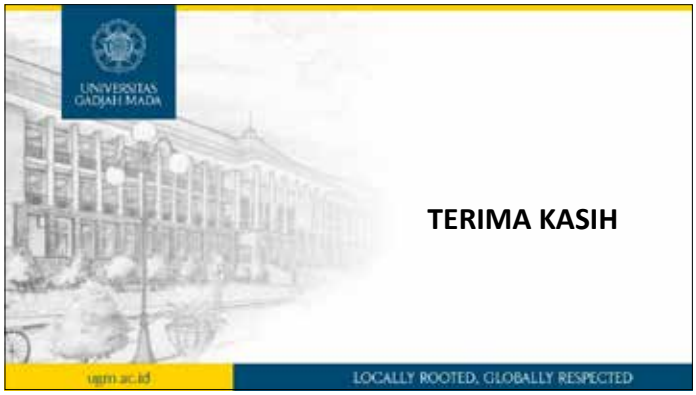
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