

REFORESTATION AND THE CONTRIBUTION TO CO₂ SEQUESTRATION IN INDONESIA

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1

MAP OF INDONESIA



1. Five big island in Indonesia
2. Total islands ± 17,500

2

Table 1: Forest Area based on Harmonization between the Consensus Forest Land Use Planning in 1999

Nr	Function	Area (Ha) *)
1	2	3
1.	Permanent Forest Land	112,275,048
-	Protection Forest	33,519,600
-	Nature Reserve and Recreation Forest	20,500,988
-	Limited Production Forest	23,057,449
-	General Production Forest	35,197,011
2	Convertible Production Forest	8,078,056
	Total (1 + 2)	120,353,104

Source: Badan Planologi Kehutanan dan Perkebunan (1999)

Note: *) Forest Area Excluding East Timor Timur Province

3

Table 2: Indonesia's Area of Critical Land

Nr	Function of the Area	Criteria of Critical Land			Total
		Somewhat Critical	Critical	Very Critical	
I	Outer Forest Area	16,082,933	8,587,558	2,102,753	26,773,245
II	Inner Forest Area	31,527,148	14,718,675	4,787,813	51,033,636
1	Conservation Forest	3,002,261	1,021,015	332,077	4,355,352
2	Protected Forest	6,051,764	2,527,270	724,664	9,303,699
3	Production Forest	8,919,109	4,284,581	2,052,204	15,255,895
4	Conversion Production Forest	5,367,368	4,212,741	969,213	10,549,323
5	Limited Production Forest	8,186,644	2,673,067	709,655	11,569,367
	TOTAL	47,610,081	23,306,233	6,890,567	77,806,881

Source: Anwar (2007)

4

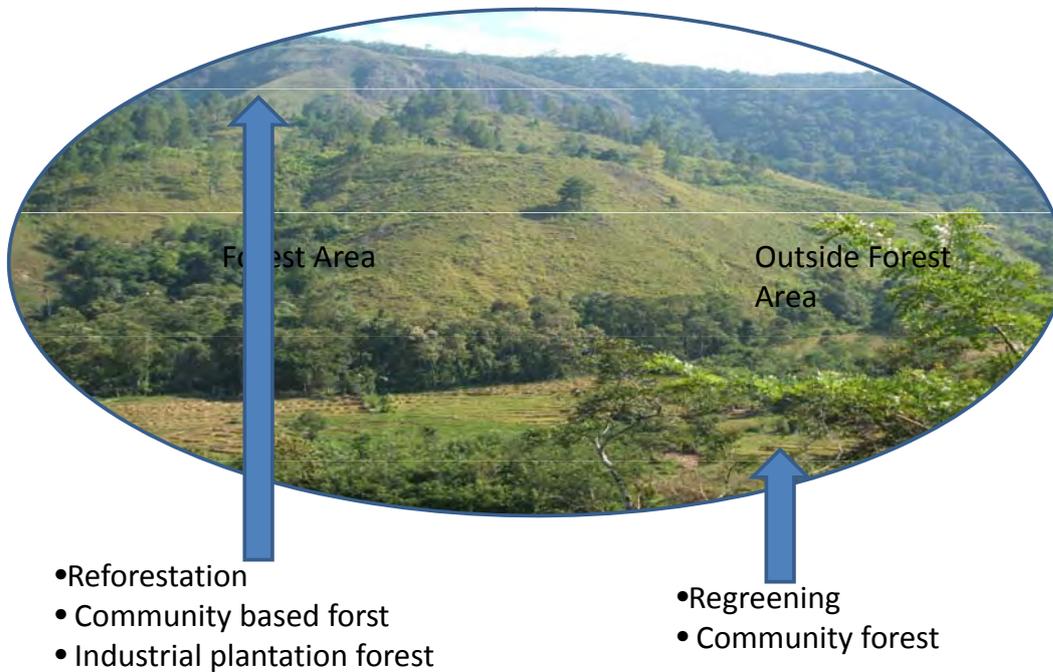
The establishment of critical land class

Erosion map (weight : 15%), Slope steepnes map % (w: 20%); Management map (w: 30%); Productivity map (w: 30%); and Outcrop map (w : 5%). Based on overlay/intersect the above data "Land degradation map" as follow : Very degradade (total score : 120-180); Degraded (181-270); Slightly degraded (271-360); Potentially degraded (361-450) and Not degraded (451-500)

5

Table 3: Planting activities in Indonesia from 1997 - 2008

Nr	Year	Reforestation (ha)	Community Forestry (ha)	Community Based Forest (ha)	Mangrove Forest (ha)
1	1997/1998	35,725	7,990	139,323	289
2	1998/1999	23,615	7,087	127,268	533
3	1999/2000	127,559	850	123,272	378
4	2000	8,986	24,556	49,844	2,609
5	2001	23,290	6,111	22,530	1,655
6	2002	42,021	13,436	38,341	4,297
7	2003	54,762	9,597	214,296	1,655
8	2004	339,166	6,684	333,291	9,536
9	2005	26,963	3,254	32,164	2,775
10	2006	246,042	3,171	248,154	7,952
11	2007	76,718	1,750	127,532	39,318
12	2008	266,921	200	227,913	10,739
	Total	1,271,768	846,686	1,683,928	81,736



Land and Forest Rehabilitation National Movement (GERHAN)

- Land and Forest Rehabilitation National Movement is a movement that involved the community in forest and land rehabilitation participatively with a target of 3,000,000 ha from 2003-2007 and annual target respectively 300,000 ha; 500,000 ha; 600,000 ha; 700,000 ha and 900,000 ha (Directorate General RLPS, 2003).

Movement of community

- One Man One Tree
- Planting a Million Trees
- Planting a Billion Trees Movement

9

Intensive Silviculture System

- Based on :
 1. quality of seedling
 2. environment manipulation
 3. pest control
- If 160 trees/hectare in 30 years the diameter can reach 50 cm, plantation can product 400 m³/hectare
- If wood density 0.5 BEF 1.6, biomass = 320 ton/hectare

10

Colaboration with International Organization

1. JIFPRO in Sekaroh West Nusa Tenggara, in 1996-1998 planted 350 ha and survive 250 ha.
2. JIFPFO-EPSON in Pleihari South Kalimantan : in 2000-2003, planted : 300 ha.

Is considered as successful rehabilitation.

11



VS



- Continuous

-Succes when the project is still assist
- After project terminated activities
become BAU

12



Fertile

Moderate

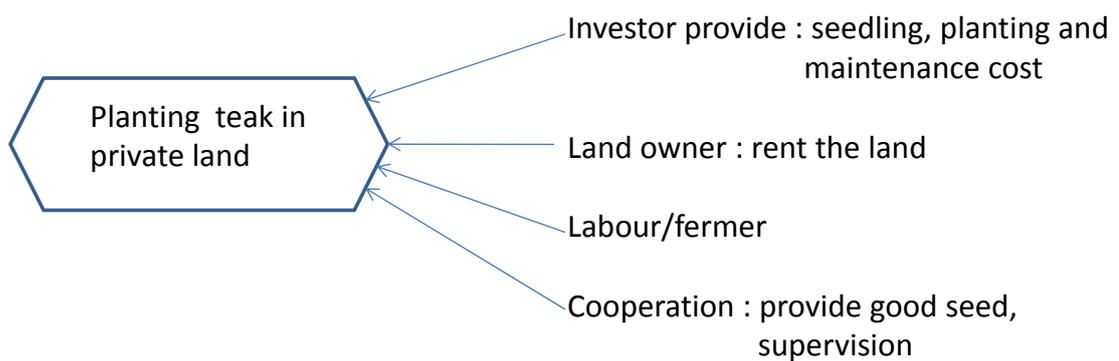
Unfertilized

Starter planting

A little human assistants

Natural regeneration

Planting Teak



Provit share at the end of cycle :

-Investor	40%
- Land owner	20%
- Farmer	15%
- Village adm	5%
- Cooperation	20%

THE CONTRIBUTION OF FOREST REHABILITATION TO THE CO₂ SEQUESTRATION IN INDONESIA

Types	Annual Average of Increment (m ³ /ha)	Specific Gravity	Cycle (yr)	Biomass on the final cycle (ton/ha)	Carbon sequestration ability (ton/ha/cycle)	Carbon sequestration ability (ton/ha/year)
Teak (<i>Tectona grandis</i>)	12	0.67	50	402	201	4.02
Pine (<i>Pinus merkusii</i>)	15	0.55	25	206	103	4.12
Sonokling (<i>Dalbergia latifolia</i>)	17	0.83	40	564	282	7.05
Mahogany (<i>Swietenia macrophylla</i>)	16	0.64	40	409	204	5.10
Agathis (<i>Agathis alba</i>)	19	0.42	35	279	140	4.00
Mangium (<i>Acacia mangium</i>)	30	0.50	7	105	52,5	7.44
Sengon (<i>Paraserianthes falcataria</i>)	38	0.40	12	182	91	7.58

Source : Taken from several studies between the Research and Development of Forestry and JIFPRO

15

Table 5: Allometric Equation from various types of plant

Types of plant	Allometric equation (Total Dry Weight) (ton/ha)	Location
<i>A. mangium</i>	TDW = 0.42 (DBH) ^{1.4}	Maribaya Bogor
<i>P. merkusii</i>	TDW = 0.1 (DBH) ^{2.29}	Cianten, Bogor
<i>S. leprosula</i>	TDW = 0.15 (DBH) ^{2.3}	Ngasuh , Bogor
Gambut	TDW = 0.10586 (DBH ²) ^{1.2747}	Central Kalimantan
<i>P. falcataria</i>	TDW=0.1479 (DBH) ^{2.2989}	Sukabumi
<i>P. falcataria</i>	TDW = 0.2831 (DBH) ^{2.063}	Kediri
<i>Avicennia marina</i>	TDW = 0.2901(DBH) ^{2.2605}	Ciasem, Subang
<i>Agathis loranthifolia</i>	TDW = 0.4725 (DBH) ^{2.0112}	Baturaden
<i>Aleurites moluccana</i>	TDW = 0.064(DBH) ^{2.4753}	Kutacane , SouthEast Aceh
<i>Rhizophora mucronata</i>	TDW = 0.1366(DBH) ^{2.4377}	Ciasem, Purwakarta

Source: Siregar, et.al.(2009)

16

Table 6 : Some allometric volume models and biomass models of several tree species

Ecosistem Type	Species	Location	Allometric models	R ²	Source
HLK	Dipterocarpaceae (non <i>Shorea</i>)	Maluku	$V=0.0002134 D^{2.4613}$	0.99	Dit.Inventarisasi Hutan (1990 e)
HLK	<i>Dipterocarpus comutus</i>	West Kalimantan	$V=0.000417D^{2.21}$	0.98	Priyanto (1997)
HLK	<i>Duabanga</i> sp	West Nusa Tenggara	$V=0.000107D^{2.5541}$	0.99	Dit.Inventarisasi Hutan (1990f)
HLK	<i>Shorea</i> spp.	Lampung	$V=0.000942 D^{2.0647}$	0.92	Soemarna (1977)
HT	<i>Paraserianthes falcataria</i>	Banten	$V=0.00011 D^{2.5414}$	0.94	Bustomi dan Imanuddin (2004)
HM	<i>Rhizophora</i> spp.	West Kalimantan	$V=0.0000534D^{2.097}H^{0.739}$	tad	Soemarna (1980a)
HT	<i>Swietenia macrophylla</i>	East Java	$V=0.000305 D^{2.162}$	tad	Wahjono dan Soemarna (1987)
HLK	<i>Palaquium</i> sp	East Kal.	BBA: $\ln W = -1.098 + 2.142 \ln D$	0.98	Basuki et al (2009)
HT	<i>Acacia mangium</i>	South Sumatra	BT ; $w=0.0226 D^{2.7470}$	0.93	Ismail (2005)

Note :HLK= dry land forest ; HT= plantation forest; HM= mangrove forest ; V = Volume; BBA = Biomass above ground; BT = total biomass; W = dry weight biomass (kg); D=diameter as breast high (cm); H = the high of trees (m).

17

Table 7: The example of the value of biomass expansion factor (BEF) of several tree species

Tree species	BEF value	Source :
<i>Paraserianthes falcataria</i>	1.34	Rusolono (2006) , was calculated
<i>Swietenia macrophylla</i>	1.36	Adinugroho dan Sidiyasa (2006)
<i>Rhizophora apiculata</i>	1.55	Amira (2008)

The computation is as follows :

$$\text{Biomass (kg)} = \text{Volume (m}^3\text{)} \times \text{wood density (kg/m}^3\text{)} \times \text{BEF}$$

18

Table 8. Carbon stocks above ground of forest plantation in different locations

No	Forest Type	Carbon stock of trees above ground (ton C/ha)	Source	Remarks :
1	<i>Agathis loranthifolia</i>	123.4	Siregar and Dharmawan (2007)	<i>A.loranthifolia</i> 40 yrs old in Baturaden, Cental Java. $Y = 0,3406 (DBH)^{2.0467}$
2	<i>Acacia mangium</i>	50.7	Heransyah (2003)	<i>A. mangium</i> 10 yrs old, PT Perhutani III, West Java $Y = 0.0471 X^{1.353}$
3	<i>Shorea leprosula</i>	1.3	Heransyah (2003)	<i>S. leprosula</i> 5 yrs old, 2 m x 2 m spacing, West Java $Y = 0,059 X^{1.1949}$
4	Community Forest (mixed)	15.56-194.97	Asyisanti (2004)	Mixed : <i>Maesopsis eminii</i> , <i>Nephelium lappaceum</i> , and <i>Coffea</i> spp, 0.5-7.5 yrs old in Karyasari, Bogor
5	Community Forest (mixed)	14.421	Langi (2007)	35 yrs old, Tareran Village, Minahasa, North Sulawesi
6	Community Forest (homogen)	162.672	Langi (2007)	<i>Elmerrillia celebica</i> in Minahasa District, North Sulawesi
7	Secondary mangrove forest	54.1-182.5	Dharmawan and Siregar (2009)	<i>Avicennia marina</i> and <i>Rhizophora mucronata</i> in Ciasem Purwakarta, Wet Java. DBH 5.5-35.5 cm. $Y=0.2064 (DBH)^{2.34}$
8	Secondary forest ex exploitation	171.8-249.1	Dharmawan et al.(2010)	Allometrix Chaves , AGB in Malinau, East Kalimantan $Y=0.0509 x p x DBH^2 x T$ DBH 7.0-70.0 ; 5-30 yrs after exploitation
9	Secondary forest in high land	39.48	Dharmawan (2010)	Allometrix biomass, AGB $Y=0.1728(DBH)^{2.2234}$ Secondary Agathis, 17 yrs old in Nagrak Pangarango, Sukabumi DBH 1.7-37.5 cm

Source :Masripatin,et al. (2010).