WHAT CAN NATIVE TREES PROVIDE IN REVEGETATING TROPICAL DEGRADED LAND?

AN EXPERIENCE OF MAN-MADE DIPTEROCARP FOREST IN INDONESIA

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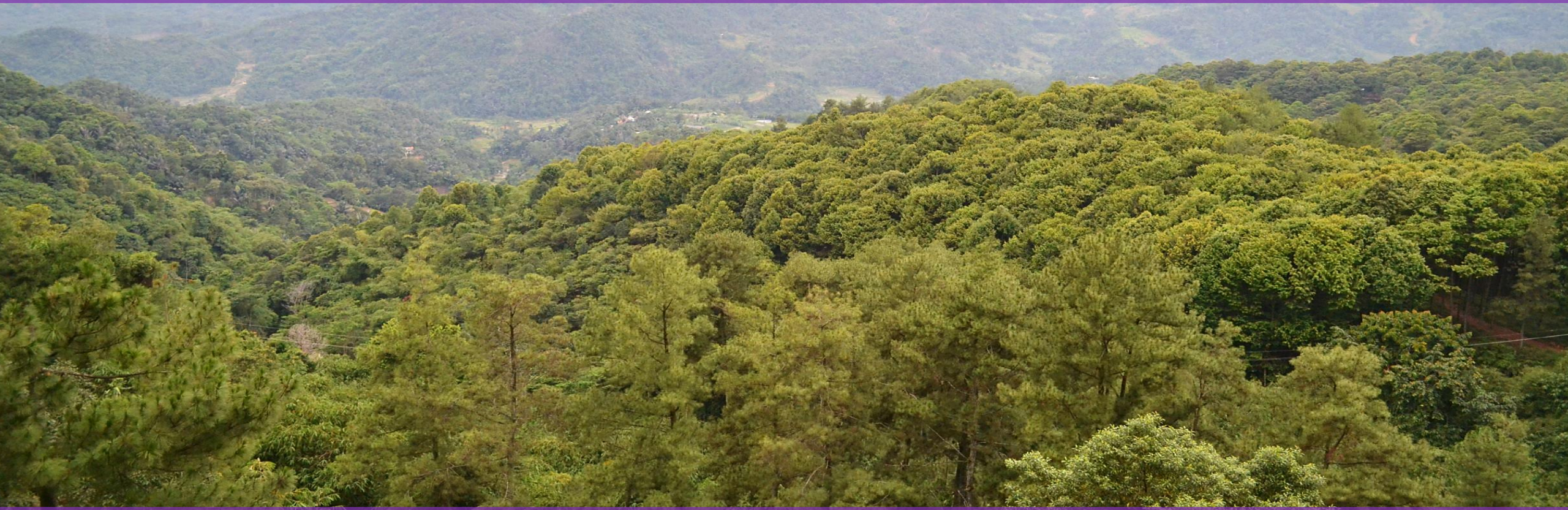

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BACKGROUND

Major drivers for deforestation and land degradation

- Expansion agricultural activities
- Unsustainable of agricultural and forestry practices
- Extractive industries
- Climate change,

Negative impact on nature's product, (i.e food, water, energy, livelihood security)

- Affect the quality of physical and mental health of human as individuals and or society
- Landscape rehabilitation and restoration become global concern

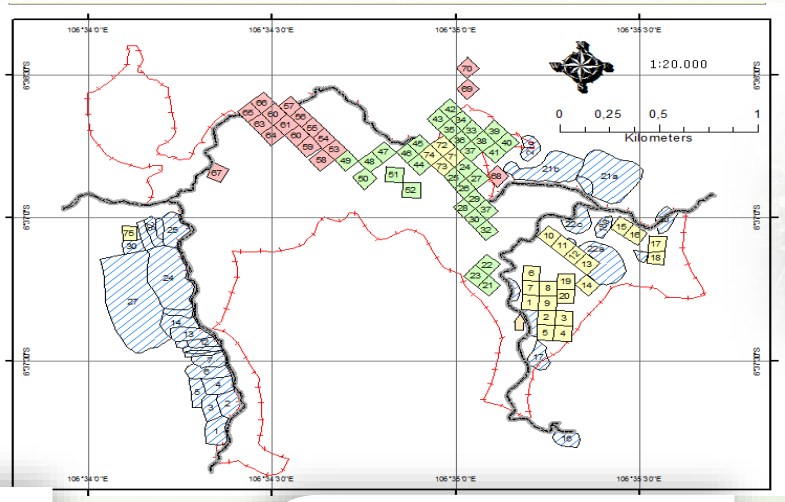
Rehabilitation using native and indigenous tree species generated many benefits

- Major commercial trees of Southeast Asia tropical rain forest
- Ecologically important
- Threaten with extinction
- Planted as rehabilitation commodities (logged-over area, ex-mining, enrichment, etc)

DIPTEROCARPACEAE

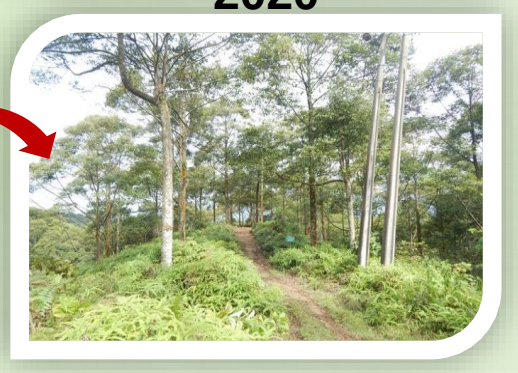
INITIAL AND TRANSFORMATION OF REVEGETATED LANDSCAPE

Planted year: 1997 – 2000
Origin : cutting and wildings
Area : 268 Ha
Elevation 500 – 900 m asl
Current numbers of planted species : 32
Targeted family : Dipterocarpaceae
Experimental and collection plots



1996

2020



1996

2020

WHAT WE GET FROM REVEGETATED LANDSCAPE?

A multifunction man-made forest

The volume standing stock for many species in the revegetated study area was relatively higher than potency at the logged over area/LOA (35 to 40 m3 ha-1 [23] in Indonesia.

Timber stock

Species	Spacing distance (m x m)	Planting techniques	Average DBH (cm)	Average height (m)	Volume per ha	DMAI (cm year^{-1})
Species with very fast DMAI value (> 1.4 cm year^{-1})						
S. platyclados	4x8	Mix	43.05	23.00	220.84	2.15
S. leprosula *	4x4	Total	24.9	16.9	127.602	1.47
S. smithiana	4x4	Mix	25.31	11.34	106.95	1.49
S. ovalis	4x4	Mix	24.43	8.77	76.87	1.44
Species with fast DMAI value (1.19 – 1.4 cm year^{-1})						
S. platyclados	4x4	Mix	22.59	10.69	160.62	1.32
Anisoptera sp.	*4x4*	*Mix*	*20.51*	*11.97*	*74.125*	*1.21*
S. balangeran	*4x4*	*Mix*	*22.86*	*10.88*	*83.65*	*1.34*
H. gregaria	*4x4*	*Mix*	*21.53*	*11.29*	*77.04*	*1.27*
Species with normal DMAI value (0.79-1.18)						
S. johorensis	4x4	Mix	20.31	11.22	68.09	1.19
S. selanica *	4x4	Total	19.6	16.2	85.992	1.15
S. pinanga	4x4	Mix	20.00	16.5	15.87	0.9
S. macrophylla	4x4	Mix	19.99	11.65	10.2	1.00
Species with moderately slow DMAI value (0.36-0.76)						
S. selanica **	2x2	Total	16.40	16.81	138.23	0.75
S. multiflora	4x4	Mix	12.84	9.00	21.80	0.75
S. palcifera	4x4	Mix	11.22	7.5	13.87	0.66
S. seminis	4x4	Mix	11.00	8.0	14.17	0.64

Natural regeneration potency

Species	Plot	Planting distance (m)	Year of planting	Year of the first flowers (age, years old)	Frequency of flowering since planted to 2020	No of potential parent trees	Number of offspring		Soil texture	Canopy coverage (%)	Slope (%)
							Seedling	Sapling			
Shorea leprosula	1	2x2	1997	2015 (18)	4 times	11	>7000	0	Loamy sand	85.96	35
	2	3x3	1997	2015(18)	4 times	34	1751	0	Loamy sand	67.50	20
	3	4x4	1997	2020 (23)	once	3	346	0	Loamy sand	66.70	35
	5	4x4	1997	2014 (17)	4 times	27	1320	1	Loamy sand	68.80	35
	6	4x4	1999	2015(16)	3 times	5	512	0	Loamy sand	62.50	25
	7	4x4	1999	2015(16)	4 times	6	562	1	Loamy sand	57.36	20
	21a	4x4	1999	2018 (19)	once	24	0	0	Sandy loam	78.94	40
Shorea pinanga	5	4 x 4	1998	2016 (18)	4 times	40	0	0	Sandy clay	62.82	50
	24	4 x 4	2000	2016 (16)	4 times	24	489	2	Sandy clay	68.28	35
Shorea platyclados	04	4 x 4	1998	2014(16)	annually	27	>11000	357	Sandy clay	62.82	50
	15	4 x 4	1999	2014(15)	3 times	8	127	14	Sandy clay	80.5	40
	20	4 x 4	1999	2016 17)	annually	96	>12000	248	Sandy clay	84.92	40
	21e	4 x 4	1999	2018 (19)	annually	13	57	0	Sandy clay	84.66	70
Shorea selanica	12	4 x 4	1998	2019 (21)	once	2	5	0	Loamy sand	67.5	20
Shorea macrophylla*)	-	4 x 4	2000	2018 (18)	2 times	5	0	0	Sandy clay	82.5	40
Shorea stenoptera*)	-	4 x 4	2000	2018 (18)	2 times	6	0	0	Sandy clay	82.5	40

*) additional planting along the main road/ non plot number

During 20 years of revegetation, six Shorea planted in the landscape showed different capacity of natural regenerations. *S. platyclados* showed the best natural regeneration (> *S. leprosula* > *S. pinanga* > *S. selanica* > *S. macrophylla and S. stenoptera*) with two flowering patterns that rarely found in nature, i.e. annual and irregular flowering with high number of survived offspring.

Soil Characteristics, Land Productivity and Potential Hydrological Value

- Slopes affects tree growth. Different slope gradients are known to have different impact on stand performance
- Gentle sloping class provides better growth (the diameter and tree height) and has thicker litter (11.7 cm) than other slope classes (6.3 – 7.9 cm)
- Various ant species were found in the revegetated forest include *Odontomachus denticulata*, *Anoplolepis gracilipes*, *Monomorium pharaonis*, and *Pheidole dentata*.
- Revegetation action can also be measured in the context of improvement on soil physical properties as marked by good soil porosity and high infiltration rate.
- The value of soil porosity was fall under "good" criterion (51.06 – 52.32%), thus in turn were directly affect the infiltration rate that categorized (Kohnke, 1968) as rather fast at *S. leprosula* stand (120 mm/hr) and fast at *S. selanica* stand (155.33 mm/hr).

Physical soil properties	Vegetation cover		Assessment criteria (Sutanto, 2005)
	S. leprosula	*S. selanica*	
Bulk Density	1.29	1.26	High
Soil porosity	51.06	52.32	Good
Moisture content	49.64	50.77	
– pF1	48.78	49.12	-
– pF2	40.11	41.28	
– pF3	16.47	19.10	
– pF4			
Drainage pore			
• Very fast	-	-	
• Fast	3.21	2.29	-
• Slow	7.84	8.67	
Permeability	1.37	2.13	-

Ectomycorrhizal association

- 5 family compromising more than 10 species of ECM fruit body collected from the observed plots. The ECM family included Amanitaceae, Boletaceae, Hydnangiaceae, Russulaceae, and Schelodermataceae
- Composition of ECM fungal body in plot of *S. selanica* was higher (103 individu ha-1) than in *S. leprosula* (69 individu ha-1)
- No ECM fungal body found in un-revegetated area
- ECM is highly correlated with the formation of man-made dipterocarp forest that was established as the result of revegetation success of more than 20 years ago.

Environmental services

Species	Spacing	Carbon stock (ton C ha-1)
S. leprosula	2 x 2 m	73,4
S. leprosula	3 x 3 m	85,6
S. leprosula	4 x 4 m	45,4
S. selanica	2 x 2 m	66,9
S. selanica	3 x 3 m	49,4
S. selanica	4 x 4 m	30,9

Aboveground tree carbon stock at certain observed plots in revegetated landscape. Denser trees tend to have higher C-stock

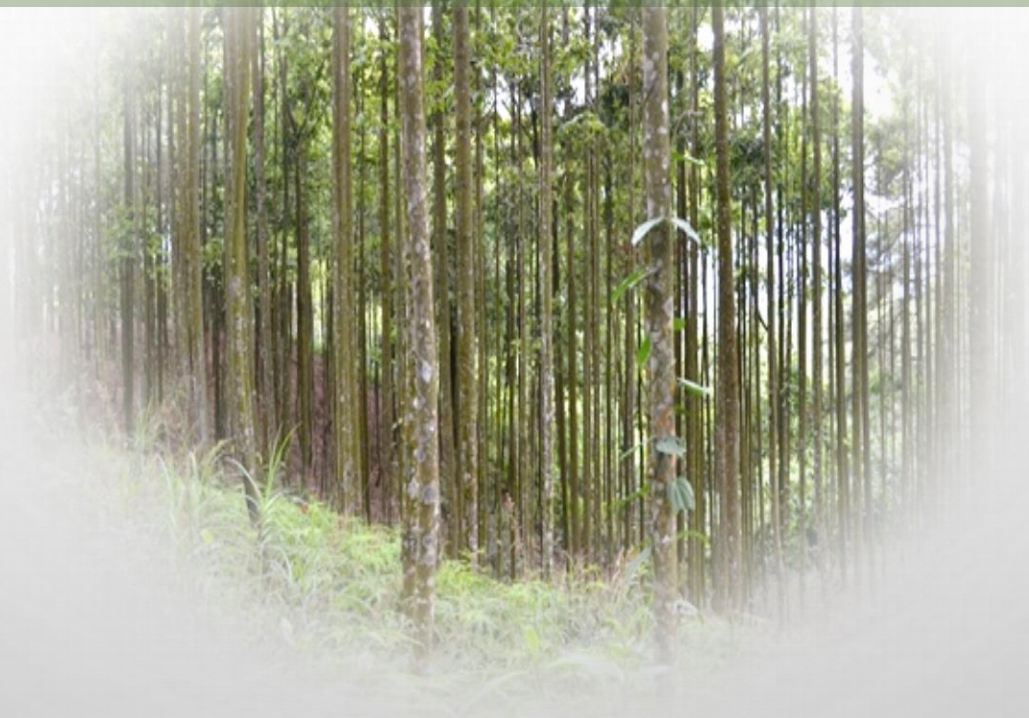
Support community livelihood

- Revegetated landscape forest has been established as a popular ecotourism destination
- Weekend visit 40 -350 person/day, weekdays visit 15 – 50 person/day
- Generating new income from selling food, goods and services which in turn it supported community livelihood (>30 food hut)
- Generating income from seller of about 600.000 IDR (equal to around US$ 42) and IDR 300.000 (equal to around US$ 21) /day during weekend and weekdays.

Water regulation

Provide continuous supply of clean water for daily live and agricultural needs

THANK YOU



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